BART Screening Analysis for Alcoa Rockdale Operations in Rockdale, Texas

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Prepared For:

Alcoa Inc.-Rockdale Operations
Rockdale, Texas

Prepared By:

TRC Environmental Corporation
650 Suffolk Street, Wannalancit Mills
Lowell, Massachusetts 01854
(978) 970-5600

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1. INTRODUCTION

TRC Environmental Corporation has conducted a modeling analysis for Alcoa Rockdale Operations located in Rockdale, Texas to determine if BART-eligible sources of this facility are subject to BART (Best Available Retrofit Technology). This analysis follows the Texas Commission on Environmental Quality (TCEQ) source-specific subject-to-BART screening modeling protocol called "Best Available Retrofit Technology (BART) Modeling Protocol to Determine Sources Subject to BART in the State of Texas" dated January 2007 with additional clarifications from the TCEQ applied. These include the use of hourly background ozone data rather than constant values as specified in the TCEQ protocol and the inclusion of PM_{10} as a pollutant to be considered in the analysis. The results presented in this report are consistent with the modeling protocol prepared by TRC dated June 28, 2007 and submitted to the TCEQ.

On July 6, 2005, the U.S. Environment Protection Agency published in the Federal Register, 40 CFR Part 51 in order to introduce new National Regional Haze Regulations for Best Available Retrofit Technology. The regional haze rule requires States to submit State Implementation Plans (SIPs) to address regional haze visibility impairment in 156 federally-protected parks and wilderness areas, commonly referred to as "Class I Areas". The final rule includes a requirement for BART for certain large stationary sources that were put in place between 1962 and 1977. The regional haze rule uses the term "BART-eligible source" to describe those sources which have the potential to emit 250 tons or more of a visibility-impairing air pollutant, were put in place between August 7, 1962 and August 7, 1977 and whose operations fall within one or more of 26 specifically listed source categories, of which Primary Aluminum Ore Reduction Plants are one.

BART review is required when the source emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility in any Class I area. In identifying a level of control of BART, States are required by section 169A(g) of the CAA to consider: (a) the costs of compliance, (b) the energy and non-air quality environmental impacts of compliance, (c) any existing pollution control technology in use at the source, (d) the remaining useful life of the source and (e) the degree of visibility improvement which may reasonably be anticipated from the use of BART.

The purpose of the modeling conducted for the Alcoa Rockdale facility was to assess the visibility impacts of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM_{10}) emissions from the sources which are BART-eligible and compare their impacts to the 0.5 change in deciview threshold at all the Class I areas that the ENVIRON (2006) screening evaluation showed to have impacts greater than 0.5 dv on visibility as it is specified in the Texas Protocol, "Best Available Retrofit Technology

(BART) Modeling Protocol to Determine Sources Subject to BART in the State of Texas" dated January 2007.

The non-steady-state CALPUFF modeling approach (Scire et al., 2000a,b) is recommended by the U.S. Environmental Protection Agency (EPA) and the Texas Commission on Environmental Quality (TCEQ) to perform source-specific subject-to-BART screening analysis. CALPUFF is also accepted to perform a conservative screening analysis for all Class I areas located beyond 300 km radius of the source. Since, all the 20 Class I areas listed in Table 1 of the TCEQ Texas Protocol are beyond the 300 km radius of the Rockdale Facility, CALPUFF modeling is retained to evaluate if the subject-to-BART Rockdale facility can be screen out. The only deviation from the TCEQ protocol is the version of CALPUFF, POSTUTIL and CALPOST codes used. The VISTAS versions of these codes available on TRC CALPUFF website, www.src.com in June 2007 at the time of the modeling were used in this analysis: Version 5.756 of CALPUFF, Version 1.52 of POSTUTIL and Version 5.6393 of CALPOST. The EPA-approved versions of the models contain known errors that make the modeling results potentially invalid. Because the coding errors are known and well documented and the code corrections are also known and readily available on the CALPUFF web site, the corrected version of the model codes has been used in the BART analysis. The U.S. EPA has indicated that the use of the EPA-approved codes are not mandatory for BART analyses due to the code errors, but rather authority for acceptance of the corrected codes is discretionary for the local/regional regulatory authorities (Fox, 2007).

CALMET dataset prepared by CENRAP, a 6 km resolution CALMET domain (CENRAP South 6 km grid) is available for 2001-2003 and was used for this analysis, as recommended in the TCEQ BART protocol.

In Section 2, a general description of the source configuration is provided. Descriptions of the data bases (meteorological, background data) used in the analysis are provided in Section 3. Section 4 includes CALMET and CALPUFF models parameters used in the modeling. The results and conclusions are summarized in Section 5.

2. SOURCE DESCRIPTION

The Alcoa Rockdale facility is an integrated aluminum smelter and fabricating facility situated in Rockdale, Texas. A BART applicability analysis was completed for the facility to determine those sources subject to the BART analysis. The BART-eligible sources include two potlines (four potrooms, Lines 7 and 8), fluid bed reactors for potlines 7 represented by two stacks, 10G1 and 10G2 and fluid bed reactors for potlines 8 represented by the two stacks 10H1 and 10H2, anode baking furnace 160, and furnaces 1, 2 and furnaces 7, 9, 10, 11 and 12 of the casthouse (red dots in Figure 2-1). All these sources are described in Table 2-1 for the line sources and Table 2-2 for the point sources.

The 24-hour average actual emission rates of SO_2, NO_x and PM_{10} with normal operations from the highest emitting day of the year were modeled, consistent with the Texas BART protocol. For purposes of the visibility calculations, particulate matter (PM_{10}) was modeled as 100% $PM_{2.5}$ in order to provide a reasonable and conservative value to the particulate matter impacts, since the exact size distribution of the PM_{10} emissions is not known. Because $PM_{2.5}$ (or PM-fine (PMF)) has a higher extinction efficiency (EE=1.0) than coarse particulate matter (PMC) in the size range between 2.5-10 μm (i.e., EE=0.6), treating all the coarse PM as PMF is conservative (i.e., likely to overestimate the predicted impacts). As a sensitivity test, the PM_{10} was also evaluated as all secondary organic aerosol (SOA) with an extinction efficiency of 4.0 as an even more conservative worst case estimate. It is not expected that the Alcoa PM_{10} emissions will be in the form of SOA, but for purposes of proving an upper bounds estimate, this assumption was evaluated as well.

Since all Class I areas are located more than 300 km away from the source no downwash computations were performed.

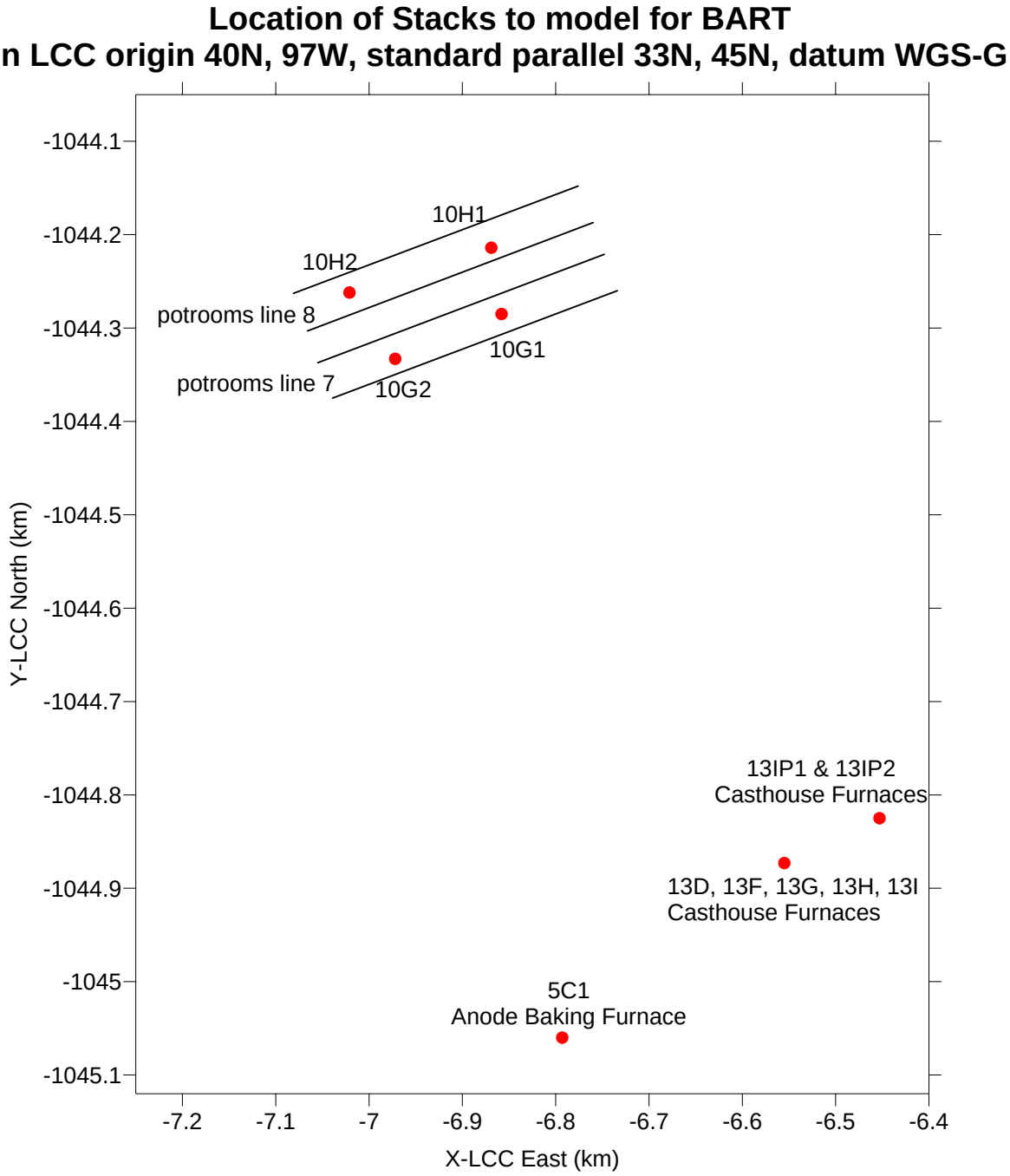

Figure 2-1. Location of stacks and lines modeled for the BART evaluation in LCC projection.

Table 2-1. Line Source Parameters and Emission Rates.

Source ID	Base Elev. (m)	Release Height (m)	Monitor Width (m)	Exit Velocity (m/s)	Delta T (Exit T – T_{air}) (°K)	Begin LCC (40N, 97W; std parallel 33N,45N) E/N (km)	Ending LCC (40N, 97W; std parallel 33N,45N) E/N (km)	SO_2 Emission rate (g/s)	NOx Emission rate (g/s)	PM_{10} Emission rate (g/s)
Line 7a	146.3	16.40	2.44	1.30	52.0	-7.039, -1044.375	-6.734, -1044.260	0.304	0.0025	1.3406
Line 7b	146.3	16.40	2.44	1.30	52.0	-7.055, -1044.337	-6.748, -1044.221	0.304	0.0025	1.3406
Line 8a	146.3	16.40	2.44	1.21	52.0	-7.066, -1044.303	-6.760, -1044.187	0.304	0.0025	1.3406
Line 8b	146.3	16.40	2.44	1.21	52.0	-7.081, -1044.263	-6.776, -1044.148	0.304	0.0025	1.3406

Notes:

For Line 7 and Line 8 an average line source buoyancy parameter (F') was computed as:

$$\mathbf{F'} = [gLW_m w(T_s - T_a)]/T_s = 1712.27\ m^4/s^3$$

Table 2-2. Point Source Parameters and Emission Rates.

Point Source ID	Source Name	LCC-X (Km)	LCC-Y (Km)	Base Elev. (m)	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Temp. (ºK)	SO_2 Emission rate (g/s)	NO_x Emission rate (g/s)	PM_{10} Emission rate (g/s)
10G1	6 Line7-East Courtyard Reactors	-6.858	-1044.285	144.3	14.92	2.99	19.50	379	20.022	0.083	2.385
10G2	6 Line7-West Courtyard Reactors	-6.972	-1044.333	144.3	14.92	2.99	19.50	379	20.022	0.083	2.385
10H1	6 Line8-East Courtyard Reactors	-6.869	-1044.214	144.3	13.73	2.69	21.33	370	20.022	0.083	2.231
10H2	6 Line8-West Courtyard Reactors	-7.021	-1044.262	144.3	13.73	2.69	21.33	370	20.022	0.083	2.231
13IP1	Casthouse Furnace 1	-6.453	-1044.825	141.0	13.50	1.22	4.26	360	0.002	0.161	0.013
13IP2	Casthouse Furnace 2	-6.453	-1044.825	141.0	13.50	1.22	4.26	360	0.002	0.161	0.013
13D	Casthouse Furnace 7	-6.555	-1044.873	143.0	13.50	1.22	4.26	360	0.002	0.098	0.358
13F	Casthouse Furnace 9	-6.555	-1044.873	143.0	13.50	1.22	4.26	360	0.002	0.094	0.302
13G	Casthouse Furnace 10	-6.555	-1044.873	143.0	13.50	1.22	4.26	360	0.002	0.094	0.328
13H	Casthouse Furnace 11	-6.555	-1044.873	143.0	13.50	1.22	4.26	360	0.002	0.094	0.328
13I	Casthouse Furnace 12	-6.555	-1044.873	143.0	13.50	1.22	4.26	360	0.002	0.094	0.302
5C1	Anode Baking Furnace 160	-6.793	-1045.060	142.0	16.24	1.93	9.76	372	5.213	1.3356	0.794

3. METEOROLOGICAL AND BACKGROUND DATA

3.1 Modeling Domain and Meteorological Data and Class I Areas

There are 20 Class I areas to be evaluated for BART in the TCEQ BART protocol. This list was developed for the subject-to-BART screening evaluation conducted by ENVIRON for the TCEQ. The Class I areas included in this present analysis are those that the ENVIRON screening evaluation showed to have impacts greater than 0.5 dv on visibility. As described in Table A-4 of "BART Exemption Screening Analysis (Draft Dec. 6, 2006)" Addendum I of Screening Analysis of Potential BART-Eligible Sources in Texas (Morris and Nopmongcol, 2006), also available on:

http://www.tceq.state.tx.us/implementation/air/sip/bart/haze.html#rulemaking.

The Alcoa Rockdale facility (i.e., ALCOA INC, on site ALCOA Sandow Plant, Account MM0001T) produced values above the screening threshold in the ENVIRON analysis at six Class I areas: Big Bend National Park (BIBE), Caney Creek Wilderness (CACR), Hercules-Glades Wilderness (HEGL), Mingo Wilderness (MING), Upper Buffalo Wilderness (UPBU) and Wichita Mountains Wildlife Refuge (WIMO). These six Class I areas are modeled in the present CALPUFF screening run.

CALMET dataset is provided by CENRAP. No CALMET runs are performed in this analysis. The domain used is called CENRAP-South-6 km domain. CALMET was run using no-observations mode. The three-dimensional meteorological data were provided by MM5 runs only. More information on this run can be found at www.cenrap.org/modeling_document.asp. Figure 3-1 displays the CENRAP 6-km resolution domain including the location of the facility and all the Class I areas to be modeled. A Lambert Conformal Projection was chosen with an origin of 40.0 North, 97.0 West and standard parallels at 33 North and 45 North. The datum used is WGS-G. The number of grid cells used: 306 x 246 grid cells. Thus, the CALMET computational domain covers an area of 1836 km by 1476 km. The CALPUFF computational domain is the same as the CALMET domain. Both the CALMET and CALPUFF domains extend beyond the Class I areas selected and the facilities in order to provide an adequate buffer zone at the boundaries, and to allow the effects of flow curvature and possible small-scale recirculation to be evaluated.

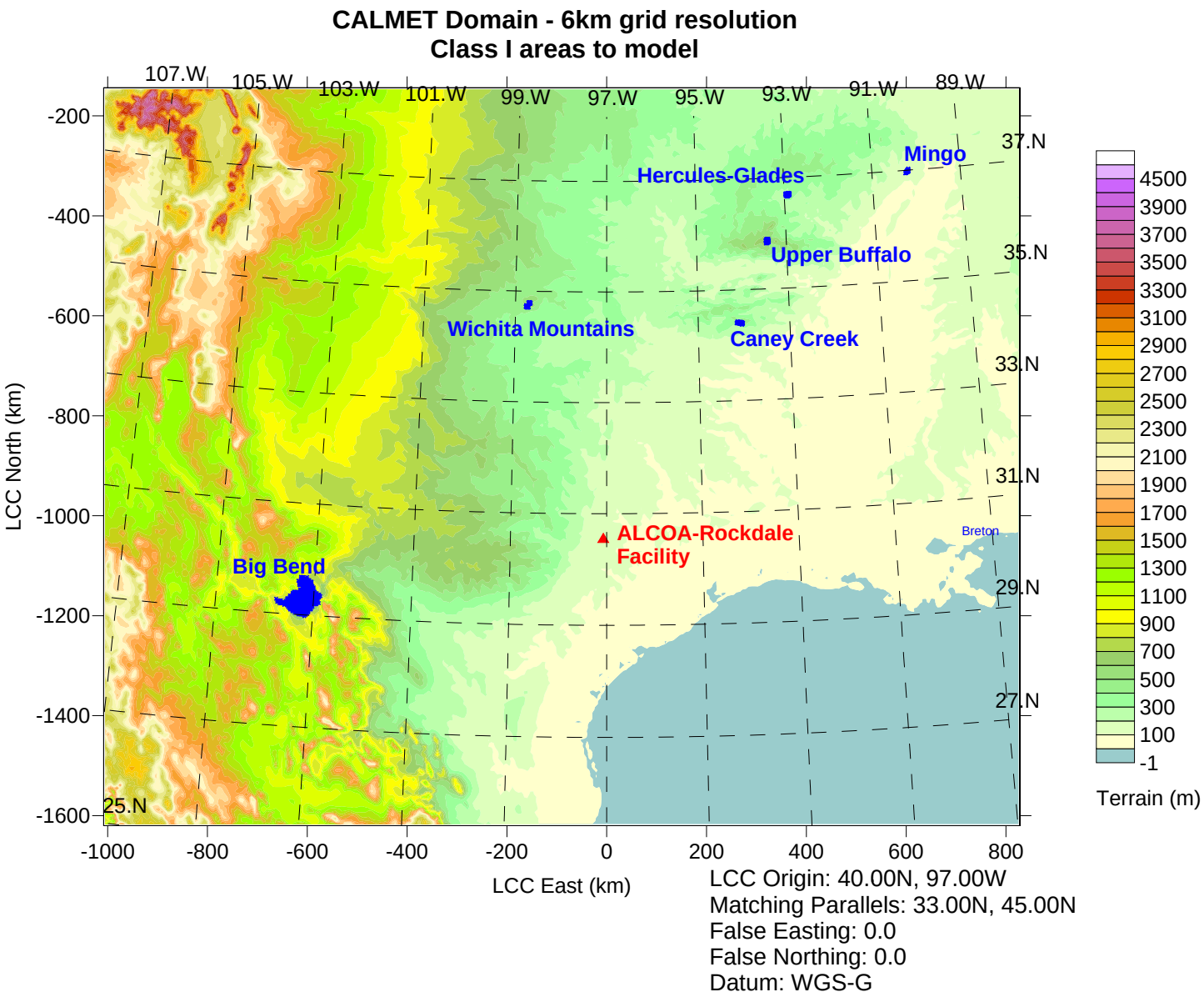

Figure 3-1. Location of the Alcoa-Rockdale facility and the Class I areas to be modeled for BART screening analysis.

3.2 Air Quality Monitoring Data

An hourly ozone concentration file provided by TCEQ with ambient ozone monitoring data from Kaufman, Longview and Houston Northwest sites was used to define hourly ozone background concentrations for this analysis. A constant monthly ozone background concentration of 40 parts per billion (ppb) is set in CALPUFF control input file as backup when hourly ozone concentrations are missing.

A constant background ammonia concentration of 3 parts per billion (ppb) as recommended in the TCEQ BART Modeling Protocol was used for CALPUFF runs for every point and line source modeled and also to repartition nitrate and nitric acid for all the sources combined.

4. AIR QUALITY MODELING METHODOLOGY

4.1 Modeling Domain

CALMET and CALPUFF use terrain-following coordinates. A modeling domain of 306 x 246 grid cells, uniform in the horizontal with a spatial resolution of 6 km was used. In the vertical, a stretched grid with finer resolution in the lower layers and somewhat coarser resolution aloft thus allowing adequate representation of the mixed layer was used. The ten vertical levels are centered at: 10, 30, 60, 120, 240, 480, 920, 1600, 2500 and 3500 meters.

CALPUFF is run for three years: 2001, 2002 and 2003. A network of discrete receptors derived from the list of receptors developed by the National Park Service (NPS) are located within the boundaries of the six Class I areas: Big Bend National Park, Wichita Mountains Wildlife Refuge, Caney Creek Wilderness, Upper Buffalo Wilderness, Mingo Wilderness and Hercules-Glades Wilderness. The total number of receptors is 818 receptors.

4.2 Meteorological Modeling Options

The 2001-2003 CENRAP-developed CALMET dataset was used for this 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.

4.3 Dispersion Modeling Options

The time zone used to run the CALMET dataset was Greenwich Mean Time (GMT) (IBTZ=0). The same time zone was used for CALPUFF modeling for consistency. An adjustment in the CALPOST run is done to compute a midnight-to-midnight local 24-hour average for visibility impact. The 24-hour average is computed from Hour 7 GMT on one day to Hour 6 GMT on the following day in order to produce the proper midnight-midnight time average.

The CALPUFF simulation is conducted using the options recommended in the TCEQ BART protocol. Listed below are the critical model options used in the analysis:

- Gaussian near-field distribution
- Transitional plume rise
- Stack tip downwash
- Puff splitting is not computed
- Pasquill-Gifford (PG) dispersion coefficients (rural areas), McElroy-Pooler coefficients (urban areas)
- Transition of σ_y to time-dependent (Heffter) growth rates
- Partial plume path adjustment for terrain
- Wet deposition, dry deposition, and chemical transformation are considered

The CALPUFF computational grid is the same as the meteorological grid.

Two important computational parameters in CALPUFF are XMXLEN (maximum length of an emitted puff, in grid units) and XSAMLEN (maximum travel distance of a puff, in grid units, during one time step). Both of these variables are set to 1.0 in the CALPUFF simulations in order to allow the wind field variability to be accounted for in the puff trajectory calculations. The first parameter ensures that the length of an emitted puff does not become so large so that it cannot respond to changes in the wind field on the scale of the meteorological grid. The model automatically increases the frequency of puff releases to ensure the length of a single puff is not larger than the grid size. The second parameter decreases the internal time step to ensure the travel distance during one time step does not exceed the grid size.

The partial plume path adjustment option was used in CALPUFF for this analysis (MCTADJ=3). The CALMET wind field incorporates the effect of the terrain on the plume trajectories. The plume path coefficient was used to characterize the local effect on ground-level concentrations. The default plume path coefficients (PPC) used for this analysis are listed below:

Stability Class	A	B	C	D	E	F
PPC	0.5	0.5	0.5	0.5	0.35	0.35

Deposition and chemical transformation effects are modeled using the default dry deposition model, the scavenging coefficient wet removal module, and the default chemical transformation mechanism (MESOPUFF II scheme). A total of six species are modeled with CALPUFF for this analysis: SO_2, SO_4, NO_x, HNO_3, NO_3, and PM. Of these six species, three are emitted by the Alcoa sources: SO_2, NO_x and PM. The chemical mechanism computes transformation rates of SO_2 to SO_4 and NO_x to NO_3/HNO_3. Constant monthly averaged ozone concentrations are provided in the CALPUFF control input file for use with the chemical transformation module. The ozone concentrations along with radiation intensity are used by the chemical transformation module as surrogates for the OH concentration during the day when the gas phase free radical chemistry is active.

To allow for flexibility each point source is modeled by itself and the two line sources were modeled in a same run. Then, all sources contributions were summed using POSTUTIL and a constant background ammonia concentration of 3 ppb was used to repartition nitrate and nitric acid.

4.4 Visibility Calculations

Calculations of the impact of the simulated plume particulate matter component concentrations on light extinction are carried out in the CALPOST postprocessor. CALPOST Method 6 was used to compute the extinction change in deciviews, using the FLAG (2000) f(RH) curve and a maximum relative humidity of 95 percent. This procedure is consistent with the TCEQ BART modeling protocol (TCEQ, 2007). The equation used is

the usual IMPROVE/EPA equation which is applied to determine the change in light extinction due to changes in component concentrations. Using the notations of CALPOST, the formula is the following:

$B_{ext} = 3f(RH)[(NH_4)2SO_4] + 3f(RH)[NH_4NO_3] + 4[OC] + 1[Soil] + 0.6[Coarse\ Mass] +10[EC] + b_{ray}$

The concentrations, in square brackets, are in $\mu g/m^3$ and b_{ext} is in units of Mm^{-1}. The Rayleigh scattering term (b_{ray}) has a default value of 10 Mm^{-1}, as recommended in EPA guidelines for tracking reasonable progress (EPA, 2003). Note that organic carbon (OC) consists of condensable particulate matter. Soil is defined as fine particulate matter smaller than 2.5 μm diameter (i.e., $PM_{2.5}$).

The haze index (HI) is calculated from the extinction coefficient via the following formula:

$HI = 10 \ln(b_{ext}/10)$

Where HI is in units of deciviews (dv) and b_{ext} is in Mm^{-1}. The impact of a source is determined by comparing HI for estimated natural background conditions with the impact of the source and without the impact of the source.

A monthly background concentration must be entered into the CALPOST input control file for all aerosols defining the background. Table 2-1 of the EPA, 2003 document gives the average natural levels of aerosols components for the two separate regions of the United States: the East, which consists of all the States east of the Mississippi River, and up to one tier of States west of the Mississippi and the West, including the desert/mountain regions of the Mountain and Pacific zones. Table 4-3 gives these background concentrations for each of the six Class I areas modeled. These concentrations were used to compute a natural background extinction following the formulae:

$B_{ext} = 3f(RH)[(NH_4)_2SO_4] + 3f(RH)[NH_4NO_3] + 4[OC] + 1[Soil] + 0.6[Coarse\ Mass] +10[EC] + b_{ray}$

Table 4-4 provides the monthly f(RH) values based on the centroid of the Class I area as required for application of Method 6. The f(RH) values for each month are extracted from Appendix A of EPA, 2003 document.

The highest simulated light extinction change is compared to the threshold value of 0.5 deciview. If the sources modeled have an impact below the 0.5dv threshold, they are exempt for the remainder of the BART process. If the sources modeled have impacts at or above 0.5dv a refined CALPUFF modeling will be performed.

Table 4-3. Average Annual Natural Levels of Aerosol Components (µg/m^3).

Class I Area	Region	SO_4	NO_3	OC	EC	Soil	Coarse Mass
Big Bend	WEST	0.12	0.10	0.47	0.02	0.50	3.00
Caney Creek	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Hercules-Glades	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Mingo	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Upper-Buffalo	EAST	0.23	0.10	1.40	0.02	0.50	3.00
Wichita Mountains	WEST	0.12	0.10	0.47	0.02	0.50	3.00

Source: Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program (September 2003), Table 2-1.

Table 4-4. Monthly Site-Specific f(RH) Values for Visibility Method 6 Based on the Centroid of the Class I Area.

Class I Area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
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
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
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
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
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
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

Source: *Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Program (September 2003), Appendix A, Table A-3.*

5. RESULTS

The results of BART screening analysis using CALPOST Method 6, as recommended by TCEQ BART protocol, for Alcoa Rockdale Facility in Texas are summarized in the Tables 5-1 to 5-6. The background concentrations from which the change in light extinction is computed are based on the annual average natural background values recommended by the EPA (see Table 4-3).

These results are presented for two assumptions regarding the PM_{10}, i.e., assuming all the PM_{10} is in the form of fine particulate matter ($PM_{2.5}$) and a second assumption regarding all the PM_{10} is in the form of secondary organic aerosols (SOA). Tables 5-1 gives visibility impact results for 2001 based on the assumption of all PM10 being in the form of PM2.5, while Table 5-2 presents the results assuming PM10 is in the form of SOA. Tables 5-3 through Table 5-6 present the results for 2002 and 2003.

The highest simulated changes in light extinction for each year and each Class I area are compared to the threshold value of 0.5 deciview. Consistent with the Texas BART modeling protocol, the peak impact rather than the 98th percentile value was used in the comparison with the screening threshold of 0.5 dv. The use of the peak value adds an additional measure of conservatism to the modeling because the BART rule is based on the use of the 98th percentile impacts. Note that the 24-hour average of change in light extinction is computed from Hour 7 of one day to Hour 6 of next day to obtain the 24-hour average in local time since the modeling was done in Greenwich Mean Time (GMT).

For all six Class I areas (Big Bend National Park, Caney Creek, Wichita Mountains, Upper Buffalo, Mingo and Hercules-Glades), the largest changes in light extinction are below the 0.5 deciview threshold for all three years modeled with both assumptions regarding PM_{10}.

In conclusion, based on the CALPUFF visibility modeling results for the 2001-2003 period, the Alcoa Rockdale facility is exempt from the remainder of the BART process.

Table 5-1. Summary of Visibility Impacts for 2001 using Method 6 – All PM_{10} Treated as $PM_{2.5}$.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Day (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.221	-605.803; -1200.954	018 h6	0	0
Caney Creek Wilderness	0.371	271.856; -617.471	047 h6	0	0
Hercules-Glades Wilderness	0.189	358.209; -355.067	261 h6	0	0
Mingo Wilderness	0.128	598.202; -314.996	047 h6	0	0
Upper Buffalo Wilderness	0.192	322.103; -455.186	047 h6	0	0
Wichita Mtns. Wildlife Refuge	0.288	-157.041; -573.384	250 h6	0	0

Table 5-2. Summary of Visibility Impacts for 2001 using Method 6 – All PM_{10} Treated as SOA.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Day (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.254	-605.803; -1200.954	018 h6	0	0
Caney Creek Wilderness	0.397	271.856; -617.471	047 h6	0	0
Hercules-Glades Wilderness	0.202	358.209; -355.067	261 h6	0	0
Mingo Wilderness	0.137	598.202; -314.996	047 h6	0	0
Upper Buffalo Wilderness	0.215	323.987; -445.894	038 h6	0	0
Wichita Mtns. Wildlife Refuge	0.308	-157.041; -573.384	250 h6	0	0

Table 5-3. Summary of Visibility Impacts for 2002 using Method 6 – All PM_{10} Treated as $PM_{2.5}$.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Ending Period (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.297	-660.365; -1171.846	305 h6	0	0
Caney Creek Wilderness	0.225	260.303; -615.071	124 h6	0	0
Hercules-Glades Wilderness	0.113	366.353; -354.701	121 h6	0	0
Mingo Wilderness	0.138	604.141; -305.322	364 h6	0	0
Upper Buffalo Wilderness	0.122	323.987; -445.894	214 h6	0	0
Wichita Mtns. Wildlife Refuge	0.291	-158.756; -583.496	282 h6	0	0

Table 5-4. Summary of Visibility Impacts for 2002 using Method 6 – All PM_{10} Treated as SOA.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Day (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.361	-660.365; -1171.846	305 h6	0	0
Caney Creek Wilderness	0.250	260.303; -615.071	124 h6	0	0
Hercules-Glades Wilderness	0.135	366.353; -354.701	121 h6	0	0
Mingo Wilderness	0.169	600.805; -310.187	364 h6	0	0
Upper Buffalo Wilderness	0.146	323.987; -445.894	214 h6	0	0
Wichita Mtns. Wildlife Refuge	0.331	-158.756; -583.496	282 h6	0	0

Table 5-5. Summary of Visibility Impacts for 2003 using Method 6 – All PM_{10} Treated as $PM_{2.5}$.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Day (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.152	-573.650; -1161.058	142 h6	0	0
Caney Creek Wilderness	0.313	271.705; -612.861	065 h6	0	0
Hercules-Glades Wilderness	0.181	359.194; -360.551	196 h6	0	0
Mingo Wilderness	0.121	598.202; -314.996	321 h6	0	0
Upper Buffalo Wilderness	0.177	322.103; -455.186	321 h6	0	0
Wichita Mtns. Wildlife Refuge	0.268	-152.496; -574.391	016 h6	0	0

Table 5-6. Summary of Visibility Impacts for 2003 using Method 6 – All PM_{10} Treated as SOA.

Class I Area	Largest Delta-deciview (dv)	Receptor location	Day (in UTC)	No. of days above 0.5dv	No. of days above 1dv
Big Bend NP	0.175	-573.650; -1161.058	142 h6	0	0
Caney Creek Wilderness	0.345	271.705; -612.861	065 h6	0	0
Hercules-Glades Wilderness	0.196	358.413; -359.665	196 h6	0	0
Mingo Wilderness	0.131	598.802; -313.105	034 h6	0	0
Upper Buffalo Wilderness	0.195	322.103; -455.186	321 h6	0	0
Wichita Mtns. Wildlife Refuge	0.296	-152.479; -573.470	016 h6	0	0

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