Appendix 5c - Additional BART information for SABIC

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BEST AVAILABLE RETROFIT TECHNOLOGY (BART) MODELING PROTOCOL
FOR SABIC INNOVATIVE PLASTICS MT. VERNON, LLC
MT. VERNON, INDIANA

"Draft- for Discussion with IDEM 02/25/08"

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APPENDICES

EXECUTIVE SUMMARY

This document provides the modeling protocol for the application of the CALPUFF Model to determine visibility impacts and Best Available Retrofit Technology (BART) applicability for the Sabic Innovative Plastics Mt. Vernon, LLC (Sabic Innovative Plastics) facility, (formerly GE Plastics Mt. Vernon, Inc.), located just southwest (about 1 mile) of Mt. Vernon, Indiana. Indiana is part of the Midwest Regional Planning Organization (Midwest RPO), which was organized and funded by the U.S. EPA to facilitate the assessment of visibility impairment in the region. The Midwest RPO has not developed any specific guidance for air quality modeling for visibility impacts in support of BART exemptions and BART application review. However, the Lake Michigan Air Directors Consortium (LADCO) developed the Single Source Modeling to Support Regional Haze BART Modeling Protocol (March 21, 2006), which they followed in providing visibility impacts for non-EGU sources across the Midwest RPO. Also, neighboring Kentucky sources along the south shore of the Ohio River have been evaluated following guidance provided by the Visibility Improvement State and Tribal Association of the Southeast (VISTAS). Due to the similarity between these river sites and the lack of specific Indiana or Midwest RPO BART visibility impact modeling guidance, this protocol follows guidance provided by the general guidelines of the U.S. EPA in 40 CFR Part 51 Appendix W and Appendix Y, the VISTAS protocol guidance, and the LADCO protocol. The specific VISTAS documentation is called the Protocol for the Application of the CALPUFF Model for Analysis of Best Available Retrofit Technology (BART) (Revision 3.2 – 8/31/06) which describes "common procedures for carrying out air quality modeling to support BART determinations in the VISTAS states that are consistent with guidelines of the U.S. Environmental Protection Agency in 40 CFR Part 51 Appendix W and Appendix Y".

The modeling that is proposed herein focuses on the modeling analysis to determine if the visibility impacts due to the Sabic Innovative Plastics emissions from the BART-eligible source are less than or greater than the visibility level of 0.5 deciviews (dv) which is the threshold used to determine whether a source contributes to visibility impairment. Previous screening level modeling performed by LADCO on behalf of IDEM indicated that the Sabic Innovative Plastics sources would exceed the 0.5 dv threshold for visibility impacts at five Class I areas for a total of 28 days over a three year modeling period, with 19 of those days being in the Mammoth Cave National Park and six being in Mingo Wilderness. The highest exceedence in a single year was 9 days at Mammoth Cave National Park in 2003. This previous modeling used a 36km grid resolution meteorological and modeling domain and released all emissions from one combined stack at Sabic Innovative Plastics; which, by most modeling guidelines for such analyses, would be considered a screening level analysis. The modeling herein proposes to build on this baseline analysis by LADCO, and with consideration of individual stacks and their associated emissions as well as a higher resolution 4km meteorological and modeling domain. The improved modeling resolution and source apportionment are considered to be more "refined" modeling than the original coarse 36km, combined stack modeling by LADCO. Such modeling analysis will provide a more robust analysis of the visibility impacts and days of significant impact for emissions from the Sabic Innovative Plastics BART-eligible source. The refined modeling also considers applicable federally enforceable emission caps and unit limitations. If this refined modeling results in visibility impacts of 0.5 dv for < 8 days for all individual years and < 22 days for all three years combined, then IDEM should exempt the Sabic Innovative Plastics facility from further BART analysis. Conversely, if the more refined modeling results in visibility impacts of 0.5 dv for ≥ 8 days for all individual years and ≥ 22 days for all three years combined, the results would not support exempting the Sabic Innovative Plastics source from BART analysis. If the latter case is true, additional modeling will be performed that calculates the incremental impact of selected BART controls on specific units using the 4km refined methodology presented herein.

This protocol describes the modeling methodologies to be followed for two steps, namely, the updated 36km modeling approach and the 4km refined grid modeling approach. Details regarding model selection, model options, sources, meteorological data, speciation, chemical formulation, visibility calculations, post-processing, and presentation of results are provided in this protocol. The methodology also describes the Sabic Innovative Plastics facility in Mt. Vernon, the sources and emissions, the locations of each source, and the selection of the appropriate modeling domain. Summary tables of all visibility calculations will be presented as specified in the final documentation for the modeling.

1.0 INTRODUCTION

1.1 BACKGROUND ON BART

On 6 July 2005, the U.S. Environmental Protection Agency (EPA) published final amendments to its 1999 Regional Haze Rule (RHR) in the Federal Register, including Appendix Y, the final guidance for Best Available Retrofit Technology (BART) determinations (70 FR 39104-39172). The rule applies to any BART-eligible source that ‘‘emits any air pollutant which may reasonably be anticipated to cause or contribute to any impairment of visibility” in any mandatory Class I federal area. States retain the authority to exempt certain BART-eligible sources based on dispersion modeling demonstrating that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area. States also have the authority to define the modeling procedures used to establish BART emissions limits on those sources for which controls are required (IDEM has not exercised such authority although they have performed preliminary exemption modeling through LADCO). To assist the states, the EPA has offered guidelines for how BART modeling should be conducted. The regional air group, the Visibility Improvement State and Tribal Association of the Southeast (VISTAS), which is comprised of all States in the Southeast U.S. (including Kentucky, Florida, South Carolina, North Carolina, Georgia, Mississippi, Alabama, Tennessee, Virginia, West Virginia, and the Eastern Band of the Cherokee Nation) also has prepared guidance to follow in how BART visibility impact modeling should be conducted. Because these states are immediately adjacent to Sabic Innovative Plastics in the Midwest RPO, the VISTAS guidance provides a relevant initial framework for this proposed modeling protocol for the Sabic Innovative Plastics source in Mt. Vernon, Indiana. In developing this protocol, the LADCO single source protocol (entitled Single Source Modeling to Support Regional Haze BART Modeling Protocol (March 21, 2006) was also used as a guide.

1.2 BACKGROUND ON SABIC INNOVATIVE PLASTICS

Sabic Innovative Plastics owns and operates a chemical manufacturing source in Posey County, Indiana. The source is located on the north side of the Ohio River, near Mt. Vernon, Indiana. The area is characterized by rolling, forested, and mixed residential, farm, and industrial land use. Terrain is notable, but not a significant feature in the area and across the potential study modeling domain, and will be considered in the modeling. The facility makes a variety of polymers using chemical processes, which are supported by heaters, boilers, and non-chemical manufacturing activities. The Sabic Innovative Plastics facility is located on about 1000 acres and employs more than 1500 persons. Operations in the chemical process BART-eligible source include boilers and heaters as well as other processes that account for emissions of SO_2, NO_x, and PM_{10} in the plant. Figure 1 shows the approximate location of the Sabic Innovative Plastics plant, and Figure 2 shows a topographical map (USGS 7.5’ quadrangle) of the near vicinity.

Figure 1. Regional Location Map of Sabic Innovative Plastics

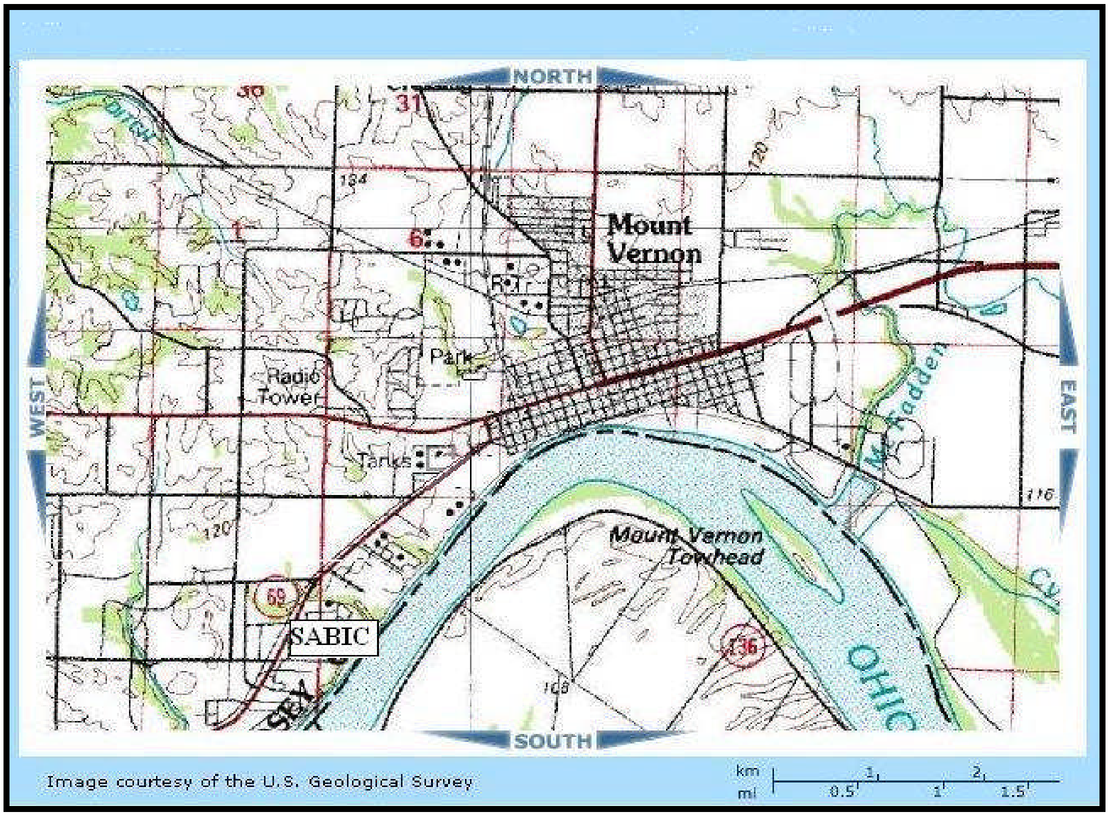


Figure 2. USGS Map of the Mt. Vernon, Indiana Area

In December 2005, Sabic Innovative Plastics provided information pertaining to its BART-eligible source emission units in response to IDEM's BART survey. The BART-eligible source point and fugitive sources, along with their source parameters, are shown in Appendix A. (Appendix A reflects updated information developed from additional evaluations conducted since the December 2005 survey.) All coordinates for the sources, originally in Universal Transverse Mercator (UTM), Zone 16 coordinates, were converted to the Lambert Conformal Coordinates (LCC) as presented in Appendix B (specifications for this conversion are described in Section 2.2). The maximum 24hr emission rates for each pollutant are presented in Appendix C.

1.3 STUDY OBJECTIVES

A recent modeling study by LADCO/IDEM at a 36km grid scale indicated that that the Sabic Innovative Plastics sources would exceed the 0.5 dv contribution threshold for visibility impacts at five Class I areas for a total of 28 days over a three year modeling period. The distribution of days above 0.5 dv was 19 days at Mammoth Cave NP (KY), six days at Mingo Wilderness (MO), and one day each at Sipsey Wilderness (AL), Linville Gorge (NC), and Hercules-Glades Wilderness (MO). The highest exceedence in a single year was 9 days at Mammoth Cave National Park in 2003. The LADCO/IDEM modeling used a 36km grid resolution meteorological and modeling domain and released the combined SO_2, NO_x, and $PM_{2.5}$ emissions from one combined stack with arithmetically averaged parameters at Sabic Innovative Plastics.

The objective of the modeling proposed herein is to analyze the visibility impacts of the individual stacks and their associated emissions using the coarse 36km modeling domain as well as an improved 4km meteorological and modeling domain. The improved modeling resolution and source apportionment are considered to be more "refined" modeling that will allow a more defined modeling approach than the original LADCO/IDEM coarse grid analysis and provide more representative visibility impacts. This modeling is intended to replace the coarse grid modeling. If this improved resolution modeling results in a visibility impact greater than the visibility impact threshold of 0.5 dv for $\geq$ 8 days for all individual years and $\geq$ 22 days for all three years combined, the Sabic Innovative Plastics sources that are subject to BART controls will undergo additional modeling to calculate the incremental impact of selected BART controls.

1.4 CALPUFF MODELING SYSTEM

The modeling for Class I area visibility impacts will be performed with the CALPUFF Model and its various companion programs, including CALMET (meteorological processing), CALPOST, and POSTUTIL (both post-processing programs). The CALPUFF modeling system has been adopted by the EPA as a guideline model for source-receptor distances greater than 50 km. CALPUFF was recommended for Class I impact assessments by the FLM Workgroup (FLAG, 2000), by the Interagency Workgroup on Air Quality Modeling (IWAQM) (EPA, 1998), and by VISTAS (VISTAS, 2006) for BART modeling. As recommended in these guidance documents, CALPUFF is the primary modeling system for the initial and refined grid source-specific modeling applications for Class I areas. The model's formulation provides the appropriate tools for assessing and simulating the various geographical and meteorological influences, the stack and stack gas conditions, the atmospheric and physical processes and the gas-phase, aerosol, and aqueous-phase chemical processes that influence ambient air concentrations, deposition, and visibility.

The CALPUFF modeling system was originally developed as a component of a three-part modeling system sponsored by the California Air Resources Board (CARB) in the mid-1980s. The CARB sought to develop a new puff-based model, a new grid-based model and an improved meteorological processor that would support application of the two. CALGRID was the urban-scale photochemical grid model resulting from the project (Yamartino et al., 1992) comparable in science and capabilities to the Urban Airshed Model (UAM-IV) (Scheffe and Morris, 1993). The model formulation was aimed at overcoming the deficiencies in EPA's steady-state Gaussian plume models that were routinely used for inert and linearly reactive materials (principally SO_2) from elevated point sources. Thus, the CALGRID model was designed to treat the complexities of urban-scale photochemical processes while CALPUFF was formulated to treat the non-steady state transport, diffusion, linear reaction, and deposition of primary pollutants from point sources.

CALPUFF is a non-steady state numerical air quality model that simulates the transport, diffusion, deposition, and chemical transformation of SO_2, NO_x, and particulate emissions from point, line, and area sources. Emissions are characterized by diffusing puffs that are transported by the wind and within which chemical reactions take place. The main components of the model are CALMET (a three-dimensional kinematic meteorological interpolator), CALPUFF (the core dispersion and chemical transformation module), and CALPOST (a post-processing package). Figure 3 from the CALPUFF User's Guide (Scire et al, 2000) shows a flow diagram of the model. The most recent EPA approved version of CALPUFF (Version 5.8) is proposed for use in this study.

The CALMET processor is used to generate meteorological data sets for modeling studies using a combination of meteorological, geophysical, land use, and elevation data. For this analysis meteorological data at the 4km resolution will be used and consists of three years of data for 2001-2003 using MM5-generated (version 3.6) data supplemented with National Weather Service surface and upper air sounding observations. Because the VISTAS RPO has already processed such 4km data through the U.S. Fish & Wildlife Services in Denver, Colorado in CALMET 5.8 format in a domain that covers southern Indiana and Eastern U.S., these data are proposed for use in this modeling.

The CALPUFF Model contains the algorithms for determining the transport and dispersion of emissions into modeling grids at time steps commensurate with meteorology and puff tracking. To perform the most representative analysis possible of the potential visibility impacts of Sabic Innovative Plastics, the modeling study will follow the applicable guidelines as noted in more detail in the sections that follow.

Post-processors will be used after the CALPUFF Model calculates hourly air concentrations. CALPOST, POSTUTIL, and CALSUM will be used as needed to generate air concentrations on an individual emission basis for various averaging times to be used in the visibility calculations.

The processors will then also be used to estimate potential visibility impacts, combining particle size contributions, repartitioning of nitrates, and summation of individual source impacts if required.

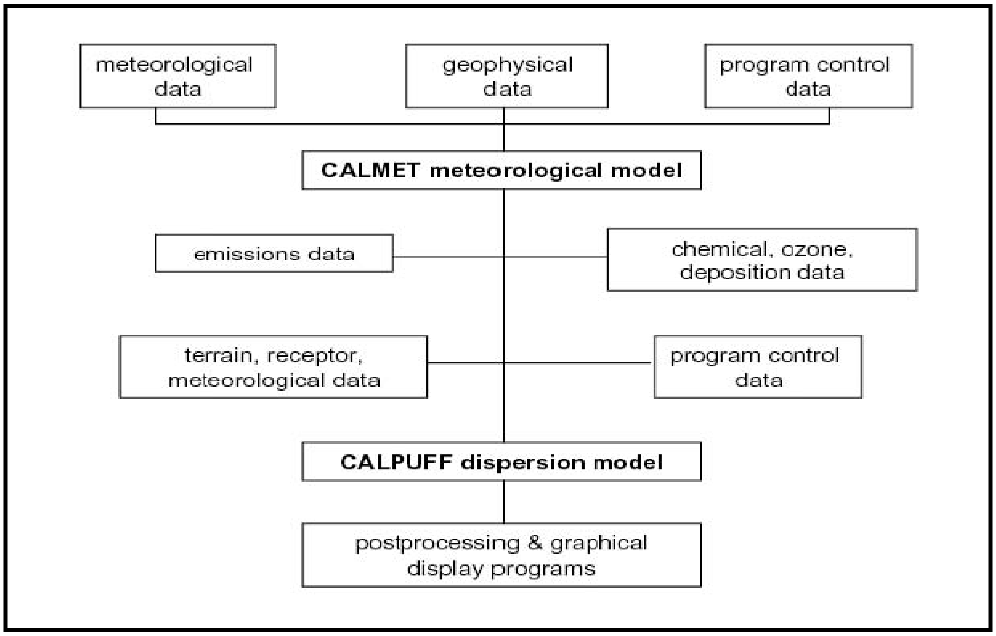


Figure 3. CALPUFF Modeling Schematic (Scire, et al., 2000)

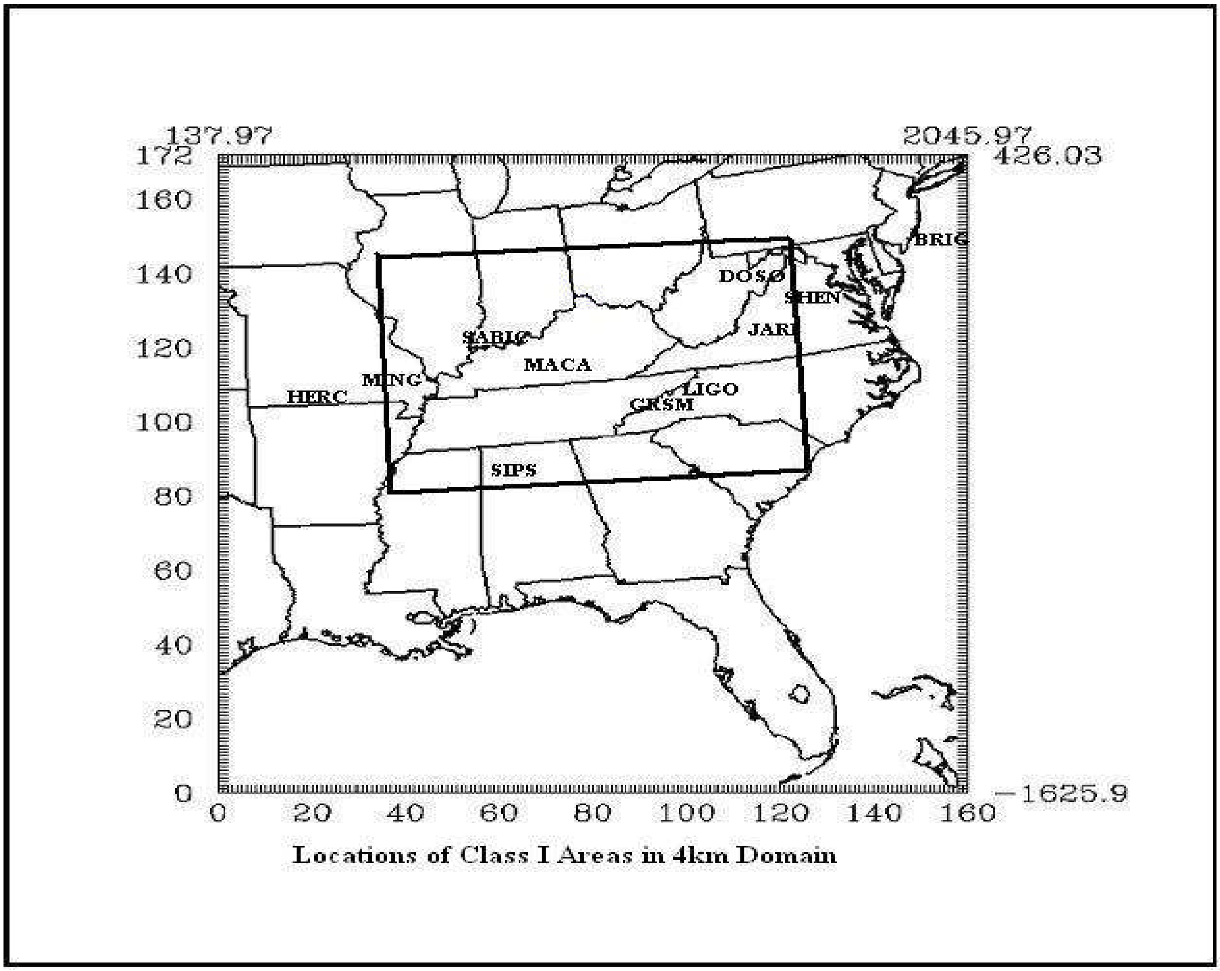
1.5 LOCATION OF SABIC INNOVATIVE PLASTICS VS. CLASS I AREAS

A number of Class I areas are in the eastern U.S. region surrounding the Sabic Innovative Plastics facility in Mt. Vernon, Indiana. Most Class I areas considered by the LADCO/IDEM modeling will be considered in the proposed 4km analysis. Those Class I areas within 300 km of Sabic Innovative Plastics are within the range of the most credible application of CALPUFF. The distance from Sabic Innovative Plastics to the nearest receptor and the farthest receptor in each Class I area is presented below.

- Boundary Waters Canoe Area, Minnesota 1127-1211 km
- Brigantine National Wildlife Refuge, New Jersey 1191-1205 km
- Dolly Sods Wilderness Area, West Virginia 754-762 km
- Great Gulf Wilderness Area, New Hampshire 1570-1576 km
- Great Smoky Mountains National Park, Tennessee 437-503 km
- Hercules-Glades Wilderness, Missouri 459-468 km
- Isle Royale National Park, Michigan 1100-1154 km
- James River Face Wilderness Area, Virginia 745-753 km

- Linville Gorge Wilderness Area, North Carolina 578-587 km
- Lyle Brook Wilderness, Vermont 1387-1398 km
- Mammoth Cave National Park, Kentucky 165-186 km
- Mingo National Wildlife Refuge, Missouri 221-231 km
- Seney Wilderness, Michigan 935-947 km
- Shenandoah National Park, Virginia 799-861 km
- Sipsey Wilderness, Alabama 393-404 km
- Voyageurs National Park, Minnesota 1215-1263 km

Figure 4 shows the approximate location of these areas with regard to Sabic Innovative Plastics. Some very distant areas to the north and northeast are not shown. All identified Class I areas listed above will be modeled in the 36km grid analysis while only those Class I areas with receptors within the 4km modeling domain of Sabic Innovative Plastics, i.e. Dolly Sods, James River Face, Mammoth Cave, Great Smokies, Linville Gorge, Mingo, and Sipsey will be included in the refined modeling. Outlines of the individual Class I areas and all associated receptors arranged in a gridded array over each area as found on the National Park Service website are shown in Appendix D. Only those Class I areas having impacts above the visibility threshold levels will be further modeled if BART controls are required to be evaluated.



(Boundary Waters, Great Gulf, Isle Royale, Lye Brook, Seney and Voyageurs not shown)

Figure 4. Locations of Class I Areas

2.0 COARSE MODELING APPROACH

The first step that is proposed in this BART visibility modeling protocol is to use the LADCO coarse 36km grid meteorology and modeling domain with Sabic Innovative Plastics unit differentiation and specific source emissions. This modeling is intended to confirm the baseline LADCO modeling as well as provide additional source and emission refinement to evaluate whether Sabic Innovative Plastics can be exempted from further BART analysis using a consistent and conservative set of meteorological and dispersion options. A pre-computed set of meteorological files provided by IDEM in the 36km format and pre-defined CALPUFF input option configurations, based on LADCO CALPUFF modeling which followed guidance in the final BART rule (70 FR 39104-39172) and other EPA and FLAG model guidance, allows relatively simple screening simulations. The regional modeling domain for the coarse modeling approach will include all Class I areas in the original LADCO modeling that are presented in Section 2 herein. The objective of this analysis is to determine whether more detailed analysis (i.e., more than the LADCO/IDEM combined source approach) of Sabic Innovative Plastics emissions for those BART-eligible sources identified by IDEM result in visibility impacts greater than the threshold of 0.5 dv. The second objective of this coarse grid modeling is to determine which Class I areas should be included in a refined analysis if the coarse modeling indicates a source may significantly impact visibility. This coarse modeling approach uses three-dimensional meteorological fields and the full CALPUFF model, and thus can be considered to be a reasonable indicator of the outcome from a refined CALPUFF analysis considering a high probability of moderate conservatism.

This section discusses the modeling data fields, the model options, and presentation of results that will be used and generated for performing the visibility modeling analysis for the Sabic Innovative Plastics facility.

2.1 MODEL SELECTION

As recommended by recent protocols and guidance, the CALPUFF modeling system will be used for visibility impact assessment. For the 36km coarse grid modeling, the version of CALPUFF that was used by LADCO will likewise be used here even though this is not the most current regulatory version recommended by U.S. EPA. CALPUFF Version 5.771a along with the CALMET Version 5.53a 36km meteorological data will be used for this coarse visibility modeling.

2.2 MODELING DOMAIN

The computational modeling domain serves as the basis for all dispersion and visibility modeling that will be performed. The domain represents the extent of the study area and the modeling grid provides a consistent format for conducting the modeling and for translating the meteorology data to the computation level. The computational grid will be specified in a Lambert Conformal Conic (LCC) grid. This protocol proposes the use of the 36km grid domain that was used in the

LADCO/IDEM modeling. The grid consisted of 97 36km cells in the east-west direction and 90 36km cells in the north-south direction. In terms of LCC coordinates, the two matching parallels were 33^{o} and 45^{o,} the latitude and longitude of the center of the grid was 40^{o} N and 97^{o} W, respectively, and the grid origin was at -900km east and -1620km north. Figure 5 shows the overall LCC-based 36km modeling domain with the location of Sabic Innovative Plastics indicated.

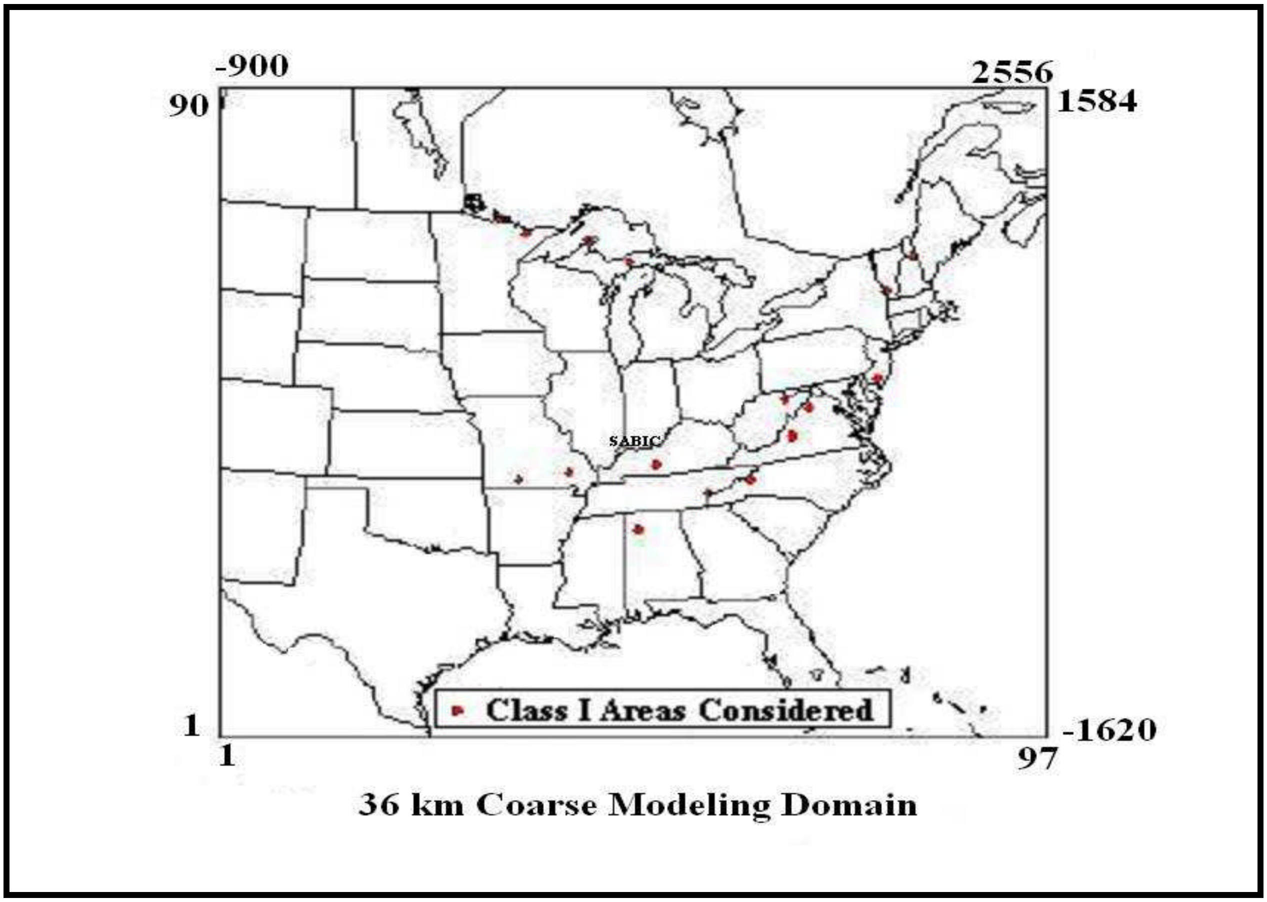


Figure 5. Proposed 36-km Modeling Grid
For the Sabic Innovative Plastics Modeling

2.3 RECEPTOR LOCATIONS FOR CLASS I AREAS

Receptors used by the LADCO/IDEM CALPUFF modeling over the 36km grid domain for each Class I area were taken from the website of the National Park Service (NPS) Class I receptor database (http://www2.nature.nps.gov/air/Maps/Receptors/index.cfm). These locations were projected into the computational grid, and reformatted for input into CALPUFF. Elevations for each receptor were determined from digital elevation data from the NPS receptor data sets. A graphical representation of the locations of the Class I areas for this 36km modeling is shown in Figure 5.

2.4 METEOROLOGICAL DATA

Pre-processed CALMET 5.53a meteorological files were obtained from IDEM on a 36km grid basis for the modeling domain shown in Figure 5. These will be used in all coarse grid modeling. Three years of MM5 meteorological data were processed by LADCO using CALMET Version 5.53a and are available for this regional coarse grid CALPUFF modeling effort. These base data sets include the years 2002, 2003, and 2004.
These meteorological data sets were processed using CALMET in a No-Observations mode and produced annual meteorological data files at the 36km grid resolution for the overall eastern U.S. meteorological domain. The CALMET output files in the form of CALPUFF-ready three-dimensional meteorological files were made available and obtained from IDEM in August 2007.

2.5 CALPUFF MODEL OPTIONS AND CONFIGURATION

The CALPUFF modeling parameters will follow the LADCO/IDEM 2006 guidance and previous modeling. A brief discussion of several key inputs is provided below.

- Chemical mechanism: MESOPUFF II module
- Species modeled: SO_2, SO_4, NO_x, HNO_3, NO_3 and $PM_{2.5}$ for these coarse grid runs. All emission rates will be based on the most appropriate level of the EPA BART guidance, i.e., monitored data or the 24-hour potential-to-emit emission rate using the fuel characteristics, the maximum capacity of each unit, and the appropriate AP-42, or other, emission factor. Emissions will be included for all species originally modeled by LADCO/IDEM, namely, SO_2, NO_x, and $PM_{2.5}$.
- Excluded emissions: VOC and ammonia/ammonia compound emitting sources will be excluded from the modeling. All other emissions specified by BART will be included. All other emissions were greater than the *de minimis* levels (40 tons per year for SO_2 and NO_x and 15 tons per year for PM_{10}) and thus, all will be modeled.
- Dispersion coefficients: The Pasquill-Gifford dispersion coefficients will be used.
- Ozone dataset: Seasonal domain averaged ozone concentrations based on the LADCO modeling will be used for the coarse grid modeling. These values are monthly and equal: 31, 31, 31, 37, 37, 37, 33, 33, 33, 27, 27, 27 ppb.
- Background ammonia concentration: Seasonal domain averaged ammonia concentrations based on the LADCO/IDEM modeling will be used for the coarse grid modeling. These values are monthly and equal: .3, .3, .3, .5, .5, .5, .5, .5, .5, .5, .5, .5 ppb
- Puff representation: the integrated puff sampling methodology will be used.
- Building downwash: Building and structure downwash effects will be ignored as all Class I areas are greater than 50 km from Sabic Innovative Plastics.

2.6 VISIBILITY IMPACT THRESHOLD

Pursuant to the final BART guidance, the LADCO/IDEM protocol (March 2006), and 326 IAC 26-1-4(a) the criteria to determine if a source is contributing to visibility impairment is the 98th percentile value in the modeling that is equal to 0.5 dv. This 0.5 dv visibility impairment is a 0.5 dv change from natural conditions. The 98th percentile is interpreted as any source with ≥22 days of visibility impairment over the three year modeling period or ≥ 8 days of visibility impairment over any one year modeled. Along with this threshold determination, within each Class I area the number of days above 0.5 dv and the number of receptors greater than 0.5 dv will be determined.

2.7 CALPOST AND POSTUTIL ANALYSIS

The CALPUFF Model calculates air concentrations of all species modeled, and postprocessor programs are used to generate the final visibility impairment in terms of light extinction. The visibility analysis evaluates the potential change in light extinction relative to the natural background due to the Sabic Innovative Plastics BART-eligible sources. The two main postprocessors of interest for this BART application are the CALPOST and POSTUTIL programs. CALPOST will be used to process the CALPUFF outputs. When performing visibility-related modeling, CALPOST uses concentrations from CALPUFF to compute light extinction and related measures of visibility (e.g., haze index in deciviews), with results reported for a 24-hour averaging time. The CALPOST processor contains several options for evaluating visibility impacts, including the method described in the BART guidance, which uses monthly average relative humidity values.

The POSTUTIL processor is a program that allows the cumulative impacts of multiple sources from different simulations to be summed, which may be required if the number of units at Sabic Innovative Plastics require multiple CALPUFF runs. POSTUTIL also contains a chemistry module to evaluate the equilibrium relationship between nitric acid and nitrate aerosols. This capability allows the potential non-linear effects ammonia scavenging by background sulfate and nitrate sources to be evaluated in the formation of nitrate from an individual source.

Inputs that will be designated for the CALPOST and POSTUTIL analysis include:

- Visibility calculations: Method 6 will be used in this coarse grid modeling approach using Class I area-specific (centroid) monthly average relative humidity values (from EPA, 2003a)
- Species considered in visibility analysis: sulfate, nitrate, and fine PM.
- Natural background light extinction: EPA (2003b) values at the haze index value in deciviews for the 20% best days will be used for the natural background light extinction. This analysis will use the LADCO natural background light extinction, B_{ext}, technique which adjusts the Class I area specific chemically speciated natural background concentrations (using the Eastern U.S. as the basis).

- Rayleigh scattering value: 10 Mm^{-1} (all Class I areas)
- Light extinction efficiencies: the default EPA (2003b) values will be used and are in the LADCO/IDEM input files
- Ammonia limiting technique: will be used in the initial approach modeling

2.8 DOCUMENTATION AND CALPUFF MODEL OUTPUTS

For the coarse grid modeling approach a number of products documenting the analysis will be prepared. These will include:

- Map of the Sabic Innovative Plastics facility location and Class I areas (similar to that presented in this protocol),
- A table listing all Class I areas in the modeling domain and those in neighboring states, as well as a table listing the impacts at those Class I areas as shown by example in Table 2,
- A summary table summarizing the results of the initial approach modeling,
- Discussion of whether the Sabic Innovative Plastics sources were greater than or less than the impact threshold of 0.5 dv, the Class I areas affected, and the number of such events.

Table 2. Format of Table of CALPUFF Model Results in the 36km Modeling Domain to Demonstrate Sabic Innovative Plastics Visibility Impacts

Class I Area	Distance from Sabic Innovative Plastics to Nearest Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact > 0.5 dv in Class I area: 2004		# of days and # of receptors with impact >0.5 dv in Class I area for 3-yr period: 2002-2004		Max. 24-hr impact over 3 yr period
Boundary Waters, MN	1127									
Brigatine, NJ	1191									
Dolly Sods, WV	754									
Great Gulf, NH	1570									
Great Smoky Mts., TN	435									
Hercules Glade, MO	459									
Isle Royale, MI	1100									
James River	745									

Class I Area	Distance from Sabic Innovative Plastics to Nearest Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact > 0.5 dv in Class I area: 2004		# of days and # of receptors with impact >0.5 dv in Class I area for 3-yr period: 2002-2004		Max. 24-hr impact over 3 yr period
Face, VA										
Linville Gorge, NC	578									
Lyle Brook, VT	1387									
Mammoth Cave, KY	165									
Mingo, MO	221									
Seney, MI	935									
Shenandoah, VA	799									
Sipsey, AL	393									
Voyageurs, MN	1215									

3.0 FINER GRID MODELING METHODOLOGY

The coarse grid (36km) analysis outlined in Section 2 was intended to verify the LADCO/IDEM CALPUFF modeling results and to introduce better source and emissions data into the analysis. If this coarse grid visibility modeling of the Sabic Innovative Plastics sources shows 98th percentile visibility impacts that are greater than the contributing impact threshold of 0.5 dv for BART applicability, even considering the additional source differentiation and spatial allocation of emissions, further modeling analysis will be performed using a 4km refined grid modeling approach. This second modeling step uses a more detailed modeling grid at the 4km grid spacing, more robust meteorological data also at the 4km spacing, and other less conservative model assumptions in CALPUFF. This finer grid resolution modeling will allow a more representative characterization of complex terrain and wind flow in and around Sabic Innovative Plastics as well as at each Class I area. While Sabic Innovative Plastics may not be in a significant complex terrain situation, many of the Class I areas are in such situations along with intervening regions between Sabic Innovative Plastics and the Class I areas. This finer grid modeling proposes to utilize recently developed (summer 2007) CALMET 4km meteorological data sets produced by the U.S. Fish & Wildlife Service in the CALMET Version 5.8 format. These are available for five sub-regional domains in the VISTAS RPO covering much of the eastern U.S. If this modeling does not pass the visibility impact threshold for the finer grid modeling, i.e., the 98th percentile change in deciviews, further modeling of BART alternative controls will be performed following this 4km modeling approach. Pre-computed sets of meteorological files at a 4km grid spacing and a pre-defined CALPUFF input option configuration (proposed herein), based on guidance in the final BART rule (70 FR 39104-39172) and other EPA and FLAG model guidance, will allow a straightforward application of the CALPUFF Model in this finer grid modeling approach.

3.1 MODEL SELECTION

The CALPUFF modeling system will be used for all sources at the Sabic Innovative Plastics facility for the finer grid visibility impact assessment. This protocol proposes to use CALPUFF Version 5.8 for all modeling which is the most recent U.S. EPA recommended regulatory version and is consistent with the CALMET Version 5.8 meteorological data sets.

3.2 MODELING DOMAIN

The computational modeling domain serves as the basis for all dispersion and visibility modeling that will be performed. The domain represents the extent of the study area and the modeling grid provides a consistent format for conducting the modeling and for translating the meteorology data to the computation level. The VISTAS RPO is broken into five sub-regional domains with the 4km resolution. These are shown in Figure 6. Sub-Domain 3 was selected to be used for the finer grid modeling for Sabic Innovative Plastics as it covered the areas most likely to have Class I areas influenced by Sabic Innovative Plastics. Other areas will be included if coarse grid modeling results in visibility impacts greater than the 0.5 dv threshold. Sub-Domain 3 contains a 4 km grid meteorological data set which will be used for all computational analyses in

CALPUFF. This proposed modeling grid encompasses most of the Class I areas within 300-400 km of Sabic Innovative Plastics.

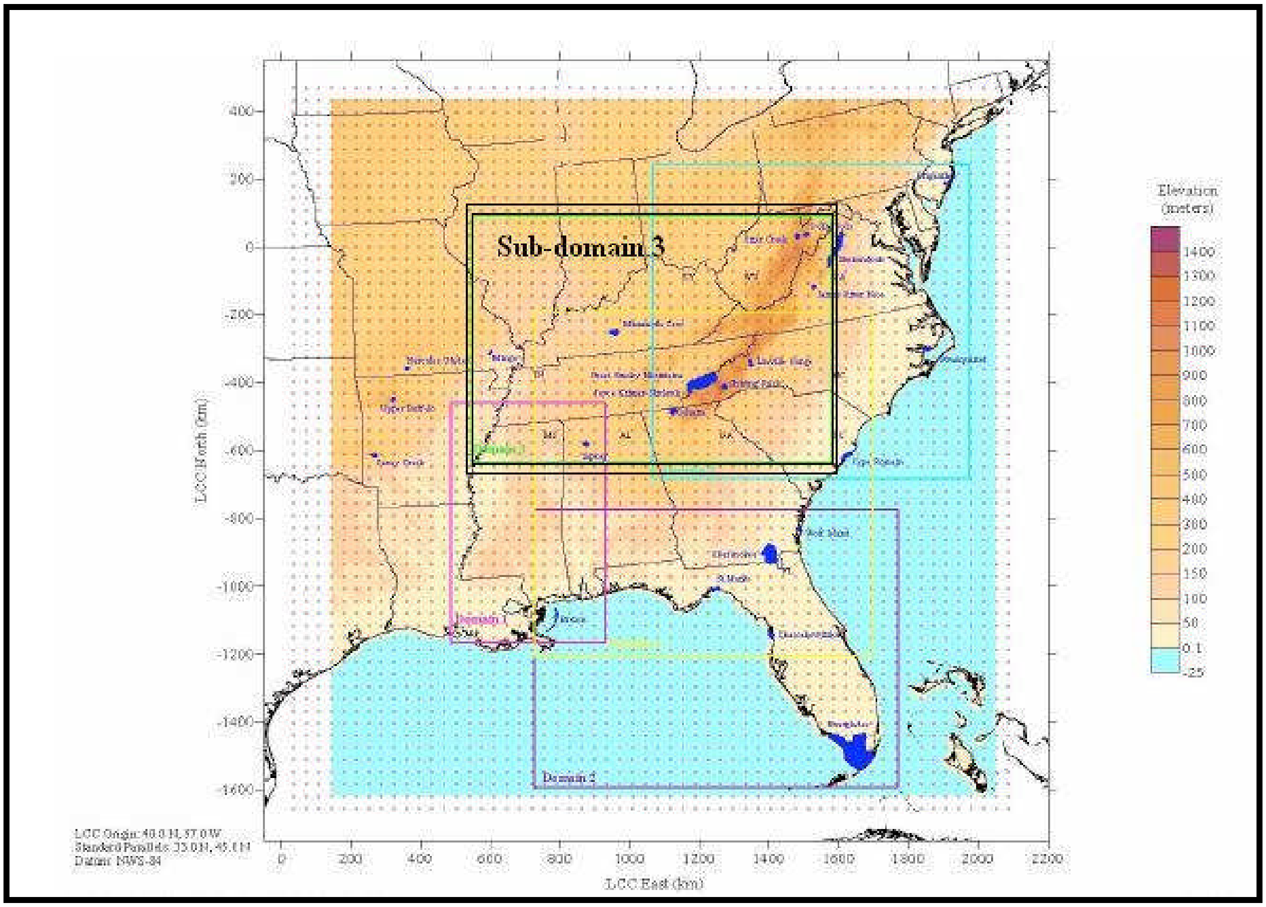


Figure 6. Sub-Domain 3 for 4km Grid Modeling Within All VISTAS Domains

The computational grid will be specified in Lambert Conformal Conic (LCC) grid coordinates. The grid will have a 4km grid cell spacing with approximately 263 columns by 185 rows. In terms of LCC coordinates, the two matching parallels will be 33^{o} and 45^{o}, the latitude and longitude of the center of the grid is 40^{o} N and 97^{o} W, respectively, and the grid origin was at 538 and -638 km, respectively for east and north. Figure 7 shows the proposed 4km modeling domain.

3.3 RECEPTOR LOCATIONS FOR CLASS I AREAS

The Class I area receptor locations will be taken from the National Park Service (NPS) Class I receptor database (http://www2.nature.nps.gov/air/Maps/Receptors/index.cfm). These locations will be projected into the computational grid, and reformatted in Lambert Conformal Conic coordinates for input into CALPUFF. Elevations for each receptor will be determined from digital elevation data from the NPS information. All Class I areas that did not pass the initial screening visibility modeling in Section 2 will be included in this analysis or at a minimum all seven of those areas shown in Sub-Domain 3 that were illustrated in Figure 4.

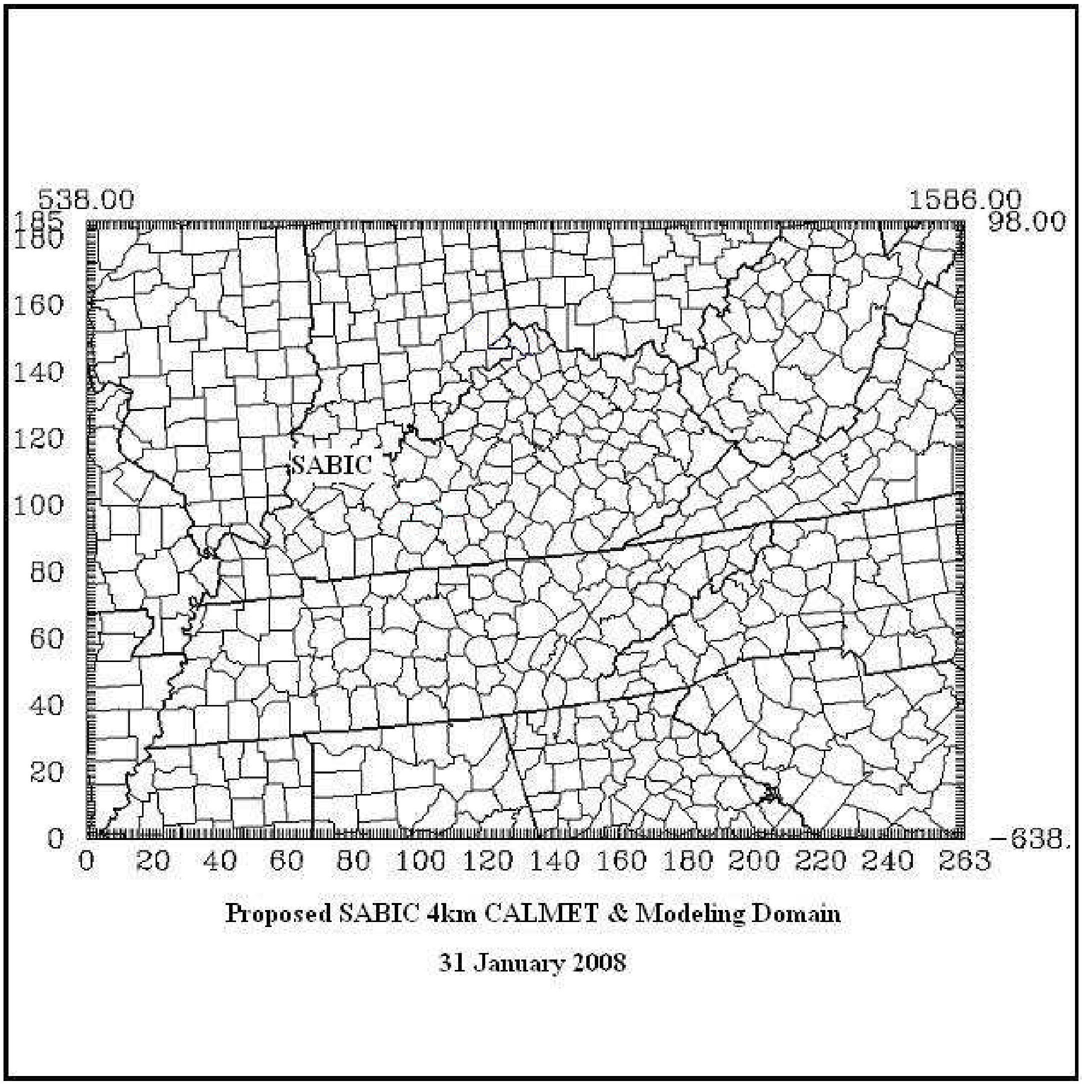


Figure 7. Sub-domain 3 for the 4km CALMET Finer Grid Modeling and Proposed Sabic Innovative Plastics CALPUFF Computational Grid

3.4 METEOROLOGICAL DATA

Sub-Domain 3, as shown in Figure 7, will be the data set that will be used to best characterize the Sabic Innovative Plastics impact area. Three years of pre-computed sub-regional CALMET meteorological data for Sub-Domain 3 will be used for the Sabic Innovative Plastics visibility modeling. Three years of MM5 meteorological data along with NWS observations were used by the US F&WS to generate these 4km meteorological datasets using CALMET 5.8. These data sets include the years 2001-2003:

- 2001 MM5 dataset at 12-km and 36-km grid (developed for EPA)

- 2002 MM5 dataset at 12-km and 36-km grid (developed by VISTAS)
- 2003 MM5 dataset at 36-km grid (developed by the Midwest Regional Planning Organization).

These data sets were processed using CALMET in a hybrid mode using both the MM5 data to define the initial guess fields and meteorological observational data in the CALMET calculations. These 4km CALMET (Version 5.8) output files in the form of CALPUFF-ready three-dimensional meteorological files have been made available and currently reside on the Alpine Geophysics computers in Denver, Colorado.

3.5 CALPUFF MODEL OPTIONS AND CONFIGURATION

The CALPUFF modeling parameters and options selection adhered to VISTAS, EPA, and FLM guidance documents as well as being mindful of the LADCO/IDEM protocol. A summary of the proposed modeling option selections on a parameter by parameter input basis is provided in Appendix E. Most of the discussion concerning these options that was presented in Section 2.5 of this protocol for the coarse modeling is the same for the finer grid modeling. A few exceptions are noted below which address features of the finer grid modeling that make it less conservative than the initial modeling approach and also make it more consistent with a finer grid modeling approach.

- Terrain data: use higher resolution terrain DEM data (~3 arc second USGS data)
- Ammonia limiting technique (ALM): will be used in the finer grid modeling

3.6 VISIBILITY IMPACT THRESHOLD

In accordance with the final BART guidance and 326 IAC 26-1-4(a), the threshold value to define whether a source “contributes” to visibility impairment is a 0.5 dv change from natural conditions. For this finer grid BART modeling, the test for evaluating whether Sabic Innovative Plastics is contributing to visibility impairment is based on the 98th percentile modeled 24-hour visibility impact from the CALPUFF modeling. For this analysis the facility would be considered to not contribute to visibility impairment in a given year if the 7th highest day is lower than 0.5 dv and over a three year period if the 21st highest 24-hour impact is less than 0.5 DV.

3.7 CALPOST AND POSTUTIL ANALYSIS

The CALPUFF Model calculates air concentrations of all species modeled, and postprocessor programs are used to generate the final visibility impairment in terms of light extinction. The visibility analysis evaluates the potential change in light extinction relative to the natural background due to the Sabic Innovative Plastics BART-eligible sources. The two main postprocessors of interest for this BART application are the CALPOST and POSTUTIL programs. CALPOST will be used to process the CALPUFF outputs. When performing visibility-related modeling, CALPOST uses concentrations from CALPUFF to compute light extinction and related measures of visibility (e.g., haze index in deciviews), with results reported for a 24-hour averaging time. The CALPOST processor contains several options for evaluating visibility impacts, including the method described in the BART guidance, which uses monthly average relative humidity values.

POSTUTIL also contains a chemistry module to evaluate the equilibrium relationship between nitric acid and nitrate aerosols. This capability allows the potential non-linear effects ammonia scavenging by background sulfate and nitrate sources to be evaluated in the formation of nitrate from an individual source. POSTUTIL will also be used to apply the ammonia limiting method to the results which adjusts for a hierarchy of reactivity of SO_2 and NO_x in the atmosphere.

Inputs that will be designated for the CALPOST and POSTUTIL analysis for the finer grid modeling include:

- Visibility calculations: Method 6 will be used in this 4km finer modeling approach using Class I area-specific (centroid) monthly relative humidity values (from EPA, 2003a)
- Species considered in visibility analysis: SO_2, NO_x, and $PM_{2.5}$. The consideration of other particulate species may be considered if the results of this PM2.5-only approach show the SABIC Innovative Plastics source contributes to visibility impairment at a Class 1 area. Elemental carbon, secondary organics and other particle sizes may be considered, as appropriate.
- Natural background light extinction: EPA (2003b) values at the haze index value in deciviews for the 20% best days will be used for the natural background light extinction. The technique employed by LADCO/IDEM will be used.
- The LADCO natural background light extinction, B_{ext}, technique adjusts the Class I area specific chemically speciated natural background concentrations (using the Eastern U.S. as the basis).
- Rayleigh scattering value: 10 Mm^{-1} (all Class I areas)
- Light extinction efficiencies: the default EPA (2003b) values will be used

3.8 DOCUMENTATION AND CALPUFF MODEL OUTPUTS

For the finer modeling approach a number of products documenting the analysis will be prepared. These will include:

- Map of the Sabic Innovative Plastics facility location and Class I areas that did not pass the initial modeling approach and were subject to this finer grid modeling,
- A discussion of any visibility impairment attributed to the Sabic Innovative Plastics source on 98th percentile days in each meteorological year (8th highest) and 98th percentile days over all three meteorological years (22nd highest), which ever is greater compared to the 0.5 dv threshold. The impact from Sabic Innovative Plastics is the change in visibility

above natural background or the delta-dv in the CALPUFF output. It is calculated by taking the total visibility impairment minus impairment on the 20% best days for natural background visibility which equals delta-dv, the visibility impact attributed to Sabic Innovative Plastics,

- For the Class I area with the maximum visibility impact, a discussion of the number of days below the 98th percentile that the impact of Sabic Innovative Plastics exceeds 0.5 dv, the number of receptors where the impact exceeds 0.5 dv, and the maximum visibility impact will be prepared,
- A table comparing the results of the 36km coarse grid modeling and the 4km finer grid modeling for those Class I areas for which visibility impacts exceeded the 0.5 dv threshold in the 36km modeling, and
- A table comparing the results of the LADCO/IDEM modeling to this 4km modeling.

4.0 BART CONTROL MODELING

If the Sabic Innovative Plastics BART-eligible source is determined by modeling, under this protocol, to cause or contribute to visibility impairment at a Class 1 area, Sabic Innovative Plastics will prepare and submit to IDEM a BART analysis, in accordance with 326 IAC 26-1-6. The finer grid modeling methodology set forth in Section 3 will be used for all additional modeling for the BART analysis.

5.0 REFERENCES

AP-42, 1995. *Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources.* U.S. Environmental Protection Agency, AP-42, Fifth Edition, January , 1995, Research Triangle Park, North Carolina.

Earth Tech. 2005a. Comments on observations vs. no-observations mode in CALMET. Prepared for VISTAS Technical Analysis Work Group, Asheville, NC.

Earth Tech. 2005b. Summary of methods for computing visibility in CALPUFF. Prepared for VISTAS Technical Analysis Work Group, Asheville, NC.

EPA, 2003a. Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule, U.S. EPA, Research Triangle Park, North Carolina. EPA-454/B-03-005.

EPA, 2003b. Guidance for Tracking Progress Under the Regional Haze Rule", U.S. EPA, Research Triangle Park, North Carolina. EPA-454/B-03-004..

FLAG, 2000. Federal Land Managers' Air Quality Values Workgroup Phase I Report, prepared by the Federal Land Managers Advisory Group, December 2000.

Grell, G. A., J. Dudhia, and D. R. Stauffer. 1994. A Description of the Fifth Generation Penn State/NCAR Mesoscale Model (MM5). NCAR Tech. Note, NCAR TN-398-STR, 138 pp.

IWAQM. 1998. Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long-Range Transport and Impacts on Regional Visibility. EPA-454/R-98-019. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Part, NC.

Notar, J. 2005. Federal Land Managers Class I Visibility Issues. EPA Regional, State, and Local Dispersion Modeler's Workshop, 16-20 May. New Orleans, LA.
Available at: http://www.cleanairinfo.com/modelingworkshop/disp_index.htm

Reisman, J. and G. Frisbie, 2004: Calculating Realistic PM10 Emissions from Cooling Towers, Environmental Progress, Volume 21, Issue 2, Greystone Environmental Consultants, Sacramento, CA.

Scire, J. S., F. R. Robe, M. E. Fernau, and R. J. Yamartino, 2000a: A user's guide for the CALMET Meteorological Model (version 5.0). Tech. Rep., Earth Tech, Inc., Concord, MA, 332 pp. [Available online at http://www.src.com/calpuff/calpuffl.htm.

Scire, J. S., D. G. Strimaitis, and R. J. Yamartino, 2000b: A user's guide for the CALPUFF Dispersion Model (version 5.0). Tech. Rep., Earth Tech, Inc., Concord, MA, 521 pp. [Available online at http://www.src.com/calpuff/calpuffl.htm.]

Scire, J.S., Z. Wu and G. Moore, 2003: Evaluation of the CALPUFF model in predicting concentration, visibility and deposition at Class I areas in Wyoming. Presented at the AWMA Specialty Conference: *Guideline on Air Quality Models: The Path Forward*. Mystic, CT, 22-24 October 2003.

NPS, 2006. http://www2.nature.nps.gov/air/permits/ect/index.cfm, U. S. National Park Service website, July, 2006.

VISTAS, 2006. Tombach, I., P. Brewer, T. Rogers, and C. Arrington. Protocol for the Application of the CALPUFF Model for Analysis of Best Available Retrofit Technology (BART), Revision 3.2 of the December 22, 2005 version, August 31, 2006.

APPENDIX A

SABIC INNOVATIVE PLASTICS BART-ELIGIBLE SOURCE EMISSION UNITS

To Be Provided

APPENDIX B

UTM AND LCC COORDINATES

To Be Provided

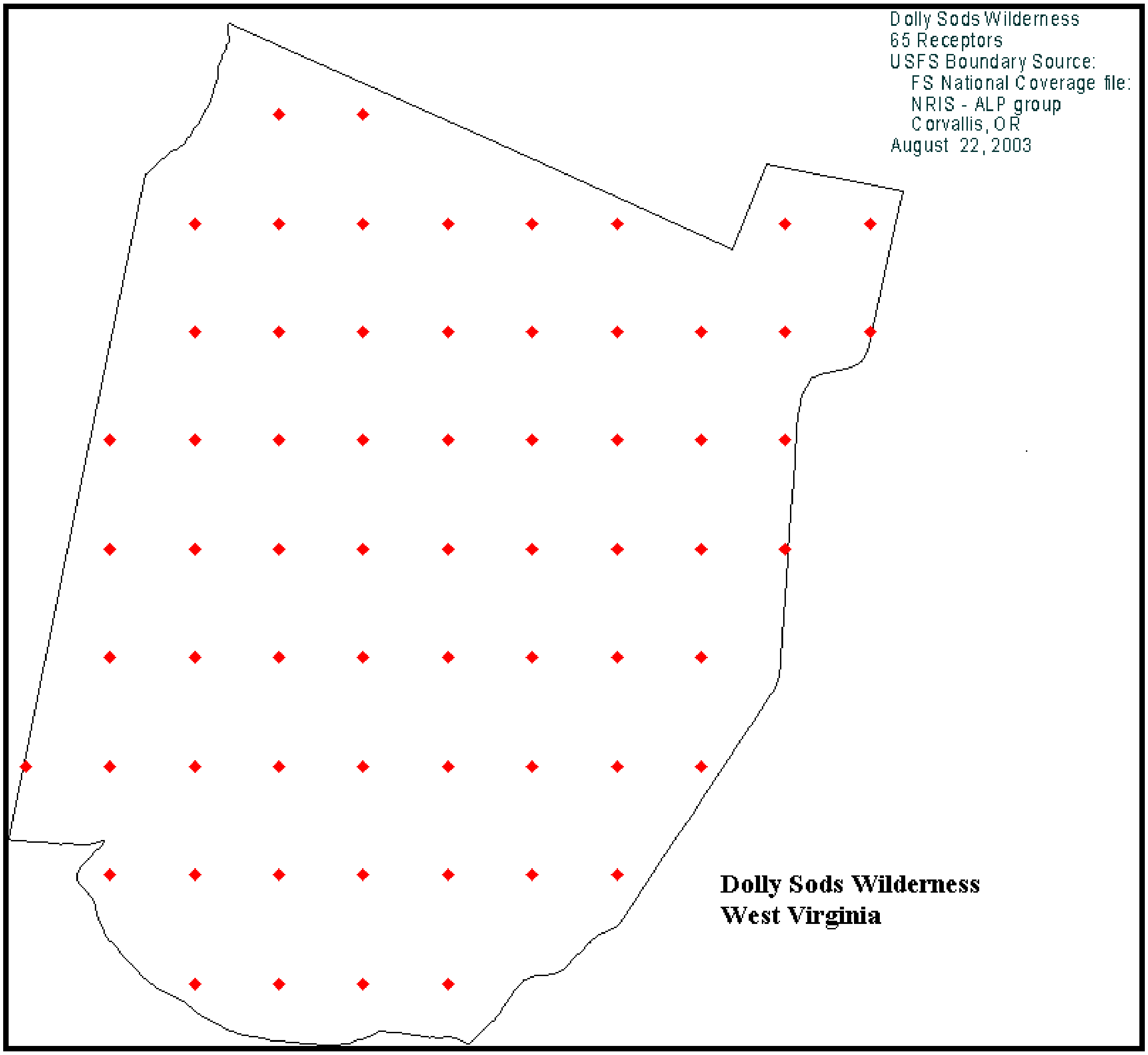
APPENDIX C

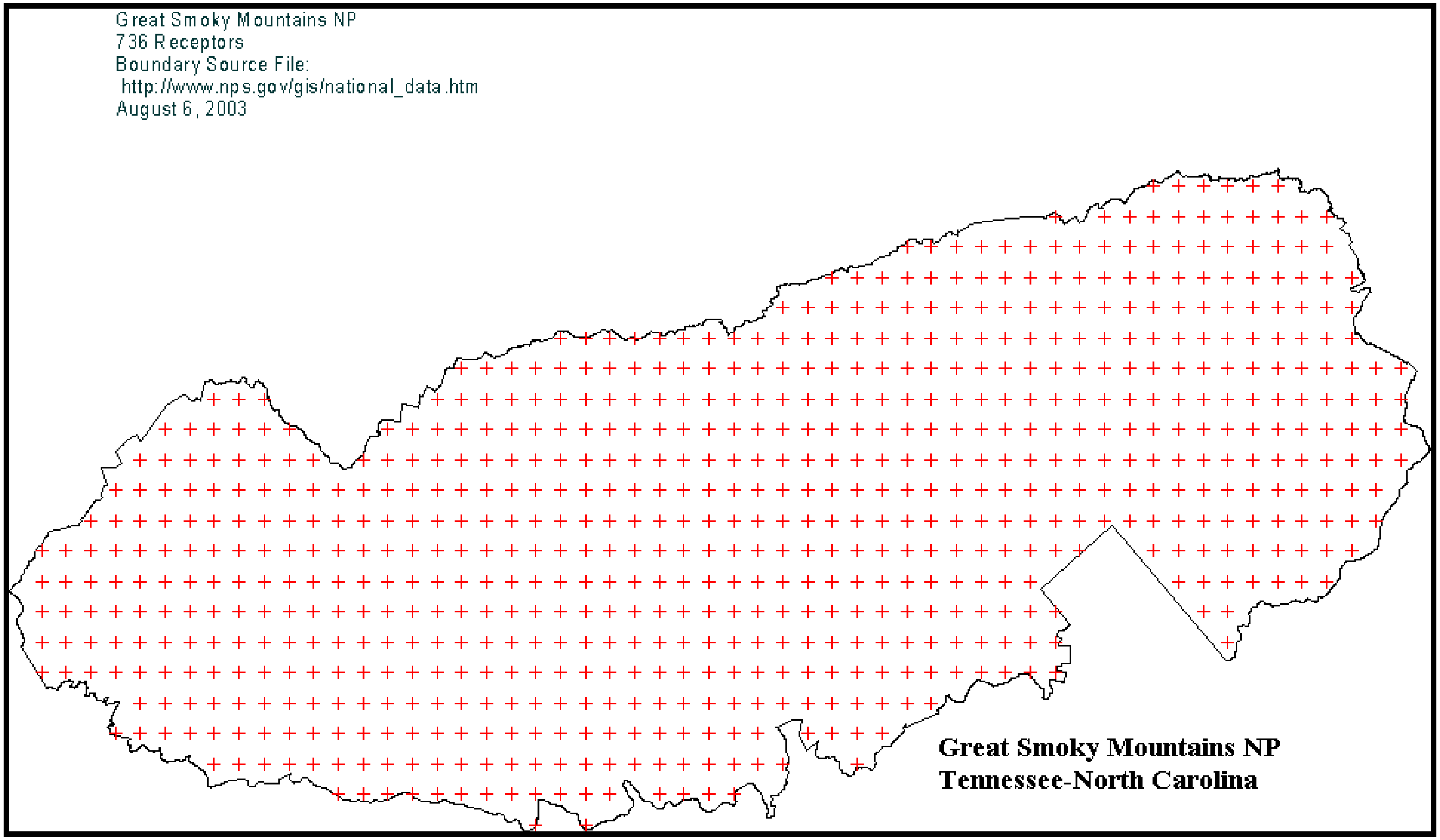
SABIC INNOVATIVE PLASTICS BART-ELIGIBLE SOURCE MAXIMUM 24-HR EMISSION RATES

To Be Provided

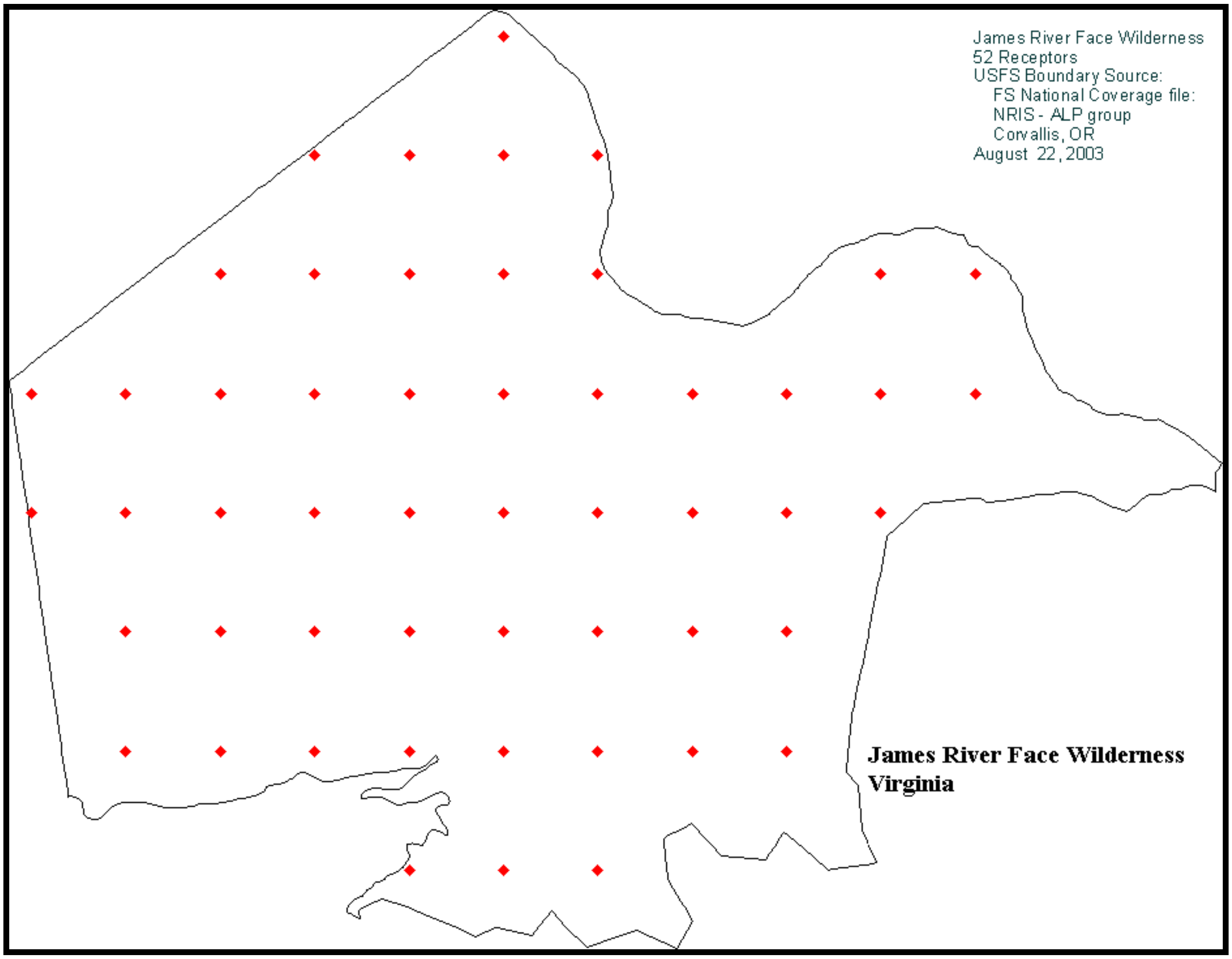
APPENDIX D

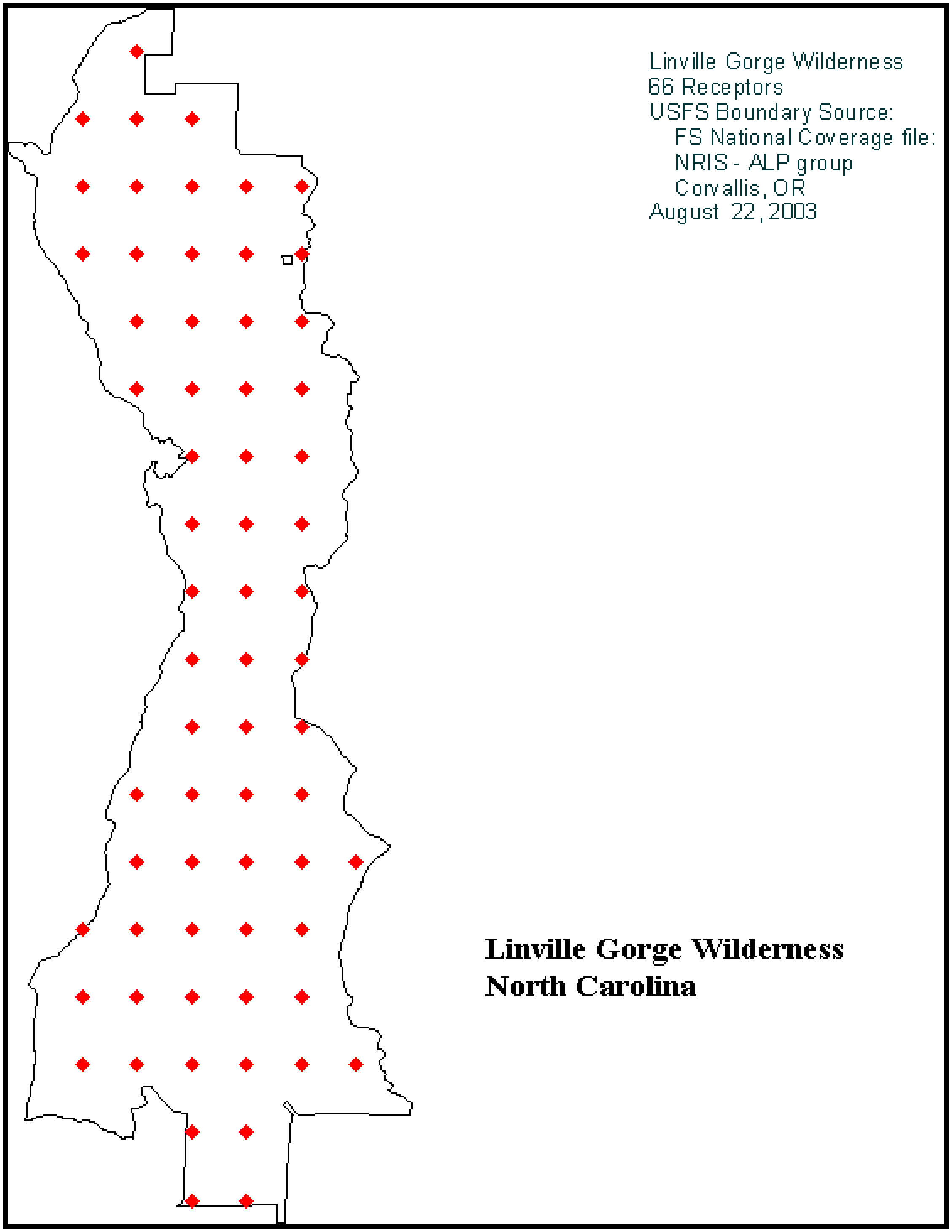
MAPS OF CLASS I AREA RECEPTORS

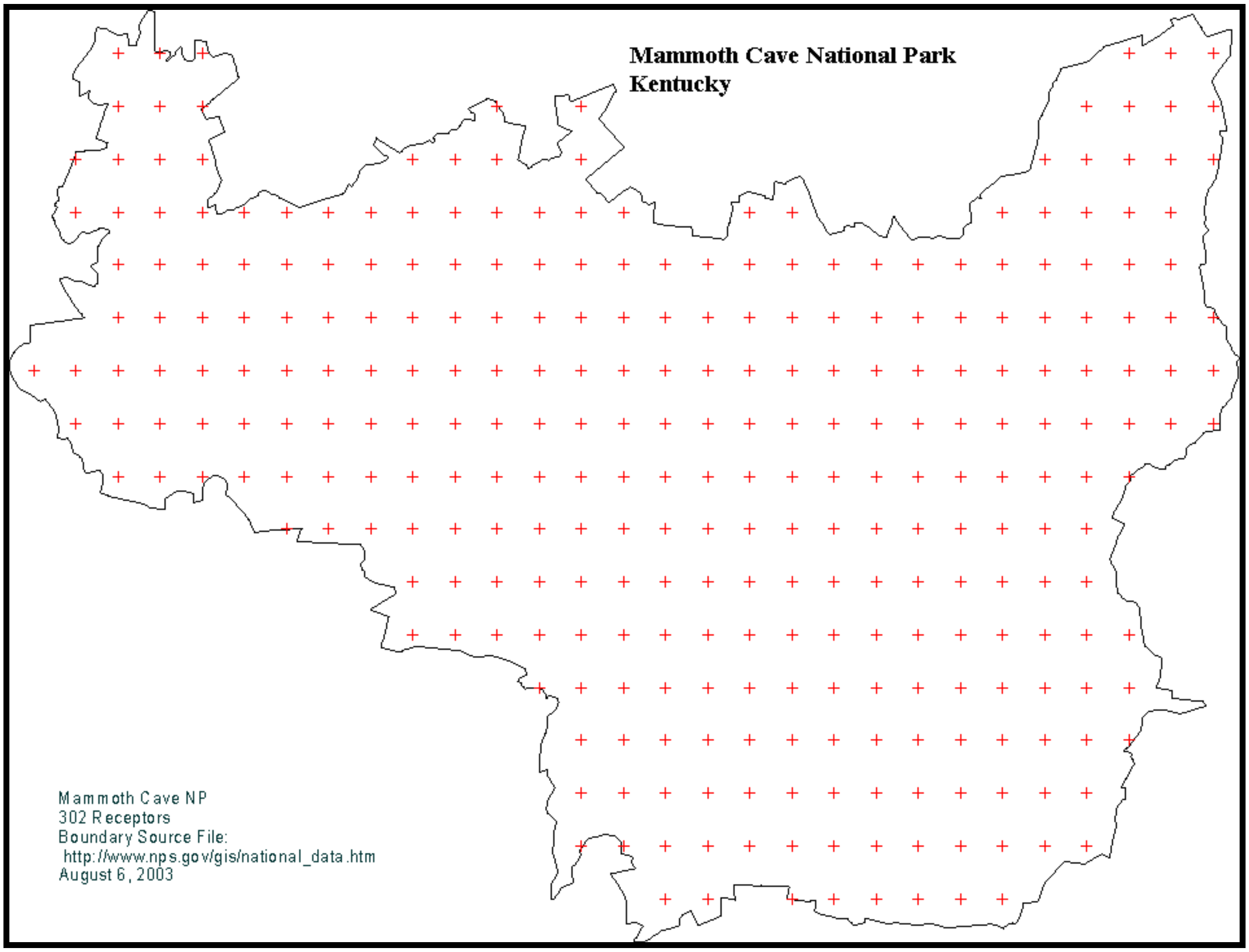

Dolly Sods Wilderness
65 Receptors
USFS Boundary Source:
FS National Coverage file:
NRIS - ALP group
Corvallis, OR
August 22, 2003
Dolly Sods Wilderness
West Virginia

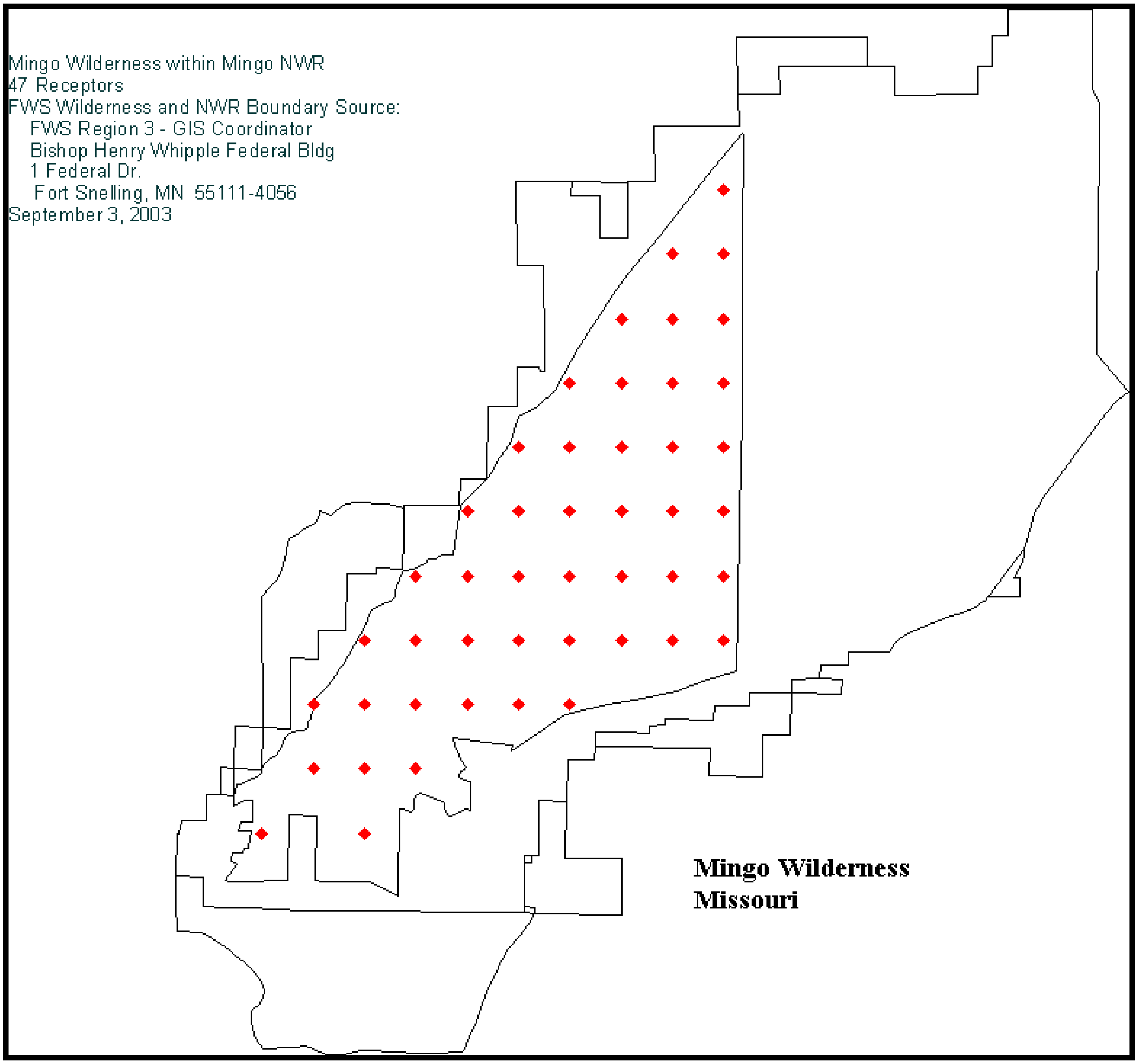


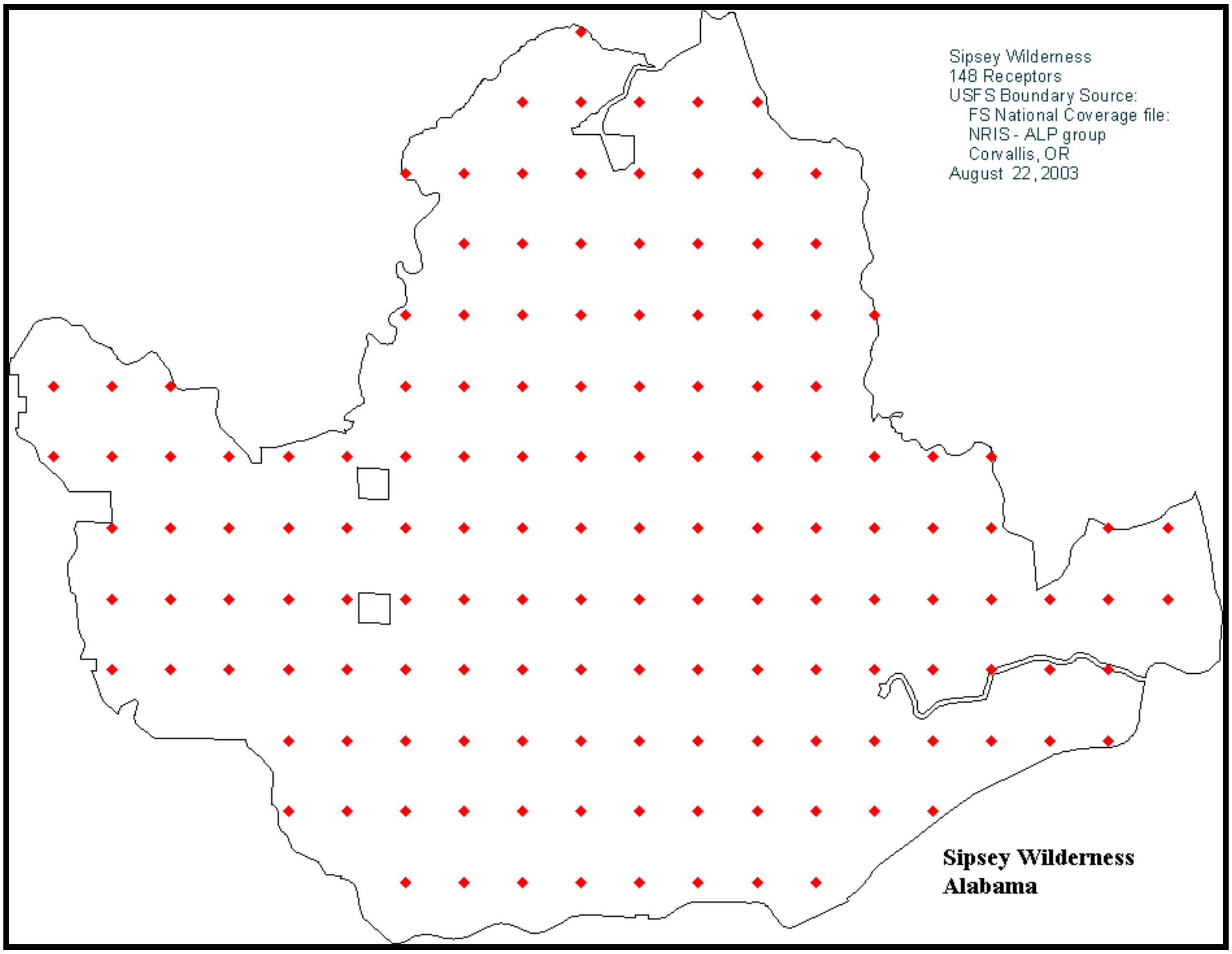
Great Smoky Mountains NP
736 Receptors
Boundary Source File:
http://www.nps.gov/gis/national_data.htm
August 6, 2003
Great Smoky Mountains NP
Tennessee-North Carolina


James River Face Wilderness
52 Receptors
USFS Boundary Source:
FS National Coverage file:
NRIS - ALP group
Corvallis, OR
August 22, 2003
James River Face Wilderness
Virginia


Linville Gorge Wilderness
66 Receptors
USFS Boundary Source:
FS National Coverage file:
NRIS - ALP group
Corvallis, OR
August 22, 2003
Linville Gorge Wilderness
North Carolina


Mammoth Cave National Park
Kentucky
Mammoth Cave NP
302 Receptors
Boundary Source File:
http://www.nps.gov/gis/national_data.htm
August 6, 2003


Mingo Wilderness within Mingo NWR
47 Receptors
FWS Wilderness and NWR Boundary Source:
FWS Region 3 - GIS Coordinator
Bishop Henry Whipple Federal Bldg
1 Federal Dr.
Fort Snelling, MN 55111-4056
September 3, 2003
Mingo Wilderness
Missouri


Sipsey Wilderness
148 Receptors
USFS Boundary Source:
FS National Coverage file:
NRIS - ALP group
Corvallis, OR
August 22, 2003
Sipsey Wilderness
Alabama

APPENDIX E

CALPUFF OPTIONS

Table E-1. Input Groups in the CALPUFF Control File.

Input Group	Description	Applicable to Sabic Innovative Plastics?
0	Input and output file names	Yes
1	General run control parameters	Yes
2	Technical options	Yes
3	Species list	Yes
4	Grid control parameters	Yes
5	Output options	Yes
6	Sub grid scale complex terrain inputs	No
7	Dry deposition parameters for gases	Yes
8	Dry deposition parameters for particles	Yes
9	Miscellaneous dry deposition for parameters	Yes
10	Wet deposition parameters	Yes
11	Chemistry parameters	Yes
12	Diffusion and computational parameters	Yes
13	Point source parameters	Yes
14	Area source parameters	Yes
15	Line source parameters	No
16	Volume source parameters	No
17	Discrete receptor information	Yes

Table E-2. CALPUFF Model Input Group 0: Input and Output File Names.

Parameter	FLM/EPA Default	Sabic Innovative Plastics Refined Modeling	Comments
METDAT	CALMET.DAT	varies by year and month	Met input
PUFLST	CALPUFF.LST	varies by year	Output
CONDAT	CONC.DAT	varies by year	Output concentrations
DFDAT	DFLX.DAT	N/A	Output dry deposition
WFDAT	WFLX.DAT	N/A	Output wet deposition
VISDAT	VISB.DAT	varies	Output visibility calculations
OZDAT	OZONE.DAT	N/A	Ozone data – use monthly averages
LCFILES	--	T	File names converted to upper case
NMETDAT	1	364/yr & 12/yr	Number of CALMET.DAT files
NPTDAT	0	0	Number of PTEMARB.DAT files
NARDAT	0	0	Number of BAEMARB.DAT files
NVOLDAT	0	0	Number of VOLEMARB.DAT files

Table E-3. CALPUFF Model Input Group 1: General Run Control Parameters

Parameter	FLM/EPA Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
METRUN	0	0	All model periods in met file(s) were run
IBYR		variable	Starting year – 2001, 2002, 2003
IBMO	-	1	Starting month
IBDY	-	1	Starting day
IBHR	-	1	Starting hour
XBTZ		0	Base time zone (0 = MM5 data)
IRLG	-	Hrs in met set	Length of run (hrs)
NSPEC	5	6	Number of chemical species
NSE	3	3	Number of chemical species to be emitted
ITEST	2	2	Program is executed after SETUP phase
MRESTART	0	0	Do not read or write a restart file during run
NRESPD	0	0	File written only at last period
METFM	1	1	CALMET binary file (CALMET.MET)
AVET	60	60	Averaging time in minutes
PGTIME	60	60	PG Averaging time in minutes

Table E-4. CALPUFF Model Input Group 2: Technical Options

Parameter	FLM/EPA Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
MGAUSS	1	1	Gaussian distribution used in near field
MCTADJ	3	3	Partial plume path terrain adjustment
MCTSG	0	0	Scale-scale complex terrain not modeled
MSLUG	0	0	Near-field puffs not modeled as elongated
MTRANS	1	1	Transitional plume rise modeled
MTIP	1	1	Stack tip downwash used
MSHEAR	0	0	(0,1) Vertical wind shear (not modeled, modeled)
MSPLIT	0	0	Puffs are not split
MCHEM	1	1	Transformation rates computed internally using (RIVID/ARM3) scheme
MAQCHEM	0	0	Aqueous phase transformation not modeled
MWET	1	1	Wet removal modeled
MDRY	1	1	Dry deposition modeled
MDISP	3	3	PG dispersion coefficients for rural areas (computed using ISCST approximation) and MP coefficients in urban areas
MTURBVW	3	3	Use both σv and σw from PROFILE.DAT to compute σy and σz (n/a)
MDISP2	3	3	PG dispersion coefficients for rural areas (computed using ISCST3 approximation) and MP coefficients in urban areas when measured turbulence data is missing
MROUGH	0	0	PG σy and σz not adjusted for roughness

Parameter	FLM/EPA Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
MPARTL	1	1	No partial plume penetration of elevated inversion
MTINV	0	0	Strength of temperature inversion computed from default gradients
MPDF	0	0	PDF not used for dispersion under convective conditions
MSGTIBL	0	0	Sub-grid TIBL module not used for shoreline
MBCON	0	0	Boundary concentration conditions not modeled
MFOG	0	0	Do not configure for FOG model output
MREG	1	1	Technical option selections must conform to USEPA Long Range Transport (LRT) guidance

Table E-5. CALPUFF Model Input Group 3: Species List-Chemistry Options.

CSPEC	Modeled[1]	Emitted[2]	Dry Deposition[3]	Output Group Number
SO_2	1	1	1	0
SO_4^{-2}	1	0	2	0
NO_x	1	1	1	0
HNO_3	1	0	1	0
NO_3	1	0	2	0
PM25	1	1	2	0

Notes: **1.) 0=no, 1=yes**
2.) 0=no, 1=yes
3.) 0=none, 1=computed gas, 2=computed particle, 3=user-specified

Table E-6. CALPUFF Model Input Group 4: Map Projection and Grid Control Parameters.

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
PMAP	UTM	LCC	Map projection system
IUTMZN	-	-	UTM zone for grid coordinates
UTMHEM	-	-	Hemisphere for UTM coordinate system
DATUM	WGS-G	NAS-C/ NWS-84	Datum-region for output coordinates
NX	-	97/263	Number of X grid cells in meteorological grid
NY		90/185	Number of Y grid cells in meteorological grid
NZ	-	15/10	Number of vertical layers in meteorological grid
DGRIDKM	-	36/4	Grid spacing (km)
ZFACE	-	0,20,40,80, 160,320,640, 1200,2000, 3000, 4000	Cell face heights in 4km meteorological grid (m)
XORIGKM	-	-900/538	Reference X coordinate for SW corner of grid cell (1,1) of meteorological grid (km)

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
YORIGKM	-	-1600/-638	Reference Y coordinate for SW corner of grid cell (1,1) of meteorological grid (km)
IBCOMP	-	1	X index of lower left corner of the computational grid
JBCOMP	-	1	Y index of lower left corner of the computational grids
IECOMP	-	97/263	X index of the upper right corner of the computational grid
JECOMP	-	90/185	Y index of the upper right corner of the computational grid
LSAMP	T	F	Sampling grid is not used
IBSAMP	-	1	X index of lower left corner of the sampling grid
JBSAMP	-	1	Y index of lower left corner of the sampling grid
IESAMP	-	97/263	X index of upper right corner of the sampling grid
JESAMP	-	90/185	Y index of upper right corner of the sampling grid
MESHDN	1	1	Nesting factor of the sampling grid

Table E-7. CALPUFF Model Input Group 5: Output Options.

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
ICON	1	1	Output file CONC.DAT containing concentrations is ated
IDRY	1	0	Output file DFLX.DAT containing dry fluxes is created
IWET	1	0	Output file WFLX.DAT containing wet fluxes is created
IVIS	1	1	Output file containing relative humidity data is not created
LCOMPRS	T	T	Perform data compression in output file
IMFLX	0	0	Do not calculate mass fluxes across specific boundaries
IMBAL	0	0	Mass balances for each species reported hourly
ICPRT	0	0	Do not print concentration fields to the output list file
IDPRT	0	0	Do not print dry flux fields to the output list file
IWPRT	0	0	Do not print wet flux fields to the output list file
ICFRQ	1	1	Concentration fields are printed to output list file every 1 hour
IDFRQ	1	1	Dry flux fields are printed to output list file every 1 hour
IWFRQ	1	1	Wet flux fields are printed to output list file every 1 hour
IPRTU	1	3	Units for line printer output are in specified by user for concentration and for deposition
IMESG	1	2	Messages tracking the progress of run are written on screen
LDEBUG	F	F	Logical value for debug output
IPFDEB	1	1	First puff to track

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NPFDEB	1	1	Number of puffs to track
NN1	1	1	Meteorological period to start output
NN2	10	10	Meteorological period to end output

Table E-8. CALPUFF Model Input Group 6: Sub-Grid Scale Complex Terrain Inputs.

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NHILL	0	0	Number of terrain features
NCTREC	0	0	Number of special complex terrain receptors
MHILL	-	-	Input terrain and receptor data for CTSG hills input in CTDM format
XHILL2M	1	1	Conversion factor for changing horizontal dimensions to meters
ZHILL2M	1	1	Conversion factor for changing vertical dimensions to meters
XCTDMKM	-	-	X origin of CTDM system relative to CALPUFF coordinate system (km)
YCTDMKM	-	-	Y origin of CTDM system relative to CALPUFF coordinate system (km)

Table E-9. CALPUFF Model Input Group 7: Dry Deposition Parameters for Gases.

Species	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
SO_2	0.1509	0.1509	Diffusivity
	1000	1000	Alpha star
	8.0	8.0	Reactivity
	0.0	0.0	Mesophyll resistance
	0.04	0.04	Henry's Law coefficient
NO_x	0.1656	0.1656	Diffusivity
	1.0	1.0	Alpha star
	8	8	Reactivity
	5	5	Mesophyll resistance
	3.5	3.5	Henry's Law coefficient
HNO_3	0.1628	0.1628	Diffusivity
	1	1	Alpha star
	18	18	Reactivity
	0	0	Mesophyll resistance
	0.00000008	0.00000008	Henry's Law coefficient for

Table E-10. CALPUFF Model Input Group 8: Dry Deposition Parameters for Particles.

Species	Default	East Bend Initial and Finer Modeling	Comments
SO_4^{-2}	0.48	0.48	Default mass mean diameter of $SO4^{-2}$ [µm]
NO_3^-	0.48	0.48	Default mass mean diameter of $NO3^-$ [µm]
PM25	0.48	0.48	Default mass mean diameter used by LADCO/IDEM

Table E-11. CALPUFF Model Input Group 9: Miscellaneous Dry Deposition Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
RCUTR	30	30	Reference cuticle resistance (s/cm)
RGR	10	10	Reference ground resistance (s/cm)
REACTR	8	8	Reference pollutant reactivity
NINT	9	9	Number of particle size intervals for effective particle deposition velocity
IVEG	1	1	Vegetation in non-irrigated areas is active and unstressed

Table E-12. CALPUFF Model Input Group 10: Wet Deposition Parameters.

Species	Default	East Bend Initial and Finer Modeling	Comments
SO_2	3.0E-05	3.0E-05	Scavenging coefficient for liquid precipitation [s-1]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s-1]
$SO4^{-2}$	1.0E-04	1.0E-04	Scavenging coefficient for liquid precipitation [s-1]
	3.0E-05	3.0E-05	Scavenging coefficient for frozen precipitation [s-1]
NO_x	0.0	0.0	Scavenging coefficient for liquid precipitation [s-1]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s-1]
HNO_3	6.0E-05	6.0E-05	Scavenging coefficient for liquid precipitation [s-1]
	0.0	0.0	Scavenging coefficient for frozen precipitation [s-1]
NO_3^-	1.0E-04	1.0E-04	Scavenging coefficient for liquid precipitation [s-1]
	3.0E-05	3.0E-05	Scavenging coefficient for frozen precipitation [s-1]

Table E-13. CALPUFF Model Input Group 11: Chemistry Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
MOZ	1	-	Hourly ozone values will not be used
BCKO3	-	Varies	Background ozone concentration (ppb) by month
BCKNH3	12*10	Varies	Background ammonia concentration (ppb) by month
RNITE1	0.2	0.2	Nighttime NO2 loss rate in percent/hour
RNITE2	2	2	Nighttime NOX loss rate in percent/hour
RNITE3	2	2	Nighttime HNO3 loss rate in percent/hour
MH202	1	1	Background H2O2 concentrations (Aqueous phase transformations not modeled)
BCKH202	-	1	Background monthly H2O2 concentrations (Aqueous phase transformations not modeled)
BCKPMF	-	-	Fine particulate concentration for Secondary Organic Aerosol Option
OFRAC	-	-	Organic fraction of fine particulate for SOA Option
VCNX	-	-	VOC/NOx ratio for SOA Option

Table E-14. CALPUFF Model Input Group 12: Miscellaneous Dispersion and Computation Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
SYDEP	550	550	Horizontal size of a puff in meters beyond which the time dependant dispersion equation of Heffter (1965) is used
MHFTSZ	0	0	Do not use Heffter formulas for sigma z
JSUP	5	5	Stability class used to determine dispersion rates for puffs above boundary layer
CONK1	0.01	0.01	Vertical dispersion constant for stable conditions
CONK2	0.1	0.1	Vertical dispersion constant for neutral/stable conditions
TBD	0.5	0.5	Use ISC transition point for determining the transition point between the Schulman-Scire to Huber-Snyder Building Downwash scheme
IURB1	10	10	Lower range of land use categories for which urban dispersion is assumed
IURB2	19	19	Upper range of land use categories for which urban dispersion is assumed
ILANDUIN	20	20	Land use category for modeling domain
XLAIIN	3.0	3.0	Leaf area index for modeling domain

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
ZOIN	0.25	0.25	Roughness length in meters for modeling domain
ELEVIN	0.0	0.0	Elevation above sea level
XLATIN	-999	0.	North latitude of station in degrees
XLONIN	-999	0.	South latitude of station in degrees
ANEMHT	10	10	Anemometer height in meters
ISIGMAV	1	1	Sigma-v is read for lateral turbulence data
IMIXCTDM	0	0	Predicted mixing heights are used
XMXLEN	1	1	Maximum length of emitted slug in meteorological grid units
XSAMLEN	1	1	Maximum travel distance of slug or puff in meteorological grid units during one sampling unit
MXNEW	99	99	Maximum number of puffs or slugs released from one source during one time step
MXSAM	99	99	Maximum number of sampling steps during one time step for a puff or slug
NCOUNT	2	2	Number of iterations used when computing the transport wind for a sampling step that includes transitional plume rise
SYMIN	1	1	Minimum sigma y in metres for a new puff or slug
SZMIN	1	1	Minimum sigma z in metres for a new puff or slug

Table E-15. CALPUFF Model Input Group 13: Point Source Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NPT1	-	5	Number of point sources with constant stack parameters or variable emission rate scale factors
IPTU	1	3	Units for point source emission rates are lb/hr
NSPT1	0	0	Number of source-species combinations with variable emissions scaling factors
NPT2	-	0	Number of point sources with variable emission parameters provided in external file

Table E-16. CALPUFF Model Input Group 14: Area Source Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NAR1		1	Number of polygon area sources
IARU	1	3	Units for area source emission rates are g/m2/s
NSAR1	0	-	Number of source species combinations with variable emissions scaling factors
NAR2	-	-	Number of buoyant polygon area sources with variable location and emission parameters

Table E-17. CALPUFF Model Input Group 15: Line Source Parameters.

Parameters	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NLN2	-	0	Number of buoyant line sources with variable location and emission parameters
NLINES	-	-	Number of buoyant line sources
ILNU	1	-	Units for line source emission rates is g/s
NSLN1	0	-	Number of source-species combinations with variable emissions scaling factors
MXNSEG	7	-	Maximum number of segments used to model each line
NLRISE	6	-	Number of distance at which transitional rise is computed
XL	-	-	Average line source length (m)
HBL	-	-	Average height of line source height (m)
WBL	-	-	Average building width (m)
WML	-	-	Average line source width (m)
DXL	-	-	Average separation between buildings (m)
FPRIMEL	-	-	Average buoyancy parameter (m4/s3)

Table E-18. CALPUFF Model Input Group 16: Volume Source Parameters.

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NVL1	-	0	Number of volume sources
IVLU	1	-	Units for volume source emission rates is g/s
NSVL1	0	-	Number of source-species combinations with variable emissions scaling factors
IGRDVL	-	-	Gridded volume source data is not used
VEFFHT	-	-	Effective height of emissions (m)
VSIGYI	-	-	Initial sigma y value (m)
VSIGZI	-	-	Initial sigma z value (m)

Table E-19. CALPUFF Model Input Group 19: Discrete Receptor Information.

Parameter	Default	Sabic Innovative Plastics Initial and Finer Modeling	Comments
NREC	-	Number per Class I area	Number of discrete receptors for each Class I area

SABIC
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May 6, 2008

FedEx Tracking No. 7920 5050 3409

Mr. Ken Ritter, Section Chief
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MENT OF ENVIRONMENTAL MANAGEMENT
OF AIR QUALITY

Re: BART Exemption Demonstration for SABIC Innovative Plastics Mt. Vernon, LLC

Dear Mr. Ritter:

By letter dated February 8, 2008, the Indiana Department of Environmental Management (IDEM) notified SABIC Innovative Plastics Mt. Vernon, LLC (SABIC) that IDEM determined SABIC is subject to BART requirements. Pursuant to 326 IAC 26-1-6 (a), SABIC is required to submit to IDEM either (1) a BART analysis, or (2) a description and analysis of the BART-eligible emission units sufficient to demonstrate that the source is not subject to BART. This letter and the enclosed companion reports provide a description and analysis demonstrating that SABIC is not subject to BART. This BART exemption demonstration is being submitted by May 8, 2008 (i.e., within ninety (90) days of IDEM's February 8 notification); accordingly, this submittal is timely pursuant to 326 IAC 26-1-6(a)(2).

BART Exemption Demonstration

On February 25, 2008, SABIC and its consultants (GZA GeoEnvironmental, Inc. and Alpine Geophysics, LLC) met with IDEM staff to discuss the draft modeling protocol proposed to be used by SABIC for BART CALPUFF modeling demonstrations. By letter, dated February 28, 2008, IDEM provided its comments and acceptance of the modeling protocol. CALPUFF modeling conducted for this BART exemption demonstration used the accepted protocol, as revised to incorporate the comments offered in IDEM's February 28, 2008 letter. The modeling protocol is set forth in the enclosed document *"Revised Best Available Retrofit Technology (BART) Modeling Protocol for SABIC Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana", April 2008.* CALPUFF model input selections, stack parameters, and emissions for the BART-eligible emission units are also provided in the enclosed modeling protocol document. The basis for emissions used in the CALPUFF model are provided in the enclosed document *"Best Available Retrofit Technology (BART) Emission Inputs for CALPUFF Modeling for SABIC Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana", April 2008.*

CALPUFF Modeling Results

CALPUFF modeling results, for the three (3) years 2001-2003, conducted in accordance with the enclosed protocol are provided in the enclosed report *"Best Available Retrofit Technology*

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BEST AVAILABLE RETROFIT TECHNOLOGY (BART) EXEMPTION MODELING RESULTS FOR SABIC INNOVATIVE PLASTICS MT. VERNON, LLC
MT. VERNON, INDIANA

Submitted to: **Indiana Department of Environmental Management**

Office of Air Management

100 N. Senate Avenue
P.O. Box 6015
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Submitted by: **SABIC Innovative Plastics Mt. Vernon, LLC**
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April 2008

GZA

ALPINE GEOPHYSICS

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EXECUTIVE SUMMARY

This document provides the results of the visibility exemption modeling that followed the guidelines of the U.S. Environmental Protection Agency in 40 CFR Part 51 Appendix Y for the analysis of the Best Available Retrofit Technology (BART) at the SABIC Innovative Plastics Mt. Vernon, LLC (SABIC) facility (formerly GE Plastics Mt. Vernon, Inc.). The facility is located just southwest (about 1 mile) of Mt. Vernon, Indiana. All Class I BART modeling followed the *Revised Best Available Retrofit Technology (BART) Modeling Protocol for Sabic Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana,* (April,2008) which is an updated version of the draft document dated February 2008 that now includes all IDEM comments (as prescribed by IDEM in a letter to David Boggs from Mark Derf). The modeling included all BART-eligible processes at the plant with emissions of SO_2, NO_x, and particulates (expressed in the modeling in the $PM_{2.5}$ size range) from boilers (coal-fired, oil-fired, and natural gas-fired), heaters, process units, and plant-wide fugitive emissions at the Mt. Vernon facility.

Indiana is part of the Midwest Regional Planning Organization (Midwest RPO), which was organized and funded by the U.S. EPA to facilitate the assessment of visibility impairment in the region. The Midwest RPO has not developed any specific guidance for air quality modeling for visibility impacts in support of BART exemptions and BART application review. This modeling followed the combined guidance of the Lake Michigan Air Directors Consortium (LADCO) in their *Single Source Modeling to Support Regional Haze BART Modeling Protocol* (March 21, 2006) and of the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) in *Protocol for the Application of the CALPUFF Model for Analysis of Best Available Retrofit Technology (BART)* (Revision 3.2 – 8/31/06). General guidance from the 40 CFR Part 51, Appendix W, the *Guideline on Air Quality Models* was also followed.

The modeling that has been performed and is documented herein focused on analysis to determine if the visibility impacts due to the SABIC emissions from the BART-eligible sources are less than or greater than the visibility level of 0.5 deciviews (dv) which is the threshold used to determine whether a source contributes to visibility impairment. Previous screening level modeling performed by LADCO on behalf of IDEM indicated that the SABIC sources would exceed the 0.5 dv threshold for visibility impacts at five Class I areas for a total of 28 days over a three year modeling period, with 19 of those days being in the Mammoth Cave National Park and six being in Mingo Wilderness. The highest single year number of visibility impacts exceeding the 0.5 dv threshold in the LADCO modeling was 9 days at Mammoth Cave National Park using a 2003 meteorological data set. This previous modeling used a 36km grid resolution meteorological and modeling domain and released all emissions from one combined stack at SABIC; which, by most modeling guidelines for such analyses, would be considered a screening level analysis. The 36km modeling with a single representative stack was repeated in this study with identical results to that of LADCO.

More refined modeling was also performed in this study which considered individual stacks and their associated emissions as well as a higher resolution 4km meteorological and modeling domain. This modeling resolution and source apportionment were considered to be more refined modeling than the original coarse 36km, combined stack modeling by LADCO.

The refined CALPUFF runs included two scenarios. Run 1: Oil Scenario represents firing residual oil in the B&W Boiler (Source 09-001). This has not been done in 10 years and the storage tank and oil supply system is no longer operable. Since this scenario still exists as a permit condition, SABIC included emissions under this scenario in the BART exemption modeling runs. Run 2: No Oil Scenario, represents firing natural gas plus supplemental hydrogen in the B&W Boiler, which is the current and on-going scenario for this boiler. It was included because its emissions are substantially lower than for the Run 1: Oil Scenario. Appendix A provides the maximum 24-hour average actual hourly (M24HAA) emission rates by emission unit for these two scenarios.

The visibility analyses conducted and documented herein at the 4km resolution using the two scenarios described above for individual sources of BART-eligible emissions demonstrated visibility impacts greater than the 0.5 dv threshold for each year of meteorology at each Class I area reviewed but less than the 98th percentile number of values greater than the 0.5 dv exemption level. For an individual year this was less than 8 day-receptor occurrences and less than 22 day-receptors for all three years combined. Thus, BART-eligible sources at the SABIC facility should be exempt from any further BART analysis. Summary tables of all visibility calculations are presented in Appendix B of this final documentation for the modeling.

1.0 RESULTS OF THE 36KM COARSE GRID MODELING

The first step in the modeling was to reproduce the LADCO coarse 36km grid modeling visibility results using identical sources, emissions, meteorology and modeling domain.[1] This modeling was intended to confirm the baseline LADCO modeling to ensure that additional source and emission refinement and refined analysis were performed in a consistent manner. A pre-computed set of meteorological files provided by IDEM in the 36km format and pre-defined CALPUFF input option configurations, based on LADCO CALPUFF modeling were followed. The regional modeling domain for the coarse modeling approach was identical to that of LADCO and included all Class I areas in the original LADCO modeling. Those Class I areas, along with the distances from SABIC to the nearest receptor and the farthest receptor in each Class I area are shown below:

- Boundary Waters Canoe Area, Minnesota 1127-1211 km
- Brigantine National Wildlife Refuge, New Jersey 1191-1205 km
- Dolly Sods Wilderness Area, West Virginia 754-762 km
- Great Gulf Wilderness Area, New Hampshire 1570-1576 km
- Great Smoky Mountains National Park, Tennessee 437-503 km
- Hercules-Glades Wilderness, Missouri 459-468 km
- Isle Royale National Park, Michigan 1100-1154 km
- James River Face Wilderness Area, Virginia 745-753 km
- Linville Gorge Wilderness Area, North Carolina 578-587 km
- Lyle Brook Wilderness, Vermont 1387-1398 km
- Mammoth Cave National Park, Kentucky 165-186 km
- Mingo National Wildlife Refuge, Missouri 221-231 km
- Seney Wilderness, Michigan 935-947 km
- Shenandoah National Park, Virginia 799-861 km
- Sipsey Wilderness, Alabama 393-404 km
- Voyageurs National Park, Minnesota 1215-1263 km

The results of these analyses are shown in Tables 1 and 2. Table 1 compares the number of days where the visibility impact was above the threshold of 0.5 dv. As can be seen the analyses performed independently using the LADCO files produced identical results to those of LADCO at every Class I area, thus demonstrating similar model performance and setting the baseline for

[1] Please see *Revised Best Available Retrofit Technology (BART) Modeling Protocol for Sabic Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana,* (April 2008), Appendix A, for the LADCO 36 km source parameters and single source emissions of NOx, SO_2, PM10 and PM2.5 emissions.

meteorological grid and source refinement in the refined, 4km modeling. Table 2 shows the maximum 24-hour visibility impact in each Class I area for each year of meteorology used in the modeling derived from the SABIC 36km CALPUFF modeling.

Table 1. Comparison of the LADCO and SABIC 36km CALPUFF Modeling of Class I Visibility Impacts

Class 1 Areas	SABIC Mt. Vernon, IN					
	2002 LADCO	2002 SABIC	2003 LADCO	2003 SABIC	2004 LADCO	2004 SABIC
Boundary Waters - MN	0	0	0	0	0	0
Brigantine Wild. - NJ	0	0	0	0	0	0
Dolly Sods - WV	0	0	0	0	0	0
Great Gulf Wild - NH	0	0	0	0	0	0
Great Smokey Mount - TN	0	0	0	0	0	0
Hercules - Glades Wild. - MO	0	0	0	0	1	1
Isle Royale - MI	0	0	0	0	0	0
James River Face - VA	0	0	0	0	0	0
Linville Gorge - NC	0	0	0	0	1	1
Lye Brook Wild. - VT	0	0	0	0	0	0
Mammoth Caves - KY	6	6	9	9	4	4
Mingo Wild. - MO	2	2	3	3	1	1
Seney Wild. - MI	0	0	0	0	0	0
Shenandoah N.P. - VA	0	0	0	0	0	0
Sipsey Wild. - AL	1	1	0	0	0	0
Voyageurs N.P. - MN	0	0	0	0	0	0
Days per year > 0.5	**9**	**9**	**12**	**12**	**7**	**7**
Total Days ('02-'04) > 0.5	**LADCO 36 km**	**28**	**SABIC 36km**	**28**		
Total Days Mammoth > 0.5 dv	**LADCO 36 km**	**19**	**SABIC 36 km**	**19**		

* A source that contributes greater than 0.5 dv > 7 days per year at any Class 1 area is considered to be a BART-eligible source.

Table 2. Maximum 24-hour Deciview Impact for Each class I Area in the in the 36km Modeling Domain Attributable to SABIC

Class I Area	Distance from SABIC to Nearest Class I area boundary, km	Max. 24-hr impact over 2002	Max. 24-hr impact over 2003	Max. 24-hr impact over 2004
Boundary Waters, MN	1127	0.040	0.162	0.050
Brigatine, NJ	1191	0.166	0.091	0.127
Dolly Sods, WV	754	0.106	0.107	0.137
Great Gulf, NH	1570	0.115	0.116	0.131
Great Smoky Mts., TN	435	0.140	0.253	0.343
Hercules Glade, MO	459	0.191	0.445	0.715
Isle Royale, MI	1100	0.121	0.238	0.100
James River Face, VA	745	0.069	0.163	0.264
Linville Gorge, NC	578	0.132	0.210	0.652
Lyle Brook, VT	1387	0.187	0.201	0.281
Mammoth Cave, KY	165	0.773	1.077	1.058
Mingo, MO	221	1.617	1.028	0.741
Seney, MI	935	0.144	0.269	0.194
Shenandoah, VA	799	0.157	0.154	0.188
Sipsey, AL	393	0.598	0.222	0.491
Voyageurs, MN	1215	0.019	0.095	0.021

2.0 REFINED GRID MODELING METHODOLOGY

Refined modeling using a 4km spaced grid for meteorology and modeling in the CALPUFF Model was performed for SABIC sources.[2] Specific source differentiation and spatial allocation of emissions as discussed in the modeling protocol was performed using the 4km refined grid modeling approach. This finer grid resolution modeling allowed a more representative characterization of terrain features and wind flow for the areas between SABIC and each Class I area. A map of the 4km modeling domain which included a subset of Class I areas compared to the 36km domain is shown in Figure 1.

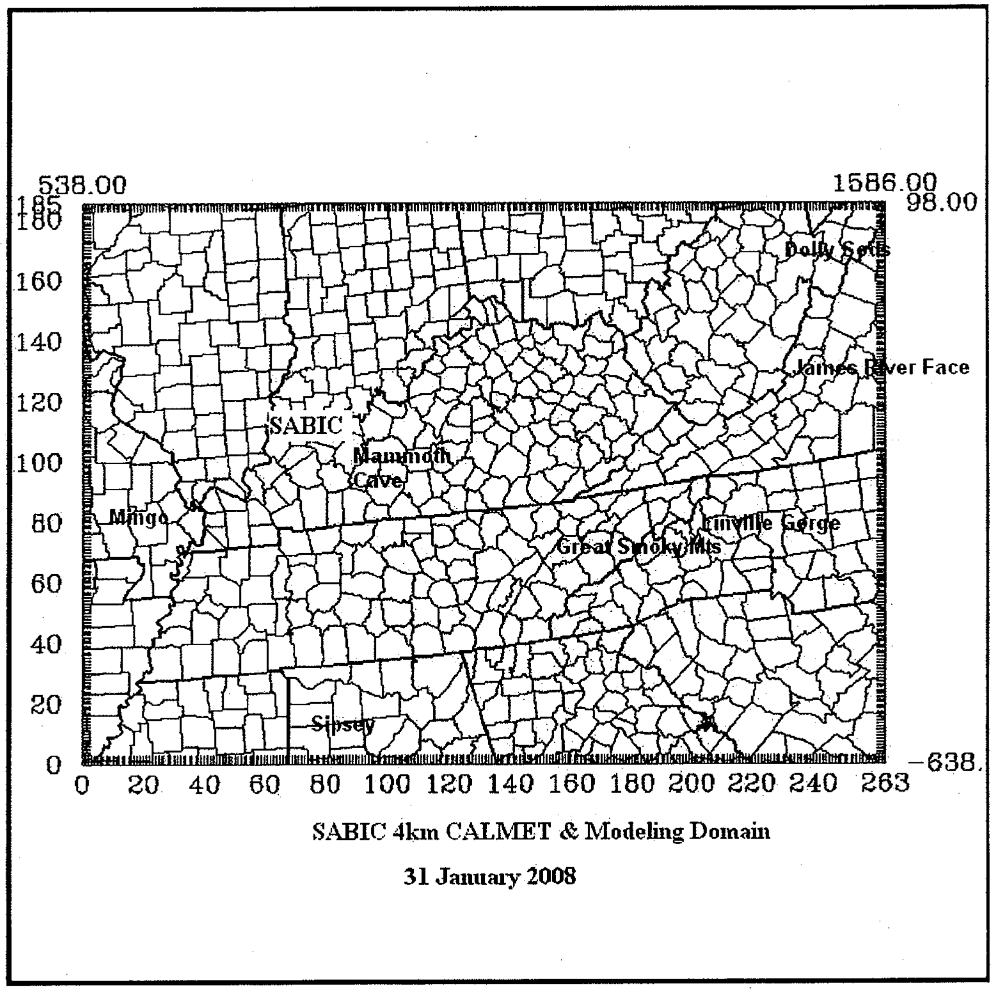

Figure 1. Refined 4km Grid Used in the SABIC CALPUFF Visibility Modeling

[2] Please see *Revised Best Available Retrofit Technology (BART) Modeling Protocol for Sabic Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana,* (April 2008), Appendix A, for the refined 4 km grid analysis source parameters for individual SABIC BART eligible emission units.

In accordance with the final BART guidance and 326 IAC 26-1-4(a), the threshold value to define whether a source "contributes" to visibility impairment is a 0.5 dv change from natural conditions. For this refined grid BART modeling, the test for evaluating whether SABIC is contributing to visibility impairment was based on the 98th percentile modeled 24-hour visibility impacts from the CALPUFF modeling. For this analysis the facility would be considered to not contribute to visibility impairment in a given year if the 7th highest day is lower than 0.5 dv and over a three year period if the 21st highest 24-hour impact is less than 0.5 dv.

3.0 REFINED GRID CALPUFF MODELING SCENARIOS AND RESULTS

CALPUFF modeling for visibility impacts was performed for two scenarios of emissions at SABIC which are explained in detail in the companion report entitled *"Best Available Retrofit Technology (BART) Emission Inputs for CALPUFF Modeling for SABIC Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana", April 2008.* (the Emissions Input Report) These CALPUFF runs included two scenarios. Run 1: Oil Scenario represents firing residual oil in the B&W Boiler (Source 09-001). This has not been done in 10 years and the storage tank and oil supply system is no longer operable. Since this scenario still exists as a permit condition, SABIC included emissions under this scenario in the BART exemption modeling runs. Run 2: No Oil Scenario, represents firing natural gas plus supplemental hydrogen in the B&W Boiler, which is the current and on-going scenario for this boiler. It was included because its emissions are substantially lower than for the Run 1: Oil Scenario. This is the current and future operating scenario for this boiler. Appendix A provides the maximum 24-hour average actual hourly (M24HAA) emission rates by emission unit for these two scenarios.[3]

Appendix B provides a series of tables summarizing the results of the two SABIC emission scenarios that were modeled for BART. Tables B-1 through B-4, present the results of the refined grid modeling for Run 1: Oil Scenario and Tables B-5 through B-8 for Run 2: No Oil Scenario. Tables B-1 and B-5 cover the number of days above the 0.5 dv threshold for each Class I area in the modeling domain for each emissions case, Run 1: Oil Scenario and Run 2: No Oil Scenario, respectively. As can be seen in the tables B-1 and B-5, the only two Class I areas with visibility impacts above the 0.5 dv were Mammoth Cave National Park and Mingo National Wildlife Refuge. The Run 1: Oil Scenario visibility impacts were generally about 10-15% higher than those of Run 2: No Oil Scenario which can be primarily attributed to the difference in SO_2 emissions at the B&W boiler. The number of days above the 0.5 dv threshold over the three year period of meteorological data modeled was 15 and 12 for Mammoth Cave for Runs 1 and 2, respectively, and 5 and 4 for Mingo for Runs 1 and 2, respectively. Thus, the remaining tables focus on the impacts at Mammoth Cave rather than Mingo (the number of values above 0.5 dv on either an annual or three year basis to identify SABIC as having "contributed" to visibility impairment was not exceeded at Mingo).

Tables B-2 and B-6 show the distribution of the number of days above 0.5 dv at Mammoth Cave for Run 1: Oil Scenario and Run 2: No Oil Scenario and illustrate that each year's number of values above 0.5 dv was less than the 98th percentile or eight days of occurrence. Thus, SABIC does not cause or contribute to visibility impairment at Mammoth Cave. To further demonstrate

[3] The M24HAA emission rates for the two CALPUFF model runs are also provided in Appendix C of *Revised Best Available Retrofit Technology (BART) Modeling Protocol for Sabic Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana,* (April 2008).

this conclusion in a more robust manner, Tables B5 and B-9 show the estimated maximum visibility impairment change for each year for each case. Table B-5 for Run 1: Oil Scenario shows that for the 2003 meteorological data set, the sixth highest value at 0.506 is just above the 0.5 dv threshold while the seventh highest value at 0.369 is well below 0.5 dv. Similarly, for Run 2: No Oil Scenario, the fifth highest values for years 2002 and 2003 at 0.521 and 0.507 are just above the 0.5 dv threshold while the sixth highest values at 0.392 and 0.462 are below 0.5 dv. Other years have fewer numbers of days greater than the 0.5 dv threshold. Finally, Tables B-6 and B-10 present the maximum days for each year and a contribution percentage attributable to each constituent. Sulfates due to SO_2 emissions are the major contributors in all cases with very little due to particulates.

4.0 CONCLUSIONS

This report has provided detailed information on the results of the Run 1: Oil and Run 2: No Oil BART emission scenarios modeled for BART applicability using CALPUFF. A summary of the number of days > 0.5 deciviews during the highest single year and the total number of days > 0.5 deciviews over the 3 year modeling period for Mammoth Cave National Park is provided in Table 3, below, along with a summary of the emissions associated with each scenario.

Table 3. CALPUFF Results and Emission Inputs Comparison Table

CALPUFF Results at Mammoth Cave National Park	Run 1: Oil Scenario	Run 2: No Oil Scenario
Highest Single Year, Days > 0.5 Deciviews	6	5
Total 3-Year, Days > 0.5 deciviews	15	12
BART Applicable?	No	No
Total NOx Emissions, lb/hr*	197.8	184.2
Total SO2 Emissions, lb/hr*	1336.7	1219.1
Total PM10 Emissions, lb/hr*	41.6	32.1
Total PM2.5 Emissions, lb/hr*	33.4	27.0
Total NOx, SO2 and PM10 Emissions, lb/hr*	1576.1	1435.4

*See companion "Emission Input Report" for more detailed information on the basis for the emission inputs to CALPUFF

The conclusion is that SABIC will not "cause or contribute to visibility impairment" in any Class I areas. These results demonstrate that the SABIC Mt. Vernon facility is exempt from having to perform a BART analysis on its BART eligible emission units because, even for Run 1: Oil Scenario (with oil utilized in the B&W Boiler), the number of days > 0.5 deciviews for the highest single year from 2001 through 2003 is 6, which is less than the BART applicability threshold of 8 days in any year, and the three year total is 15 days > 0.5 deciviews, which is less than the 22 day threshold for the three year modeling period. It is noted that the results using the Run 2: No Oil Scenario, where the fuel in the B&W Boiler is natural gas plus supplemental hydrogen, show even fewer days > 0.5 deciviews than the Run 1: Oil Scenario, which presumes oil firing in the B&W Boiler.

5.0 REFERENCES

1. 40 CFR Part 51, "Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations (Appendix Y)"; Final Rule Federal Register: July 6, 2005 (Volume 70, Number 128)

2. Indiana Department of Environmental Management (IDEM). Indiana Administrative Code, ARTICLE 26. REGIONAL HAZE. Rule 1. Best Available Retrofit Technology (IAC 326-1). Effective February 22, 2008.

3. "Revised Best Available Retrofit Technology (BART) Modeling Protocol for SABIC Innovative Plastics Mt. Vernon, LLC, Mt. Vernon, Indiana." April 2008. Alpine Geophysics LLC and GZA GeoEnvironmental Inc.

4. "Best Available Retrofit Technology Emission Inputs for CALPUFF Modeling for SABIC Innovative Plastics, Mt. Vernon LLC," April 2008. Sabic Innovative Plastics and GZA GeoEnvironmental Inc.

APPENDIX A

SABIC BART-ELIGIBLE SOURCE
MAXIMUM 24-HR EMISSION RATES FOR REFINED 4KM GRID SCENARIOS

Table A-1. SABIC Refined 4 km Grid, Run 1: Oil Scenario in B&W Boiler

Unit ID	BART Emission Unit Description	NO_x Emissions	SO_2 Emissions	PM_{10} Emissions	$PM_{2.5}$ Emissions
		lb/hr	lb/hr	lb/hr	lb/hr
09-001	09-001 B& W	54.2	117.6	10.81	7.64
09-002	09-002 Erie	81.2	702.8	17.75	15.88
09-002	09-002 Lasker	42.0	363.3	8.24	7.50
08-706	09-002 Flare (COS) going to 08-706	0.62	152.8	0.03	0.007
09-106	09-106 Riley	17.9	0.11	1.343	1.34
12-001	12-001 (H109) Hot Oil Heater	1.9	0.011	0.14	0.14
00000	Transfer & Finishing Fugitive Emissions	0.0	0	3.42	0.86
Emission Totals		197.7	1336.6	41.7	33.4

Table A-2. SABIC Refined 4 km Grid, Run 2: No Oil Scenario in B&W Boiler

Unit ID	BART Emission Unit Description	NO_x Emissions	SO_2 Emissions	PM_{10} Emissions	$PM_{2.5}$ Emissions
		lb/hr	lb/hr	lb/hr	lb/hr
09-001	09-001 B& W	40.6	0.10	1.30	1.30
09-002	09-002 Erie	81.2	702.8	17.75	15.88
09-002	09-002 Lasker	42.0	363.3	8.24	7.50
08-706	09-002 Flare (COS) going to 08-706	0.62	152.8	0.03	0.007
09-106	09-106 Riley	17.9	0.11	1.343	1.34
12-001	12-001 (H109) Hot Oil Heater	1.9	0.011	0.14	0.14
00000	Transfer & Finishing Fugitive Emissions	0.0	0	3.42	0.86
Emission Totals		184.1	1219.1	32.2	27.0

APPENDIX B

BART CALPUFF RESULTS FOR SABIC EMISSION SCENARIOS

Table B-1. Summary of Run 1: Oil Scenario in B&W Boiler - CALPUFF/CALPOST Model Results FOR ALL CLASS I AREAS in the 4km Refined Grid FOR SABIC Mt. Vernon, Indiana

Class I Area	Distance from source to Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2001		# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact >1. 0 dv in Class I area for 3-yr period: 2001-2003		Max. 24-hr impact over 3- yr period
Dolly Sods Wilderness, WV	754	0	0	0	0	0	0	0	0	0.200
James River Face Wilderness, VA	745	0	0	0	0	0	0	0	0	0.205
Mammoth Cave, KY	165	4	2	5	4	6	6	0	0	1.019
Great Smoky Mts., TN	435	0	0	0	0	0	0	0	0	0.334
Linville Gorge Wilderness, NC	578	0	0	0	0	0	0	0	0	0.312
Mingo National Wildlife Refuge, MO	221	0	0	2	1	3	2	0	0	0.838
Sipsey Wilderness, AL	393	0	0	0	0	0	0	0	0	0.423

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TABLE B-2. CLASS I AREA VISIBILITY IMPAIRMENT ANALYSIS OF RUN 1: OIL SCENARIO IN B&W BOILER AT MAMMOTH CAVE NATIONAL PARK DUE TO SABIC MT. VERNON, INDIANA USING REFINED 4KM GRID

Year	Visibility Impairment	
	Maximum Plume Extinction	**Number of Days > 0.5 dv**
2001	0.732	4
2002	0.954	5
2003	1.019	6
BART Threshold Maximum Extinction Change in Class I Area	0.5	N/A

TABLE B-3. SUMMARY OF RANKEDRUN 1: OIL SCENARIO IN B&W BOILER CALPUFF/CALPOST MODEL RESULTS FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

Class I Area	Rank	2001 Delta-deciview Ranks 1-8	2002 Delta-deciview Ranks 1-8	2003 Delta-deciview Ranks 1-8
Mammoth Cave, KY	1	0.732	0.954	1.019
	2	0.656	0.868	0.644
	3	0.534	0.614	0.561
	4	0.51	0.593	0.556
	5	0.467	0.54	0.551
	6	0.444	0.43	0.506
	7	0.423	0.402	0.369
	8	0.422	0.399	0.356

Shaded cells are greater than 0.5 dv.

TABLE B-4. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.732	76.00	22.67	1.33
2001	241	302	0.656	95.77	3.56	0.67
2001	240	119	0.534	97.02	1.86	1.12
2001	264	119	0.51	76.27	21.57	2.16
2002	347	21	0.954	88.72	10.68	0.59
2002	213	300	0.868	98.16	0.9	0.94
2002	361	297	0.614	60.68	37.42	1.9
2002	202	297	0.593	98.64	0.4	0.96
2002	358	47	0.54	67.72	29.9	2.38
2003	349	227	1.019	81.72	17.4	0.88
2003	156	65	0.644	90.46	7.74	1.8
2003	171	275	0.561	94.58	4.46	0.96
2003	340	302	0.556	78.58	19.92	1.5
2003	263	300	0.551	92.28	6.62	1.09
2003	6	297	0.506	82.14	16.44	1.42

TABLE B-5. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CALPUFF/CALPOST MODEL RESULTS FOR ALL CLASS I AREAS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

Class I Area	Distance from source to Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2001		# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact >1. 0 dv in Class I area for 3-yr period: 2001-2003		Max. 24-hr impact over 3- yr period
Dolly Sods Wilderness, WV	754	0	0	0	0	0	0	0	0	0.182
James River Face Wilderness, VA	745	0	0	0	0	0	0	0	0	0.187
Mammoth Cave, KY	165	2	1	5	4	5	5	0	0	0.934
Great Smoky Mts., TN	435	0	0	0	0	0	0	0	0	0.310
Linville Gorge Wilderness, NC	578	0	0	0	0	0	0	0	0	0.284
Mingo National Wildlife Refuge, MO	221	0	0	1	1	3	2	0	0	0.772
Sipsey Wilderness, AL	393	0	0	0	0	0	0	0	0	0.386

TABLE B-6. CLASS I AREA VISIBILITY IMPAIRMENT ANALYSIS OF RUN 2: NO OIL SCENARIO IN B&W BOILER AT MAMMOTH CAVE NATIONAL PARK DUE TO SABIC MT. VERNON, INDIANA USING REFINED 4KM GRID

Year	Visibility Impairment	
	Maximum Plume Extinction	Number of Days > 0.5 dv
2001	0.668	2
2002	0.882	5
2003	0.934	5
BART Threshold Maximum Extinction Change in Class I Area	0.5	N/A

TABLE B-7. SUMMARY OF RANKED RUN 2: NO OIL SCENARIO IN B&W BOILER CALPUFF/CALPOST MODEL RESULTS FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

Class I Area	Rank	2001 Delta-deciview Ranks 1-8	2002 Delta-deciview Ranks 1-8	2003 Delta-deciview Ranks 1-8
Mammoth Cave, KY	1	0.668	0.882	0.934
	2	0.598	0.804	0.59
	3	0.487	0.561	0.514
	4	0.459	0.549	0.511
	5	0.423	0.521	0.507
	6	0.406	0.392	0.462
	7	0.389	0.365	0.336
	8	0.367	0.364	0.326

Shaded cells are greater than 0.5 dv

TABLE B-8. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.668	75.68	23.14	1.18
2001	241	302	0.598	95.75	3.66	0.6
2002	347	21	0.882	88.6	10.86	0.53
2002	213	300	0.804	98.22	0.92	0.85
2002	361	297	0.561	60.12	38.2	1.68
2002	202	297	0.549	98.72	0.4	0.88
2002	358	47	0.521	67.75	30.03	2.22
2003	349	227	0.934	81.49	17.73	0.78
2003	156	65	0.59	90.43	7.95	1.62
2003	171	275	0.514	94.58	4.57	0.86
2003	340	302	0.511	78.39	20.27	1.34
2003	263	300	0.507	92.24	6.78	0.98

June 11, 2008

Mr. David L. Boggs
Principal Environmental Leader
SABIC Innovative Plastics Mt. Vernon, LLC
1 Lexan Drive
Mt. Vernon, Indiana 47620-9364

Re: Tables of Maximum Days of Visibility Greater Than 0.5 dv for Each Class I Area in the 4 km Modeling Domain of SABIC Innovative Plastics

Dear Mr. Boggs:

As we have discussed and at the request of Mr. Mark Derf of the Indiana Department of Environmental Management, I have prepared tables that summarize the refined grid modeling results for days with visibility impacts greater than 0.5 dv in each Class I area where applicable. The two areas were Mammoth Cave National Park in Kentucky (as presented in the SABIC BART modeling report in Tables B-4 and B-8) and Mingo Wilderness Area in Missouri. Visibility impacts are presented for two modeling scenarios, namely, Run 1: Oil Scenario which represents firing residual oil in the B&W Boiler (Source 09-001) and Run 2: No Oil Scenario which represents firing natural gas plus supplemental hydrogen in the B&W Boiler. The latter scenario is the current and on-going scenario for this boiler while residual oil has not been used in the B&W boiler in over ten years.

Tables B-4 and B-8 repeat the tables provided in the original document submitted to IDEM entitled *Best Available Retrofit Technology (BART) Exemption Modeling Results for SABIC Innovative Plastics Mt. Vernon LLC, Mt. Vernon, Indiana.* Tables B-4A and B-8A provide similar tables for Mingo Wilderness.

If you have any questions regarding these tables or their contents, please feel free to call me at 812-432-9484. I believe these tables are responsive to the request of Mr. Derf.

Respectfully yours,

George J Schewe

George J. Schewe, CCM, QEP
Partner and Principal Meteorologist
Alpine Geophysics, LLC

cc: Michael Szabo

TABLE B-4. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.732	76.00	22.67	1.33
2001	241	302	0.656	95.77	3.56	0.67
2001	240	119	0.534	97.02	1.86	1.12
2001	264	119	0.51	76.27	21.57	2.16
2002	347	21	0.954	88.72	10.68	0.59
2002	213	300	0.868	98.16	0.9	0.94
2002	361	297	0.614	60.68	37.42	1.9
2002	202	297	0.593	98.64	0.4	0.96
2002	358	47	0.54	67.72	29.9	2.38
2003	349	227	1.019	81.72	17.4	0.88
2003	156	65	0.644	90.46	7.74	1.8
2003	171	275	0.561	94.58	4.46	0.96
2003	340	302	0.556	78.58	19.92	1.5
2003	263	300	0.551	92.28	6.62	1.09
2003	6	297	0.506	82.14	16.44	1.42

TABLE B-8. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.668	75.68	23.14	1.18
2001	241	302	0.598	95.75	3.66	0.6
2002	347	21	0.882	88.6	10.86	0.53
2002	213	300	0.804	98.22	0.92	0.85
2002	361	297	0.561	60.12	38.2	1.68
2002	202	297	0.549	98.72	0.4	0.88
2002	358	47	0.521	67.75	30.03	2.22
2003	349	227	0.934	81.49	17.73	0.78
2003	156	65	0.59	90.43	7.95	1.62
2003	171	275	0.514	94.58	4.57	0.86
2003	340	302	0.511	78.39	20.27	1.34
2003	263	300	0.507	92.24	6.78	0.98

TABLE B-4A. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MINGO WILDERNESS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2002	345	19	0.816	71.19	26.98	1.84
2002	187	19	0.511	98.78	0.4	0.82
2003	253	19	0.838	94.18	5.22	0.6
2003	53	46	0.806	90.19	9.12	0.69
2003	252	19	0.616	94.45	4.94	0.61

TABLE B-8A. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MINGO WILDERNESS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2002	345	19	0.751	71.12	27.28	1.59
2003	253	19	0.772	94.13	5.34	0.88
2003	53	46	0.742	90.05	9.34	1.8
2003	252	19	0.56	94.41	5.05	0.96

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July 9, 2008

Mr. David L. Boggs
Principal Environmental Leader
SABIC Innovative Plastics Mt. Vernon, LLC
1 Lexan Drive
Mt. Vernon, Indiana 47620-9364

Re: Additional Tables B-1A through B-8A for Mammoth Cave NP and Mingo National Wildlife Refuge

Dear Mr. Boggs:

As we have discussed and at the suggestion of Mr. Mark Derf of the Indiana Department of Environmental Management, I performed additional CALPUFF simulations for the 4km modeling domain in the vicinity of the SABIC Innovative Plastics Mt. Vernon, LLC facility, which is located near Mt. Vernon, Indiana. As recommended by Mr. Derf, the annual average natural background extinction coefficient (b_{ext}) was used instead of the 20% best days natural background extinction coefficient. The additional model runs were only for the Mammoth Cave National Park (Kentucky) and Mingo Wilderness Area (Missouri) Class I areas; additional model runs for the other Class I areas presented in the Appendix B Tables B-1 through B-8 for Run Nos. 1 and 2 of the report entitled *Best Available Retrofit Technology (BART) Exemption Modeling Results for SABIC Innovative Plastics Mt. Vernon LLC, Mt. Vernon, Indiana* (April 2008) were not conducted. Visibility impacts are presented for the same two modeling scenarios, namely, Run 1: Oil Scenario which represents firing residual oil in the B&W Boiler (Source 09-001) and Run 2: No Oil Scenario which represents firing natural gas plus supplemental hydrogen in the B&W Boiler. The latter scenario is the current and on-going scenario for this boiler (because residual oil has not been used in the B&W boiler in over ten years). As can be seen in the attached additional Appendix B tables B-1A through B-8A, the number of days of visibility impacts greater than 0.5 dv decreased significantly at Mammoth Cave NP and somewhat at Mingo Wilderness versus the impacts previously presented in Appendix B of the above referenced report.

The methodology followed in using the annual average natural background b_{ext} was the same as that used in the previous modeling and followed the technique used in the LADCO March 21, 2006 protocol entitled *Single Source Modeling to Support Regional Haze BART Modeling Protocol*. As shown in the LADCO protocol, annual average background concentrations for the Eastern United States from Table 2-1 of the *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule* (EPA-454/B-03-005, September, 2003) for specific species were scaled to higher or lower values until a Class I area-specific natural visibility is produced. This scaling procedure was performed for each Class I area in the LADCO protocol using the 20% best visibility days. In this additional analysis, the 20% best visibility background was replaced by the annual average visibility background and each concentration rescaled. The mathematical relationship between the annual average natural background in deciviews and visual range, (1/Megameters (Mm)) is:

Annual avg. visual range (1/Mm) = 10* exp (annual avg. deciviews/10)

Alpine Geophysics, LLC 2655 South County Road 750 E, Dillsboro, Indiana 47018 (812) 432-9484 (812) 432-5013 FAX

The annual average b_{ext} values for Mammoth Cave and Mingo Wilderness were taken from Appendix B of the EPA's *Guidance for Estimating Natural Visibility Conditions under the regional Haze Rule* (EPA-454/B-03-005), September, 2003 and were 7.69 dv and 7.43 dv, respectively. These coefficients were converted to the visual range in units of 1/Mm as shown in the formula above and gave a visual range of 21.58 and 21.03 for Mammoth Cave NP and Mingo Wilderness, respectively. These values were then used in the equation which relates the annual average natural background to each species concentration with an "X" entered in each component contribution as the scaling factor. This equation is shown below:

Annual avg. visual range (1/Mm) = 3*fRH*[ammonium sulfate]*X + 3*fRH*[ammonium nitrate]*X + 4*[OC]*X + 10*[EC]*X + 1*[SOIL]*X + 0.6*[CM]*X + Raleigh Scattering,

where Raleigh scattering is 10/Mm. The bracketed concentrations are expressed as ug/m3. The fRH values represent annual average fRH calculated from the 12 monthly site specific fRH values taken from Table A-3 of EPA-454/B-03-005.

This relationship was used to calculate a scaling factor (X) for the natural background concentrations for the Eastern U.S., which were then applied to the base background concentrations. The scaling factors were 1.013 for Mammoth Cave and 0.984 for Mingo Wilderness. Table 1 below shows the average natural background levels of aerosol components in the atmosphere in the Eastern U.S., the resulting scaling factor and scaled concentrations for species contributing to the annual average natural background at each of the two Class I areas. These scaled values were entered directly for the background concentrations in the appropriate CALPOST files for visibility calculations.

Table 1. Scaled Annual Average Natural Background Values

Class I Area	Unscaled Natural Backgr., dv	Unscaled Natural Backgr., 1/Mm	Scaling Factor	Scaled Annual average fRH	Scaled Amm. Sulfate conc. (ug/m^3)	Scaled Amm. Nitrate conc. (ug/m^3)	Scaled Organic carbon conc. (ug/m^3)	Scaled Elemental carbon conc. (ug/m^3)	Scaled Soil conc. (ug/m^3)	Scaled Coarse mass conc. (ug/m^3)
MACA	7.69	21.58	1.013	3.36	0.233	0.101	1.419	0.020	0.507	3.040
MING	7.43	21.03	0.984	3.14	0.226	0.098	1.378	0.020	0.492	2.952

If you have any questions regarding these tables or their contents, please feel free to call me at 812-432-9484.

Respectfully yours,

George J Schewe

George J. Schewe, CCM, QEP
Partner and Principal Meteorologist
Alpine Geophysics, LLC

cc: Michael Szabo, GZA

ADDITIONAL TABLES

APPENDIX B

BART CALPUFF RESULTS FOR SABIC EMISSION SCENARIOS

TABLE B-1A. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CALPUFF/CALPOST MODEL RESULTS FOR SELECTED CLASS I AREAS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

Class I Area	Distance from source to Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2001		# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact >1. 0 dv in Class I area for 3-yr period: 2001-2003		Max. 24-hr impact over 3- yr period
Mammoth Cave, KY*	165	1	1	2	2	1	1	0	0	0.703
Mingo National Wildlife Refuge, MO*	221	0	0	1	1	2	2	0	0	0.575

* With annual average natural background

TABLE B-2A. CLASS I AREA VISIBILITY IMPAIRMENT ANALYSIS OF RUN 1: OIL SCENARIO IN B&W BOILER AT MAMMOTH CAVE NATIONAL PARK DUE TO SABIC MT. VERNON, INDIANA USING REFINED 4KM GRID WITH ANNUAL AVERAGE NATURAL BACKGROUND

Year	Visibility Impairment	
	Maximum Plume Extinction	Number of Days > 0.5 dv
2001	0.506	1
2002	0.657	2
2003	0.703	1
BART Threshold Maximum Extinction Change in Class I Area	0.5	N/A

TABLE B-3A. SUMMARY OF RANKED RUN 1: OIL SCENARIO IN B&W BOILER CALPUFF/CALPOST MODEL RESULTS FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

Class I Area	Rank	2001 Delta-deciview Ranks 1-8*	2002 Delta-deciview Ranks 1-8*	2003 Delta-deciview Ranks 1-8*
Mammoth Cave, KY	1	0.506	0.657	0.703
	2	0.447	0.595	0.441
	3	0.363	0.421	0.384
	4	0.346	0.405	0.380
	5	0.320	0.370	0.375
	6	0.307	0.293	0.347
	7	0.289	0.275	0.252
	8	0.288	0.273	0.243

* Shaded cells are greater than 0.5 dv.

TABLE B-4A. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.506	76.00	22.67	1.33
2002	347	21	0.657	88.72	10.68	0.59
2002	213	300	0.595	98.16	0.9	0.94
2003	349	227	0.703	81.72	17.4	0.88

TABLE B-5A. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CALPUFF/CALPOST MODEL RESULTS FOR SELECTED CLASS I AREAS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

Class I Area	Distance from source to Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2001		# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact >1. 0 dv in Class I area for 3-yr period: 2001-2003		Max. 24-hr impact over 3- yr period
Mammoth Cave, KY*	165	0	0	2	2	1	1	0	0	0.643
Mingo National Wildlife Refuge, MO*	221	0	0	1	1	2	2	0	0	0.529

* With annual average natural background

TABLE B-6A. CLASS I AREA VISIBILITY IMPAIRMENT ANALYSIS OF RUN 2: NO OIL SCENARIO IN B&W BOILER AT MAMMOTH CAVE NATIONAL PARK DUE TO SABIC MT. VERNON, INDIANA USING REFINED 4KM GRID WITH ANNUAL AVERAGE NATURAL BACKGROUND

Year	Visibility Impairment	
	Maximum Plume Extinction	Number of Days > 0.5 dv
2001	0.461	0
2002	0.607	2
2003	0.643	1
BART Threshold Maximum Extinction Change in Class I Area	0.5	N/A

TABLE B-7A. SUMMARY OF RANKED RUN 2: NO OIL SCENARIO IN B&W BOILER CALPUFF/CALPOST MODEL RESULTS FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

Class I Area	Rank	2001 Delta-deciview Ranks 1-8*	2002 Delta-deciview Ranks 1-8*	2003 Delta-deciview Ranks 1-8*
Mammoth Cave, KY	1	0.461	0.607	0.643
	2	0.407	0.550	0.404
	3	0.331	0.384	0.352
	4	0.312	0.375	0.349
	5	0.290	0.356	0.344
	6	0.280	0.266	0.316
	7	0.265	0.249	0.229
	8	0.251	0.219	0.222

*Shaded cells are greater than 0.5 dv

TABLE B-8A. SUMMARY OF RUN 2: NO OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2002	347	21	0.607	88.6	10.86	0.53
2002	213	300	0.550	98.22	0.92	0.85
2003	349	227	0.643	81.49	17.73	0.78

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ALPINE GEOPHYSICS
Atmospheric & Hydrologic Sciences

August 8, 2008

Mr. David L. Boggs
Principal Environmental Leader
SABIC Innovative Plastics Mt. Vernon, LLC
1 Lexan Drive
Mt. Vernon, Indiana 47620-9364

Re: Table B-4A for Run 1:Oil Scenario for Mammoth Cave National Park and Table B-4B for Mingo National Wildlife Refuge

Dear Mr. Boggs:

As requested by Mr. Mark Derf of the Office of Air Quality with the Indiana Department of Environmental Management, I have extracted some additional information concerning the visibility impacts for Sabic Innovative Technologies for impacts on the Mingo Wilderness area in Missouri. I have prepared a Table B-4B for Mingo Wilderness for Run 1: Oil Scenario only, as requested. I have repeated and included Table B-1A from the previous summary analysis as a reference for the Mingo Wilderness summary of visibility impacts. I have also included the previously presented Table B-4A for Mammoth Cave National Park. All of these tables used the revised annual average natural background b_{ext} that was presented in the July 7, 2008 letter describing the revised modeling and background methodology.

If you have any questions regarding these tables or their contents, please feel free to call me at 812-432-9484.

Respectfully yours,

George J Schewe

George J. Schewe, CCM, QEP
Partner and Principal Meteorologist
Alpine Geophysics, LLC

cc: Michael Szabo, GZA

ADDITIONAL TABLES

APPENDIX B

BART CALPUFF RESULTS FOR SABIC EMISSION SCENARIOS

TABLE B-1A. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CALPUFF/CALPOST MODEL RESULTS FOR SELECTED CLASS I AREAS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

Class I Area	Distance from source to Class I area boundary, km	# of days and # of receptors with impact > 0.5 dv in Class I area: 2001		# of days and # of receptors with impact > 0.5 dv in Class I area: 2002		# of days and # of receptors with impact > 0.5 dv in Class I area: 2003		# of days and # of receptors with impact >1. 0 dv in Class I area for 3-yr period: 2001-2003		Max. 24-hr impact over 3- yr period
Mammoth Cave, KY*	165	1	1	2	2	1	1	0	0	0.703
Mingo National Wildlife Refuge, MO*	221	0	0	1	1	2	2	0	0	0.575

* With annual average natural background.

TABLE B-4A. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MAMMOTH CAVE NATIONAL PARK IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2001	55	302	0.506	76.00	22.67	1.33
2002	347	21	0.657	88.72	10.68	0.59
2002	213	300	0.595	98.16	0.9	0.94
2003	349	227	0.703	81.72	17.4	0.88

TABLE B-4B. SUMMARY OF RUN 1: OIL SCENARIO IN B&W BOILER - CONTRIBUTING CONSTITUENTS TO DELTA-DV FOR MINGO WILDERNESS IN THE 4KM REFINED GRID FOR SABIC MT. VERNON, INDIANA WITH ANNUAL AVERAGE NATURAL BACKGROUND

YEAR	DAY	RECEPTOR	DELTA DV	%_SO4	%_NO3	%_PMF
2002	345	19	0.562	71.19	26.98	1.84
2003	253	19	0.575	94.18	5.22	0.60
2003	53	46	0.558	90.19	9.12	0.69