1.0 Introduction

1.1 Objectives

The Regional Haze Rule regulations require Best Available Retrofit Technology (BART) for 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. Pursuant to federal regulations, states have the option of exempting a BART-eligible source from the BART requirements based on dispersion modeling by demonstrating that the source cannot reasonably be anticipated to cause or contribute to visibility impairment in a Class I area. This modeling protocol focuses on performing the BART modeling analysis required for NO_x, SO_2, and PM_{10}.

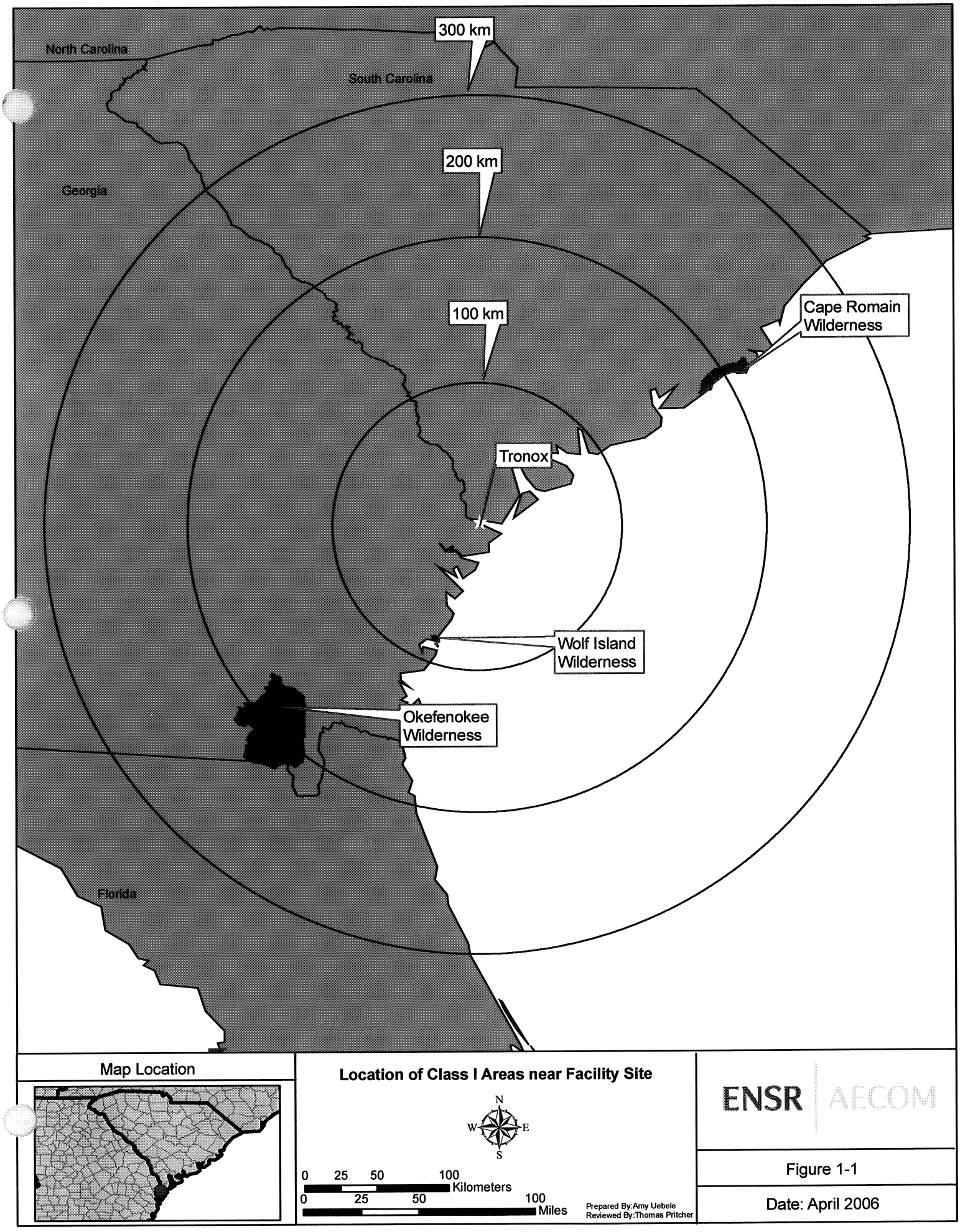
Tronox Pigments (Savannah), Inc. (Tronox) has been identified by Georgia Environmental Protection Division (GA EPD) as being a source that is eligible for consideration of BART controls for the criteria pollutants mentioned above. The purpose of this document is to summarize the procedures by which a modeling analysis will be conducted for Tronox emission sources which have been designated as BART-eligible. The modeling procedures outlined will be used to determine whether the source is subject to BART requirements (exemption modeling). If it is determined that the source is subject to BART, then the procedure will be appropriately used to evaluate the visibility impacts factor in the BART determination step (determination modeling). The modeling procedures are consistent with those outlined in the updated final Visibility Improvement State and Tribal Association of the Southeast (VISTAS) common BART modeling protocol. This protocol references relevant portions of the common VISTAS protocol. The protocol, updated March 9, 2006, is available at http://www.vistas-sesarm.org/BART/BARTModelingProtocol_rev2_9Mar2006.pdf.

1.2 Location of source vs. relevant Class I Areas

Figure 1-1 shows a plot of the Tronox Facility relative to nearby Class I Areas. There are three Class I areas within 300 km of the facility: Cape Romain, Wolf Island and Okefenokee Wilderness Areas. The BART exemption modeling will be conducted for each of these Class I areas in accordance with the referenced VISTAS common BART modeling protocol and the procedures described in this source-specific BART modeling protocol. If necessary, BART determination modeling will be performed for those Class I areas where the exemption modeling shows a greater than 0.5 deciviews (dv) impact.

1.3 Organization of protocol document

Section 2 of this protocol describes the source information that will be used as input to the BART exemption modeling and, if necessary, the BART determination modeling. Section 3 describes the input data to be used for the modeling including the modeling domain, terrain and land use, and meteorological data. Section 4 describes the air quality modeling procedures and Section 5 discusses the presentation of modeling results. Since all of the references cited are also included in the VISTAS common BART modeling protocol, no additional references section is required in this document. Appendix A is reserved for additional information, if necessary at a later date, on BART control option emissions data.


300 km
200 km
100 km
North Carolina
South Carolina
Georgia
Florida
Cape Romain Wilderness
Tronox
Wolf Island Wilderness
Okefenokee Wilderness
Map Location
Location of Class I Areas near Facility Site
N
W
E
S
0 25 50 100
Kilometers
0 25 50 100
Miles
Prepared By:Amy Uebele
Reviewed By:Thomas Pritcher
ENSR | AECOM
Figure 1-1
Date: April 2006

2.0 Source Description

2.1 Unit-specific source information

The emission sources used to assess the visibility impacts at the Class I areas within 300 km of Tronox is discussed in this section. The VISTAS protocol allows for the use of source-specific emissions and speciation factors. Otherwise, default values from AP-42 can be used as the default.

Based on the letter dated March 9, 2006, by Ms. Elisabeth Munsey, Tronox Facility cannot be exempted from BART determination requirements as according to the plant emissions and distance criteria. Specifically, the following sources have been identified as BART Eligible Sources:

- Chloride Finishing A
- Sulfuric Acid Plant

The unit-specific emission rates and emission factors are under review and will be submitted to GA EPD under separate cover. In addition, Tronox is also considering additional emission limits that could exempt the sources based on emission levels and distance to Class I Areas.

If the BART exemption modeling indicates that a BART determination is required, then one or more control options will be considered for the modeling to determine visibility improvement from the baseline case. Appendix A has been reserved for future use as an update to this protocol in the event that a BART determination is required for Tronox. Appendix A would provide plant-specific data for each control option considered to be operationally feasible, and would discuss any deviations from the default criteria pollutant speciation guidance that is appropriate for the controls implemented in each candidate BART option.

In practice, CALPUFF allows for the user to input certain components of PM_{10} as separate species and separate sizes, which will result in more accurate wet and dry deposition velocity results and also more accurate effects on light scattering. Appropriate particle size distribution information will be used for the BART exemption modeling as well as the BART determination modeling, if needed.

The proposed modeling approach is based on the best understanding of the guidance and technical considerations known at this time. If additional issues arise during the course of the analysis that requires clarification, Tronox will contact GA EPD for further guidance or to request approval for adjustments to this proposed approach.

3.0 Input data to the CALPUFF model

3.1 General modeling procedures:

VISTAS has developed five sub-regional 4-km CALMET meteorological databases for three years (2001-2003). The sub-regional modeling domains are strategically designed to cover all potential BART-eligible sources within VISTAS states and all PSD Class I areas within 300 km of those sources. The BART modeling for Tronox will be completed using the appropriate 4-km sub-domain.

USGS 90-meter Digital Elevation Model (DEM) files were used by VISTAS to generate the terrain data at 4-km resolution for input to the 4-km sub-regional CALMET run. Likewise, USGS 90-meter Composite Theme Grid (CTG) files were used by VISTAS to generate the land use data at 4-km resolution for input to the 4-km sub-regional CALMET run.

Three years of MM5 data (2001-2003) were used by VISTAS to generate the 4-km sub-regional meteorological datasets. See Sections 4.3.2 and 4.4.2 in the VISTAS common BART modeling protocol for more detail on these issues.

It is intended that the modeling for Tronox will use the 4-km sub-domain. However, if the results indicate that peak concentrations could be better predicted with a CALPUFF run using a finer grid, due to terrain, shoreline resolution, or other factors, then refinements in the modeling procedures will be considered and GA EPD will be asked to approve these refinements.

In the event that a finer grid resolution is used, CALMET must be rerun. Other modifications to inputs of CALMET would include the extent of the modeling domain, the resolution of the terrain and land use data, and other relevant settings. The same MM5 data and observations that were used for the 4-km sub-regional CALMET simulations would be used for this modeling run. The extent of the modeling domain may need to be changed because of disk space restrictions. The size of the CALMET output is directly proportional to the grid resolution of the run. The domain would be limited to the source and the exclusive Class I area(s) being assessed with a higher grid resolution, including a 50-km buffer in all directions.

If CALMET needs to be run at even a finer grid resolution, then the appropriate model setting/files (specifically the GEO.DAT file) will be modified. A summary of these modifications would be provided to GA EPD for review and approval.

3.2 Air quality database (background ozone and ammonia)

Hourly measurements of ozone from non-urban monitors, as generated by VISTAS and available on the VISTAS CALPUFF page on the Earth Tech web site (http://www.src.com/verio/download/sample_files.htm), will be used as input to CALPUFF. As for ammonia, it is intended to follow the approach recommended by VISTAS. Currently, VISTAS intends to provide hourly ammonia data, derived from CMAQ runs, for the 4-km sub-regional domain runs. If for some reason the CMAQ data are unavailable, then it is anticipated that VISTAS will recommend an alternate approach for sources to use. Two alternatives that could be considered are to use average, single-value ammonia background concentrations derived from existing references such as the 1998 IWAQM Phase 2 report (see page 14 of that report) or to use monthly-varying ammonia background values.

3.3 Natural conditions and monthly f(RH) at Class I Areas

There are three Class I areas within 300 km of Tronox (as noted in Figure 1-1). For each of the Class I areas, natural background conditions must be established in order to determine a change in natural conditions related

to a source's emissions. For the modeling described by this protocol document, it is intended to use the natural background light extinction corresponding to the 20% best days (EPA 2003 values), consistent with the VISTAS BART protocol. However, the BART rule has an inconsistency on whether the natural background should be reflective of the average conditions rather than the 20% best days' conditions. If EPA determines that the average conditions are appropriate and GA EPD adopts this position, then the CALPUFF exemption modeling will use the average background conditions for the 0.5 deciview test of contributing to visibility impairment.

To determine the input to CALPUFF, it is first necessary to convert the deciviews to extinction using the equation:

$$\text{Extinction } (Mm^{-1}) = 10 \exp(\text{deciviews}/10).$$

For example, the EPA guidance document indicates for Cape Romain Wilderness Area that the deciview value for the best 20% of days is 3.68. This is equivalent to an extinction of 14.44 inverse megameters (Mm^{-1}). In the case of average conditions, the deciview value is 7.52, which is equivalent to an extinction of 21.21 Mm^{-1}.

This extinction includes the default 10 Mm^{-1} for Rayleigh scattering. The remaining extinction is due to naturally occurring particles, and should be held constant for the entire year's simulation. Therefore, the data provided to CALPOST for Cape Romain would be the total natural background extinction minus 10 (expressed in Mm^{-1}), or 4.44, for the 20% best days case. This is most easily input as fine soil concentrations (4.44 $\mu g/m^3$) in CALPOST, since the extinction efficiency of soil (PM-fine) is 1.0 and there is no f(RH) component. The concentration entries for all other particle constituents would be set to zero, and the fine soil concentration would be kept the same for each month of the year. The monthly values for f(RH) that CALPOST needs will be taken from "Guidance for Tracking Progress Under the Regional Haze Rule" (EPA, 2003) Appendix A, Table A-3. However, it should be noted that these values correspond to the annual average background conditions, not the 20% best conditions, which would intuitively be expected to be associated with drier days than average. Therefore, Tronox reserves the right to adjust the f(RH) values for the 20% best days' humidity conditions if this refinement is needed.

4.0 Air quality modeling procedures

This section provides a summary of the modeling procedures outlined in the VISTAS protocol that will be used for the refined CALPUFF analysis to be conducted for Tronox.

4.1 Model selection and features

As noted in the VISTAS protocol, VISTAS will use the BART-specific versions of CALMET and CALPUFF that have been posted at http://www.src.com/verio/download/download.htm#VISTAS_VERSION. These versions contain enhancements funded by the Minerals Management Service (MMS) and VISTAS. They were developed by Earth Tech, Inc. and are maintained on Earth Tech's Atmospheric Studies Group CALPUFF website for public access. This release includes CALMET, CALPUFF, CALPOST, CALSUM, and POSTUTIL as well as CALVIEW.

The major features of the CALPUFF modeling system, including those of CALMET and the post processors (CALPOST and POSTUTIL) are referenced in Section 3 of the VISTAS protocol.

4.2 Modeling domain and receptors

The initial Tronox BART runs will use the sub-domain 4-km CALMET data to be supplied by VISTAS, as discussed above. This domain includes all Class I areas within 300 km of the source, plus a 50-km buffer. If there is the need for a refined analysis with a finer grid, a supplement to this modeling protocol will be provided describing the proposed procedures.

The receptors used for each of the Class I areas are based on the NPS database of Class I receptors, as recommended by VISTAS.

4.3 Technical options used in the modeling

CALMET modeling for the VISTAS-provided 4-km sub-domains will be pre-determined by the VISTAS contractor, and, therefore, it is assumed that VISTAS approves of the manner in which CALMET has been run for the sub-domain data that they provide. If it is decided to conduct additional modeling with a finer grid than 4-km, this modeling protocol will be updated to specify the technical options used in the CALMET run, in order to allow for state agency review and approval.

For CALPUFF model options, Tronox will follow the VISTAS common BART modeling protocol, which states that IWAQM (EPA, 1998) guidance should be used. The VISTAS protocol also notes that building downwash effects are not required to be included unless the state directs the source to include these effects. Since Tronox is several tens of kilometers from the nearest Class I area, building downwash effects in the CALPUFF modeling will not be included.

The POSTUTIL utility program will be used to repartition HNO_3 and NO_3 using VISTAS-provided ammonia concentrations derived from previous 2002 CMAQ modeling conducted by EPA, or an alternate ammonia concentrations approach recommended by VISTAS, if the CMAQ data is unavailable.

4.4 Light extinction and haze impact calculations

The CALPOST postprocessor will be used as prescribed in the VISTAS protocol for the calculation of the impact from the modeled source's primary and secondary criteria pollutants' concentrations on light extinction. The formula that is used is the existing (not the November 2005 revised) IMPROVE/EPA formula, which is

applied to determine a change in light extinction due to increases in the particulate matter component concentrations. Using the notation of CALPOST, the formula is the following:

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

The concentrations, in square brackets, are in units of micrograms per cubic meter ($\mu g/m^3$) and b_{ext} is in units of Mm^{-1}. The Rayleigh scattering term (b_{Ray}) has a default value of 10 Mm^{-1}, as recommended in EPA guidance for tracking reasonable progress (EPA, 2003a). However, as recommended in the VISTAS protocol, for refined 4-km grid (or smaller) CALPUFF runs, the Rayleigh scattering term will be modified for the specific elevation of the Class I area receptors. For near sea-level sites, this value is generally between 11 and 12 Mm^{-1}. Specific values can be found at:

http://vista.cira.colostate.edu/improve/Publications/GrayLit/019_RevisedIMPROVEeq/RevisedIMPROVEAlgorithm3.doc

The assessment of visibility impacts at the Class I areas will use CALPOST Method 6. Each hour's source-caused extinction is calculated by first using the hygroscopic components of the source-caused concentrations, due to ammonium sulfate and nitrate, and monthly Class I area-specific f(RH) values. The contribution to the total source-caused extinction from ammonium sulfate and nitrate is then added to the other, non-hygroscopic components of the particulate concentration (from coarse and fine soil, secondary organic aerosols, and from elemental carbon) to yield the total hourly source-caused extinction.

The BART rule significance threshold for the contribution to visibility impairment is 0.5 deciviews. The VISTAS protocol indicates that with the use of the 4-km sub-regional CALMET database, a source does not cause or contribute to visibility impairment if the 98th percentile (or 8th highest) day's change in extinction from natural conditions does not exceed 0.5 deciviews for any of the modeled years. As an added check, the 22nd highest prediction over the three years modeled should also not exceed 0.5 deciviews for a source to be exempted from a BART determination.

Figure 4-1 of the VISTAS common BART modeling protocol presents a flow chart showing the components of that modeling protocol for the analysis to determine whether a source is subject to BART. Again, it should be noted that the modeling for Tronox will focus on Sub-Regional Fine-Scale modeling as depicted in the lower half of the figure.

If the exemption modeling demonstrates that the BART-eligible units at Tronox do not cause or contribute to visibility impairment, then Tronox will not be subject to BART requirements, and no further analysis is needed. Otherwise, Tronox will proceed to perform BART determination modeling for the baseline and each control option in a similar manner as has been described in this document.

Appendix A (Reserved)

Source-Specific Emissions Data for BART Determination Options