Washington State Regional Haze State Implementation Plan

Appendix H

Best Available Retrofit Technology Modeling Protocol

Modeling Protocol for
Washington, Oregon, and Idaho:
Protocol for the Application of the CALPUFF Modeling System Pursuant to the Best Available Retrofit Technology (BART) Regulation

1. Introduction and Protocol Objective

1.1 Background

Under the Regional Haze Regulations, the U.S. Environmental Protection Agency (EPA) issued the final Guidelines for Best Available Retrofit Technology (BART) Determinations (July 6, 2005) (BART Guideline). According to the Regional Haze Rule, States are required to use these guidelines for establishing BART emission limitations for fossil fuel fired power plants having a capacity in excess of 750 megawatts. The use of these guidelines is optional for states establishing BART emission limitations for other BART-eligible sources. However, according to EPA, the BART Guideline was designed to help states and others do the following: (1) identify those sources that must comply with the BART requirement, and (2) determine the level of control technology that represents BART for each source.

This modeling protocol is a cooperative effort among Idaho Department of Environmental Quality (IDEQ), Oregon Department of Environmental Quality (ODEQ), and Washington Department of Ecology (WDOE) to develop an analysis that will be applied consistently to Idaho, Washington, and Oregon BART-eligible sources. The U.S. Fish and Wildlife Service, National Park Service, U.S. Forest Service, and U.S. EPA Region 10 were consulted during the development of this protocol (EPA 2006a, b, c). This protocol adopts the BART Guideline and addresses both the BART exemption modeling as well as the BART determination modeling. The three agencies are also collaborating on the development of a consistent three-year meteorological data set. Collaboration on the protocol and meteorological data set helps ensure modeling consistency and the sharing of resources and workload.

1.2 Objectives

The protocol describes the modeling methodology that will be used for the following purposes:

- **BART Exemption modeling** – Evaluating whether a BART-eligible source is exempt from BART controls because it is not reasonably anticipated to cause or contribute to impairment of visibility in Class I areas
- **BART Determination modeling** – Quantifying the visibility improvements of BART control options

The objectives of this protocol are to provide the following:

- A streamlined and consistent approach in determining which BART-eligible sources are subject to BART
- A clearly delineated modeling methodology
- A common CALMET/CALPUFF/POSTUTIL/CALPOST modeling configuration

2. Modeling Approach

2.1 Bart-Eligible Source List

BART-eligible source refers to the entire facility that has BART-eligible emission units.

Oregon, Washington, and Idaho are in the process of finalizing lists of BART-eligible sources. Table 1 presents the BART-eligible lists, as of July 21, 2006. Sources may be added/removed as additional information is reviewed.

Table 1. BART-eligible sources.

Washington	Oregon	Idaho
Intalco Aluminum	Amalgamated Sugar	Amalgamated Sugar – Nampa
Conoco-Phillips	PGE Boardman	Amalgamated Sugar – Paul
Centralia Powerplant (TransAlta)	Boise Cascade	Amalgamated Sugar – Twin Falls
Longview Fibre	Fort James	J.R. Simplot Don Siding Plant
Weyerhaeuser – Longview	Pope & Talbot	Potlatch Pulp and Paper
BP Cherry Point	Weyerhaeuser	Monsanto
Tesoro NW	PGE Beaver	NuWest (Agrium)
Lafarge	Georgia Pacific	
Georgia Pacific (Fort James) Camas	Smurfit	
Port Townsend Paper		
Simpson Tacoma Kraft		
Shell (Puget Sound Refining Co)		
Graymont Western		
Alcoa-Wenatchee		
Columbia		

2.2 Class I Areas

The mandatory Class I federal areas in Idaho, Oregon, and Washington, as well as neighboring states that could be impacted by BART-eligible sources, are presented in Appendix A. Figure A-1 graphically presents the BART-eligible source locations with respect to the Class I areas.

All federally mandatory Class I areas within 300 kilometers (km) of a BART-eligible source will be included in the BART exemption modeling analysis. Section 6.1(c) of the Guideline on Air Quality Models states, "It was concluded from these case studies that the CALPUFF dispersion model had performed in a reasonable manner, and had no apparent bias toward over or under prediction, so long as the transport distance was limited to less than 300km" (40 CFR 51, Appendix W). If the 300km extends into a neighboring state, visibility impairment shall also be quantified at those Class I areas. Furthermore, if it lies within the 300km radius, visibility impairment at the Columbia River Gorge Scenic Area will also be quantified for information purposes only.

2.3 *Pollutants to Consider*

The BART Guideline specifies that sulfur dioxide (SO_2), oxides of nitrogen (NO_x) and direct particulate matter (PM) emissions, including both PM_{10} and $PM_{2.5}$ should be included for both the BART exemption and BART determination modeling analyses.

The BART Guideline also discusses the inclusion of volatile organic compound (VOC), ammonia and ammonia compounds as visibility impairing pollutants. These pollutants will be included in the BART analysis if it is determined that they are reasonably anticipated to cause or contribute to visibility impairment. For sources that are selected to evaluate VOC emissions, the first criterion is the emission level. The VOC emissions will be included in the BART exemption analysis if the greater-than-six-carbon VOC gases exceed 250 tons-per-year. If speciation is not known, it will be conservatively assumed that 50% of the gas species within the total VOC emissions from a facility have greater than six carbon atoms. Idaho and Oregon have determined that there are no significant sources of VOC, ammonia, or ammonia compounds which require a full BART exemption analysis.

2.4 *Emissions and Stack Data*

The BART Guideline states, "*the emission estimates used in the models are intended to reflect steady-state operating conditions during periods of high capacity utilization."* These emissions should not generally include start-up, shutdown, or malfunction emissions. The BART Guideline recommends that states use the 24-hour average actual emission rate from the highest emitting day of the meteorological period modeled. The meteorological period is 2003 – 2005.

Depending on the availability of emissions data, the following emissions information (listed in order of priority) should be used with CALPUFF for BART exemption modeling:

- 24-hour average actual emission rate from the highest emitting day within the modeling period (2003 – 2005) (preferred). Actual emissions may be calculated using emission factors specified in Title V permits or representative stack test; or
- Allowable emissions (maximum 24-hour allowable).

States will work with the BART-eligible sources to develop an appropriate emission inventory.

If plant-wide emissions from all BART eligible units for SO_2, NO_x, and PM_{10} are less than the significant emission rate (SER) used for Prevention of Significant Deterioration, emissions of that pollutant will not be included in the BART exemption modeling. However, if plant-wide emissions from all BART eligible units exceed the SERs for these pollutants, then all emissions of that pollutant from individual emission units will be evaluated even if emissions are below the SER for an individual emission unit.

The states have the option of determining how to include small emission units in the BART exemption analysis. Fugitive dust sources at a distance greater than 10km from any Class I area are exempt from the analysis. Emission units with emissions less than the SER will be quantified, if possible, and added to the stack emissions from an emission unit that is already being evaluated. Thus, the emissions from these small units will be included in the total from the plant, but will not have to be modeled separately.

2.5 Natural Background

The natural visibility background is defined as the 20% best days. This definition of natural background is consistent with the intent of the BART Guideline (Federal Register Vol. 70, No. 128, pf 39125). The natural background values for Class I areas used in this protocol are based on EPA's "Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule" (EPA 2003). The natural background for the Columbia River Gorge Scenic Area is based on IMPROVE monitoring data, and was supplied by Scott Copeland of CIRA (Cooperative Institute for Research in the Atmosphere). These background data for Class I areas and the Columbia River Gorge are presented in Appendix B. The option presented in EPA's guidance for refining the default visibility background is not to be used in this protocol.

2.6 Visibility Calculation

The CALPUFF modeling techniques presented in this protocol will provide ground level concentrations of visibility impairing pollutants. The concentration estimates from CALPUFF are used with the current FLAG equation to calculate the extinction coefficient, as shown below.

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

As described in the IWAQM Phase 2 Report, the change in visibility for the BART exemption analysis is compared against background conditions. The delta-deciview, Δdv, value is calculated from the source's contribution to extinction, $b_{ext\ (source)}$, and background extinction, $b_{ext(bkg)}$, as follows:

$$\Delta dv = 10\ ln\ [\ (\ b_{ext(bkg)} + b_{ext\ (source)}\ ) / (\ b_{ext(bkg)}\ )\ ]$$

2.7 Model Execution

2.7.1 BART Exemption Analysis

The BART exemption modeling determines which BART-eligible sources are reasonably anticipated to cause or contribute to visibility impairment at any Class I area. This protocol adopts Option 1 in Section III of the BART Guideline. This option is the Individual Source Attribution Approach. With this approach, each BART-eligible source is modeled separately and the impact on visibility impairment in any Class I area is determined. However, this protocol also allows the state or other authority to include all BART-eligible sources in a single analysis and determine whether or not all sources together are exempt from BART if the total impact on visibility impairment at any Class I area is below the "contribute" threshold.

Sources, or in some cases groups of sources, that exceed the threshold will be considered subject to BART. Sources or groups of sources with modeled impairment below the threshold will be exempt and excused from further analyses.

For determining the visibility threshold, the recommendations in the BART Guideline are followed to assess whether a BART-eligible source is reasonably anticipated to cause or contribute to any visibility impairment in a Class I area. According to the BART Guideline:

"A single source that is responsible for a 1.0 deciview change or more should be considered to "cause" visibility impairment; a source that causes less than a 1.0 deciview change may still contribute to visibility impairment and thus be subject to BART… As a general matter, any threshold that you used for determining whether a source "contributes" to visibility impairment should not be higher than 0.5 deciviews.

In setting a threshold for "contribution," you should consider the number of emissions sources affecting the Class I areas at issue and the magnitude of the individual sources' impacts. In general, a larger number of sources causing impacts in a Class I area may warrant a lower contribution threshold. States remain free to use a threshold lower than 0.5 deciviews if they conclude that the location of a large number of BART-eligible sources within the State and in proximity to a Class I area justify this approach."

As a result, this protocol has determined that if a single source causes a 0.5 deciview or greater change from natural background, then that source is determined to be reasonably anticipated to contribute to any visibility impairment in a Class I area and will be subject to BART. For this single source analysis, the BART exemption modeling will not consider the frequency, magnitude, and duration of impairment.

In addition, as suggested by the BART Guideline, if multiple BART-eligible sources impact a given Class I area on the same day, then a lower, individual, contribution threshold may be considered. For BART-eligible sources in Oregon and Washington, the following steps will be used to address this condition: 1) after all BART-eligible sources have completed their individual BART exemption modeling, the modeled visibility impairment from all sources will be aggregated for each Class I area receptor for each day; 2) if the total for any receptor exceeds 0.5 deciview, all sources responsible for visibility impairment at that receptor for that day will be considered for further evaluation. This evaluation will include an assessment of the magnitude, frequency, duration of impairment, and other factors that affect visibility for each of the sources in the multi-source group. The inclusion of these qualifying factors in the multi-source analysis follows the direction given in the BART Guideline for interpreting the refined modeling results in the determination phase of the BART process and recommendations for sources subject to PSD analyses given in the FLAG Phase I Final Report (FLAG 2000). There is no set individual source visibility threshold for these multi-source assessments. After the multi-source evaluation, a determination will be made as to which sources, if any, from a multi-source group will be considered to have contributed to visibility impairment and be subject to BART.

2.7.2 BART Determination Analysis

The BART Determination analysis determines the degree of visibility improvement for each control option. The BART Guideline states:

"Assess the visibility improvement based on the modeled change in visibility impacts for the pre-control and post-control emission scenarios. You have the flexibility to assess visibility improvement due to BART controls by one or more methods. You may consider the frequency, magnitude, and duration components of impairment."

In order to quantify the degree of visibility improvement due to BART controls, the modeling system is executed in a similar manner as for the BART exemption analysis. Model execution and results are needed for both pre-BART control and post-BART control scenarios to allow for comparison of CALPOST delta-deciview predictions for both scenarios. The only difference between the modeling runs will be modifications to the CALPUFF inputs associated with control devices (emissions, stack parameters). In contrast to the BART exemption analysis that predicts pre-control impacts from all BART-eligible units at a source together, BART determination analyses evaluates each emission unit independently of each other after control options are in place. As explained in the BART Guideline, the states may consider the frequency, magnitude, and duration of impairment for the determination analysis.

2.7.3 Implementing BART Modeling Analysis

Each state will implement the BART analysis separately, as follows:

- Idaho – DEQ will perform both the BART exemption and BART determination modeling, working closely with the facilities and providing the facilities with the modeling analysis if they too want to perform the analysis.

- Oregon – DEQ will perform the BART exemption analysis and the individual BART-subject facilities will perform the BART determination analysis. Oregon DEQ will perform any cumulative analysis required.

- Washington – The Washington BART-eligible sources will conduct the BART exemption modeling and the BART determination analysis. Ecology and EPA will conduct any cumulative analysis required.

3. Visibility Modeling System

In general, the BART exemption modeling using the CALPUFF suite of programs will follow the procedures and recommendations outlined in two documents: the IWAQM (Interagency Workgroup on Air Quality Models) and the FLAG (Federal Land Managers Air Quality Related Values Workgroup) reports (EPA 1998, FLAG 2000). Exceptions to these procedures are explicitly described in the appropriate sections below. Tables listing the modeling parameters for each CALPUFF module are located in the Appendices.

The specific CALPUFF programs and their version numbers that will be used in both the exemption modeling and determination modeling (control evaluation) are presented in Table 2.

The CALMET meteorological domain, as described below, covers the full three-state area. The computational domains, which will be unique for each source or group of sources undergoing modeling, will be a subset of the meteorological domain. As a result, a consistent meteorological data set will be used in all analyses, but the computational domains will be tailored to suit the modeling requirements for each individual source and the Class I areas within a radius of 300km.

Table 2. CALPUFF Modeling System

Program	Version	Level
CALMET	6.211	060414
CALPUFF	6.112	060412
CALPOST	6.131	060410
POSTUTIL	1.52	060412

3.1 CALMET

The dispersion modeling will use CALMET windfields for the three-year period 2003-2005. These windfields cover the three-state area of Washington, Oregon, and Idaho, and also extend into adjacent states sufficiently to encompass all Class I areas within 300km of any BART-eligible facility included in this analysis (Figure 1). As part of the three-state collaboration on a BART protocol, it was decided to support the development of a consistent meteorological data set for use in both the BART exemption and determination analyses. Therefore, the states contracted with a consulting firm, Geomatrix, to provide this set of meteorological data for use in CALPUFF for determining whether a BART-eligible source is reasonably anticipated to cause or contribute to haze in a Federal Class I area.

One of the deliverables of that contract is a final CALMET modeling protocol that provides details on the methodology used to develop the data sets. Therefore, this BART modeling protocol only summarizes the development of the CALMET data set. For additional detail, the reader is referred to the "*Modeling Protocol for BART CALMET Datasets*" in Attachment 1.

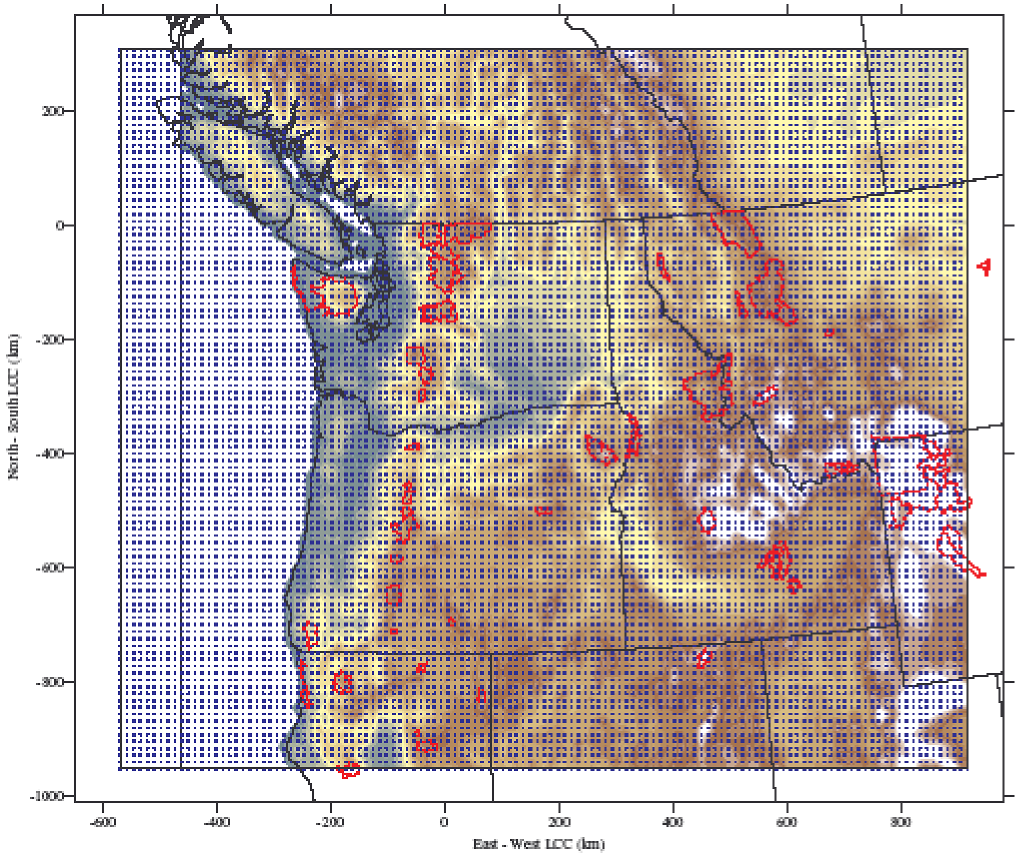

Figure 1. CALMET Meteorological Domain.

3.2 Meteorological Data

3.2.1 Mesoscale Model Data

It was the judgment of Idaho, Oregon, Washington, and EPA Region 10 that the use of three years of MM5 data developed by Western Regional Air Partnership (WRAP) would not adequately capture the meteorology in the Pacific Northwest. WRAP had run MM5 using 36-km and 12-km grids. The states and EPA Region 10 preferred a 4-km grid as it would more adequately capture the meteorology and the influences of complex terrain that characterizes the Region 10 area. Furthermore, WRAP had selected some physics options that are more appropriate for the dry southwest and not the wet northwest.

As a result, the three states contracted a consulting firm (Geomatrix) to process calendar year 2003 to 2005 forecast 12-km MM5 output files archived at the University of Washington (UW). The 12-km MM5 domain includes all of Idaho, Oregon and Washington. Portions of Montana, Wyoming, Utah, Nevada and California are also included in the domain so that BART-eligible sources near these state borders that could impact Class I areas outside of Region 10 are considered in the analysis.

The MM5 data was evaluated for model performance using the statistical evaluation tool METSTAT. CALMET Version 6.211, including a new over-water algorithm, was used to interpolate the 12-km data down to 4-km for the entire domain. The CALMET outputs were also evaluated to determine the model performance of the CALMET wind fields. At this time, METSTAT is unable to evaluate CALMET files. The statistical benchmarks listed in the WRAP Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States (ENVIRON and UCR, 2005) served as a guide for the acceptability of the MM5 data and CALMET output.

CALMET allows the user to adjust the MM5 wind fields in varying degree by the introduction of observational data, including surface, over-water, and upper air data (using the so-called NOOBS parameter). Idaho, Oregon, and Washington have determined that the observed cloud cover should be used, but that observed surface and upper air winds should not be included in CALMET as they locally distort the MM5 wind fields and have no significant effect on long range transport. As a result, the three states have judged that the MM5 simulations more than adequately characterize the regional wind patterns. It should also be noted that CALMET uses the finer scale land use and digital elevation model (DEM) data to interpolate the MM5 winds down to 4km, which improve the wind flow patterns in complex terrain within the modeling domain.

3.2.2 CALMET Control File Settings

These CALMET wind fields will be used by all BART-eligible sources within the three states for both BART exemption and BART determination modeling. The wind fields have been computed by Geomatrix using CALMET Version 6.211. Details of the parameter settings in CALMET are provided in Appendix C; however, the major assumptions are summarized below.

1) The initial-guess fields used the 12-km MM5 outputs, forecast hours 13 – 24 from every 00Z and 12Z initialization, taken from UW archives, for the three years, January 2003 – December, 2005.

2) Both the BART exemption and determination modeling will utilize the wind fields at 4km resolution.

3) The meteorological data was evaluated in two stages using the extensive database of surface observations maintained by UW. First, the MM5 12-km data was evaluated prior to running CALMM5 using the METSTAT software program and secondly, the wind fields generated by CALMET was evaluated using standard statistical evaluation techniques.

4) There are 10 vertical layers with face heights of 0, 20, 40, 65, 120, 200, 400, 700, 1200, 2200, and 4000 meters.

5) CALMET was run using NOOBS = 1. Upper air, precipitation, and relative humidity data were taken from MM5.

6) The surface wind observations were ignored by setting the relative weight of surface winds to essentially zero (R1 = 1.0E-06). The only surface observation data that was effectively used in CALMET is cloud cover. This is essentially a no-observation approach. This method is specified in this protocol because previous modeling in the Pacific Northwest shows that the radius of influence of a typical surface wind observation must be set at a small number because of the presence of local topographic features. As a result, the adjustment to or distortion of wind fields by surface observations is extremely localized, on the order of 10-15km, and has no effect on long range transport to Class I areas.

7) Precipitation data was obtained from MM5, so MM5NPSTA = -1

8) No weighting of surface and upper air observations, and BIAS = 0, and ICALM = 0

9) The terrain scale factor TERRAD = 12

10) Land use and terrain data were developed using the North American 30-arc-second data

3.3 CALPUFF

The CALPUFF modeling will use Version 6.112. This protocol generally follows the recommendation of the IWAQM and FLAG guidance documents. Details of the parameter settings in CALPUFF are provided in Appendix D; however, the major features are summarized below:

1) The three-year CALMET input files will be developed by Geomatrix and be provided as input-ready to CALPUFF.

2) The BART exemption modeling will examine the visibility impairment on Class I areas within 300km of each single source. Where BART-eligible sources are grouped or where their emissions could collectively impair visibility in a Class I area, the exemption modeling will also group these sources in order to examine their cumulative impact. The computational modeling domain will be sufficient to include all Class I areas within a 300km radius of a source or sources.

3) Pasquill-Gifford Dispersion coefficients will be used.

4) MESOPUFF-II chemistry algorithm will be used.

5) Building downwash will be ignored for cases with source-to-receptor distances greater than 50km, as recommended by the Federal Land Managers (FLMs) (US Fish and

Wildlife, National Park Service, and U.S. Forest Service) who were consulted for this protocol.

6) Puff splitting will not be used, following the recommendations of the FLMs.

7) Source elevations that will be entered in CALPUFF will not use actual elevations but will be based on the modeled terrain surface used in CALMET for developing wind fields. The same algorithm in CALMET that determines the elevations of the observational stations will be used to make this calculation. These modified source elevations will be provided to the BART eligible sources.

3.3.1 Emissions

Section 2.4 above presents the emissions and stack data that is required from the facilities. This section only discusses the emissions estimates needed in CALPUFF.

Primary emission, species will include the input species PM, SO_2, SO_4, and NO_x; and the additional modeled species HNO_3 and NO_3. Emissions of H_2SO_4 will be included, if known, and used for estimation of SO_4 emissions. SO_2 emissions will be reviewed to ensure "double-counting" is avoided.

The primary PM species will be treated as follows:

- BART-eligible sources are required to include both filterable and condensable fractions of PM.

  Filterable:
  Elemental Carbon (EC) (<2.5 μm)
  PM Fine (PMF) (<2.5 μm)
  PM Coarse (PMC) (2.5 – 10 μm)
  Condensable:
  Organic Carbon (SOA)
  Inorganic Aerosol (SO_4)
  Non-SO_4 inorganic aerosol

- The condensable fraction will be treated as primary emissions in the CALPUFF input file and assumed to be 100% in the $PM_{2.5}$ fraction (see NPS Web site listed below).

The states will work with the individual BART-eligible sources to develop appropriate PM speciation and size fractions. The following information sources may be used in the development of the speciation and fractions:

- U.S. National Park Service (NPS) – the NPS has developed both PM speciation and size fractions for several source categories. The information is located at http://www2.nature.nps.gov/air/Permits/ect/index.cfm

- U.S. EPA – the EPA has developed generic PM speciation for all source categories located at http://www.epa.gov/ttn/chief/emch/speciation/.

- If size fraction is not known, the following default values, based on information in the CALPUFF User's Guide, CALPUFF GUI, and AP-42 will be used:

Pollutant	Mean diameter	Standard deviation
SO_4, NO_3, PMF, SOA, EC	0.50 microns	1.5
PMC	5.00 microns	1.5

3.3.2 Ozone Background

Due to the number of BART-eligible sources and Class I areas being analyzed, a single value of 60ppb (parts per billion) is used for all months and all three states. This value was determined based on a review of available ozone data for Idaho, Oregon, and Washington.

3.3.3 Ammonia Background

As with the ozone background, a single value of 17ppb is used for the ammonia background. This value is supported by measurements made in 1996 – 1997 at Abbotsford in the Frazier River Valley of British Columbia. This value has also been commonly used as background for Prevention of Significant Deterioration modeling in the Pacific Northwest and will ensure that for BART exemption modeling, conditions are not ammonia limited. It is recognized that ammonia values may be lower in Class I areas; however, the BART analysis must account for transport through ammonia-rich areas.

3.3.4 Receptor Locations

Visibility impacts will be computed at all Class I areas and the Columbia River Gorge Scenic Area if they lie within a 300-km radius of the BART eligible source. The geolocations of the receptor points and their elevations for the Class I areas that will be used in the modeling are available for download from the National Park Service Web site at http://www2.nature.nps.gov/air/Maps/Receptors/index.cfm>.

Receptor points and elevations for the Columbia River Gorge Scenic Area will be provided by Oregon and Washington.

3.4 CALPOST and VISIBILITY POST-PROCESSING

The following assumptions will be used in CALPOST and POSTUTIL to calculate the visibility impairment:

1) For the visibility calculation, Method 6 will be employed. This method uses monthly average relative humidity and f(RH) values for each Class I area as provided in Appendix B, which are based on the EPA Guidance for Regional Haze analysis (EPA 2003).

2) Particulate species for the visibility analysis will include SO_4, NO_3, EC, OC, PMF, and PMC, as reported in the CALPOST output files.

3) POSTUTIL will not be used to speciate modeled PM_{10} concentrations, as PM_{10} will be speciated into its components (PMF, PMC, SOA, EC, SO_4) and entered as primary emissions in CALPUFF. In addition, HNO_3/NO_3 partition option in POSTUTIL will not be used for ammonia limiting.

4) Natural background extinction calculations will use the 20% best days for each Class I area in the three-state region. The natural background for the 20% best days has been refined from that which is in "Guidance for Estimating Natural Visibility Conditions Under the Regional Haze Rule" (EPA 2003). The extinction coefficients for the 20% best days have been calculated following the approach taken in the Draft Montana BART modeling protocol. This procedure uses the haze index (HI) in deciviews at the 10th percentile (median of the 20% best days) and an activity factor that is calculated for each Class I area. Tables providing the monthly f(RH) and 20% best days coefficients are provided in Appendix B, and are based on data from EPA (2003). For the exemption modeling, the Rayleigh scattering value will be 10 Mm-1 for all Class I areas.

   - The 98^{th} percentile value will be calculated for all BART-eligible sources at each mandatory Class I area.

5) The CALPOST "LST" output files will be used to determine the 98^{th} percentile of visibility impairment for each receptor in CLASS I areas.

6) The contribution threshold has the implied level of precision equal to the level of precision reported by CALPOST. Therefore, the 98^{th} percentile value will be reported to three decimal places.

4. Interpretation of Results

The change in visibility impairment for the BART exemption modeling is based on the increase in HI from a BART-eligible source or sources relative to natural background, defined as the 20% best visibility days for each Class I area. This definition of natural background is consistent with the intent of the BART guideline (Federal Register Vol. 70, No. 128, pf 39125).

The U.S. EPA recommends using the 98th percentile value from the distribution of values containing the highest modeled delta-deciview (Δdv) value for each day of the simulation from all modeled receptors at a given Class I area. The 98th percentile Δdv value will be determined in the following ways:

- The 8th highest value for each year modeled
- The 22nd highest value for the 3-year modeling period

Both methods will be used and the highest value of the two will be compared to the contribution threshold ($\Delta dv \geq 0.5$ dv). If there are more than 7 days with values greater than the contribution threshold in any single meteorological year for any Class I area, or more than 21 days in three years, then the source is considered Subject-to-BART.

5. References

40 CFR Part 51, Appendix W. *Guidelines on Air Quality Models*

ENVIRON and UCR 2005. Draft Final Report Annual 2002 MM5 Meteorological Modeling to Support Regional Haze Modeling of the Western United States. Available at http://pah.cert.ucr.edu/aqm/308/reports/mm5/DrftFnl_2002MM5_FinalWRAP_Eval.pdf. ENVIRON International Corporation and University of California Riverside). March, 2005.

EPA (U.S. Environmental Protection Agency) 1998. *Interagency Workgroup on Air Quality Modeling (IWAQM) Phase 2 Summary Report and Recommendations for Modeling Long Range Transport Impacts*, EPA-454/R-98-019, December 1998.

EPA 2003. *Guidance for Estimating Natural Visibility Conditions under the Regional Haze Rule*, EPA-454/B-03-005, September, 2003.

EPA 2006a. Conference call with Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 17, 2006.

EPA 2006b. Conference call with the Fish and Wildlife and U.S. EPA Region 10, National Park Service, and the states of ID, OR and WA. January 18, 2006.

EPA 2006c. Conference call with the Fish and Wildlife and U.S. EPA Region 10, and the states of ID, OR and WA. January 20, 2006.

Federal Land Managers' Air Quality Related Values Workgroup (FLAG) 2000. *Phase I Report*. December 2000.

Federal Register, Vol. 70, No. 128. *Regional Haze Regulations and Guidelines for Best Available Retrofit Technology (BART) Determinations*. pp. 39104 – 30172, July 6, 2005.

Appendix A

Mandatory Class I Federal Areas

and

Columbia River Gorge Scenic Area

Figure A-1

Map of BART-Eligible Sources and Class I Areas

Posted on Idaho DEQ's Regional Haze BART Website

http://www.deq.idaho.gov/air/prog_issues/pollutants/haze_bart.cfm.

Table 1. Federal Mandatory Class I Areas.

Class I Area	Federal Land Manager
Idaho	
Craters of the Moon National Monument	Park Service
Hells Canyon Wilderness	Forest Service
Sawtooth Wilderness	Forest Service
Selway-Bitterroot Wilderness	Forest Service
Yellowstone National Park	Park Service
Oregon	
Crater Lake National Park	Park Service
Diamond Peak Wilderness	Forest Service
Eagle Cap Wilderness	Forest Service
Gearhart Mountain Wilderness	Forest Service
Hells Canyon Wilderness	Forest Service
Kalmiopsis Wilderness	Forest Service
Three Sisters Wilderness	Forest Service
Mount Hood Wilderness	Forest Service
Mount Jefferson Wilderness	Forest Service
Mount Washington Wilderness	Forest Service
Mountain Lakes Wilderness	Forest Service
Strawberry Mountain Wilderness	Forest Service
Washington	
Alpine Lakes Wilderness	Forest Service
Goat Rocks Wilderness	Forest Service
Glacier Peak Wilderness	Forest Service
Mount Adams Wilderness	Forest Service
Mount Ranier National Park	Park Service
North Cascades National Park	Park Service
Olympic National Park	Park Service
Pasayten Wilderness	Forest Service
Neighboring States	
Anaconda-Pintler Wilderness (MT)	Forest Service
Bob Marshall Wilderness (MT)	Forest Service
Cabinet Mountains Wilderness (MT)	Forest Service
Gates of the Mountain Wilderness (MT)	Forest Service
Glacier National Park (MT)	Park Service
Missions Mountain Wilderness (MT)	Forest Service
Scapegoat Wilderness (MT)	Forest Service
Red Rock Lakes Refuge (MT)	Fish & Wildlife Service
Bridger Wilderness (WY)	Forest Service
Fitzpatrick Wilderness (WY)	Forest Service
Grand Teton National Park (WY)	Park Service
North Absaroka Wilderness (WY)	Forest Service
Teton Wilderness (WY)	Forest Service
Washakie Wilderness (WY)	Forest Service
Caribous Wilderness (CA)	Forest Service

Table 1. Federal Mandatory Class I Areas.

Class I Area	Federal Land Manager
Lassen Volcanic National Park (CA)	Park Service
Lava Beds National Monument (CA)	Park Service
Marble Mountain Wilderness (CA)	Forest Service
Redwood National Park (CA)	Park Service
South Warner Wilderness (CA)	Forest Service
Thousand Lakes Wilderness (CA)	Forest Service
Yolla Bolly-Middle Eel Wilderness (CA)	Forest Service
Jarbridge Wilderness (NV)	Forest Service

Hells Canyon is located in Idaho and Oregon.
Yellowstone is located in Idaho, Montana and Wyoming.

Appendix B

Natural Visibility Background

and

Monthly Relative Humidity f(RH)

Adjustment to speciated particulate (Western States) to reflect 20% Best Visibility Days conditions

Monthly f(RH) are from *Appendix A of Draft Guidance for Estimating Natural Visibility Conditions under the RHR (Sept. 2003* **).**

Background extinction coefficients (20% Best Days) have been calculated using Annual Avg bext, Best 20% bext, and activity factors.

		CALPOST Input Group 2 Monthly extinction coefficients for hygroscopic species (RHFAC)												CALPOST Input Group 2 Background extinction coefficients (20% Best Days)					
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	BKSO4	BKNO3	BKPMC	BKOC	SOIL	BKEC
Class I Area	State	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	f(RH)	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3
CaribouWilderness	CA	3.69	3.13	2.83	2.45	2.37	2.17	2.07	2.13	2.20	2.38	3.01	3.41	0.048	0.040	1.20	0.188	0.200	0.008
LassenVolcanic	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.189	0.201	0.008
Lava Beds NP	CA	3.98	3.36	3.07	2.70	2.62	2.43	2.31	2.34	2.42	2.72	3.52	3.81	0.050	0.042	1.26	0.197	0.210	0.008
MarbleMountain	CA	4.44	3.79	3.74	3.33	3.37	3.24	3.18	3.19	3.24	3.37	4.12	4.15	0.052	0.043	1.30	0.204	0.217	0.009
RedwoodNP	CA	4.42	3.91	4.56	3.91	4.50	4.70	4.86	4.72	4.31	3.66	3.81	3.40	0.054	0.045	1.34	0.210	0.224	0.009
SouthWarner	CA	3.62	3.08	2.72	2.35	2.29	2.12	1.90	1.92	1.97	2.30	3.05	3.44	0.048	0.040	1.21	0.190	0.202	0.008
ThousandLakes	CA	3.81	3.19	2.91	2.53	2.42	2.19	2.09	2.14	2.23	2.43	3.13	3.53	0.048	0.040	1.21	0.190	0.202	0.008
Yolla Bolly Middle Eel Wilderr	CA	3.95	3.35	3.14	2.76	2.68	2.47	2.44	2.50	2.56	2.70	3.31	3.62	0.049	0.041	1.24	0.194	0.206	0.008
Craters of the Moon	ID	3.13	2.74	2.28	2.02	2.01	1.81	1.43	1.42	1.57	1.97	2.77	3.04	0.046	0.038	1.15	0.180	0.192	0.008
HellsCanyon	ID	3.70	3.12	2.51	2.17	2.12	2.00	1.63	1.58	1.79	2.41	3.45	3.87	0.048	0.040	1.21	0.190	0.202	0.008
SawtoothWilderness	ID	3.34	2.87	2.32	2.01	2.00	1.84	1.43	1.40	1.50	1.96	2.94	3.31	0.046	0.039	1.16	0.182	0.193	0.008
Selway-BitterrootWilderness	ID	3.50	3.02	2.59	2.34	2.36	2.31	1.93	1.86	2.09	2.55	3.30	3.50	0.048	0.040	1.21	0.190	0.202	0.008
Anaconda-PintlerWilderness	MT	3.32	2.88	2.54	2.35	2.36	2.31	1.96	1.88	2.10	2.52	3.15	3.29	0.048	0.040	1.20	0.188	0.200	0.008
BobMarshall	MT	3.57	3.10	2.77	2.59	2.66	2.70	2.34	2.23	2.58	2.92	3.47	3.54	0.049	0.041	1.22	0.191	0.203	0.008
CabinetMountains	MT	3.81	3.27	2.85	2.61	2.66	2.68	2.30	2.18	2.56	2.98	3.70	3.86	0.050	0.041	1.24	0.195	0.207	0.008
Gates of the Mountain	MT	2.89	2.57	2.42	2.30	2.30	2.27	2.03	1.94	2.12	2.41	2.75	2.81	0.047	0.039	1.18	0.185	0.197	0.008
GlacierNP	MT	4.01	3.47	3.18	3.06	3.24	3.39	2.76	2.60	3.19	3.45	3.82	3.89	0.051	0.043	1.28	0.200	0.213	0.009
MissionMountain	MT	3.60	3.13	2.73	2.52	2.60	2.62	2.27	2.19	2.50	2.87	3.51	3.59	0.049	0.041	1.23	0.193	0.205	0.008
RedRock Lakes	MT	2.73	2.46	2.28	2.12	2.10	1.91	1.67	1.58	1.77	2.07	2.56	2.68	0.046	0.039	1.16	0.181	0.193	0.008
ScapegoatWilderness	MT	3.19	2.81	2.57	2.43	2.45	2.44	2.14	2.04	2.28	2.61	3.08	3.14	0.048	0.040	1.20	0.188	0.200	0.008
Crater Lake NP	OR	4.57	3.92	3.68	3.36	3.22	2.99	2.84	2.87	3.05	3.59	4.57	4.56	0.053	0.044	1.32	0.206	0.219	0.009
DiamondPeak	OR	4.52	3.96	3.64	3.66	3.16	3.12	2.90	2.93	3.05	3.67	4.55	4.57	0.053	0.044	1.33	0.208	0.222	0.009
Eagle Cap	OR	3.77	3.16	2.47	2.10	2.04	1.87	1.61	1.56	1.61	2.25	3.44	3.97	0.049	0.041	1.22	0.191	0.203	0.008
Gearhart Mountain	OR	3.96	3.38	3.06	2.75	2.65	2.48	2.28	2.30	2.38	2.84	3.65	3.84	0.050	0.042	1.25	0.196	0.208	0.008
Kalmiopsis Wilderness	OR	4.54	3.90	3.83	3.45	3.46	3.32	3.20	3.20	3.29	3.56	4.39	4.32	0.053	0.044	1.32	0.206	0.219	0.009
Mount Hood	OR	4.29	3.81	3.46	3.87	2.95	3.15	2.85	3.00	3.10	3.86	4.53	4.55	0.053	0.044	1.33	0.209	0.222	0.009
Mount Jefferson	OR	4.41	3.90	3.56	3.74	3.07	3.11	2.89	2.91	3.03	3.78	4.55	4.54	0.054	0.045	1.34	0.210	0.223	0.009
Mountain Lakes	OR	4.29	3.62	3.32	2.98	2.86	2.64	2.49	2.50	2.64	3.10	4.12	4.26	0.051	0.043	1.28	0.201	0.214	0.009
MountWashington	OR	4.44	3.93	3.58	3.73	3.09	3.11	2.98	2.91	3.02	3.76	4.56	4.56	0.054	0.045	1.36	0.213	0.227	0.009
StrawberryMountain	OR	3.89	3.33	2.75	2.93	2.27	2.39	1.98	1.97	1.87	2.63	3.69	4.07	0.050	0.042	1.26	0.197	0.210	0.008
ThreeSisters	OR	4.47	3.95	3.61	3.72	3.11	3.11	3.00	2.91	3.03	3.79	4.60	4.57	0.054	0.045	1.35	0.212	0.226	0.009
AlpineLakes	WA	4.25	3.79	3.47	3.90	2.93	3.22	2.92	3.12	3.25	3.91	4.47	4.51	0.054	0.045	1.35	0.212	0.225	0.009
GlacierPeak	WA	4.16	3.72	3.42	3.75	2.91	3.16	2.88	3.14	3.33	3.90	4.42	4.43	0.054	0.045	1.34	0.210	0.223	0.009
GoatRocks	WA	4.25	3.75	3.36	4.24	2.83	3.38	3.03	3.19	3.07	3.77	4.42	4.55	0.054	0.045	1.34	0.210	0.224	0.009
Mount Adams	WA	4.29	3.80	3.44	4.40	2.92	3.49	3.12	3.27	3.13	3.86	4.49	4.56	0.053	0.044	1.33	0.209	0.222	0.009
MountRainier	WA	4.42	3.96	3.64	4.65	3.06	3.69	3.30	3.50	3.40	4.11	4.66	4.66	0.055	0.045	1.36	0.214	0.227	0.009
NorthCascades NP	WA	4.10	3.69	3.43	3.74	2.93	3.20	2.93	3.23	3.45	3.93	4.39	4.38	0.053	0.044	1.33	0.209	0.222	0.009
OlympicNP	WA	4.51	4.08	3.82	4.08	3.17	3.46	3.12	3.48	3.71	4.38	4.83	4.75	0.054	0.045	1.36	0.213	0.226	0.009
PasaytenWilderness	WA	4.17	3.72	3.41	3.72	2.89	3.16	2.88	3.15	3.32	3.86	4.42	4.46	0.053	0.044	1.33	0.208	0.222	0.009
BridgerWilderness	WY	2.52	2.35	2.34	2.19	2.10	1.80	1.50	1.49	1.74	2.00	2.44	2.42	0.046	0.038	1.14	0.178	0.190	0.008
FitzpatrickWilderness	WY	2.51	2.33	2.24	2.13	2.09	1.80	1.51	1.46	1.73	1.98	2.39	2.44	0.046	0.038	1.14	0.179	0.190	0.008
Grand Teton NP	WY	2.62	2.39	2.24	2.10	2.06	1.79	1.52	1.47	1.72	2.00	2.43	2.55	0.046	0.038	1.14	0.178	0.190	0.008
NorthAbsaroka	WY	2.43	2.27	2.24	2.17	2.14	1.93	1.69	1.56	1.76	2.04	2.35	2.40	0.046	0.038	1.14	0.178	0.190	0.008
TetonWilderness	WY	2.53	2.35	2.24	2.12	2.10	1.85	1.59	1.51	1.74	2.02	2.40	2.48	0.046	0.038	1.14	0.178	0.190	0.008
WashakieWilderness	WY	2.50	2.34	2.23	2.12	2.11	1.84	1.56	1.49	1.75	2.00	2.38	2.46	0.046	0.038	1.14	0.179	0.190	0.008
YellowstoneNP	WY	2.54	2.36	2.27	2.16	2.15	1.94	1.69	1.59	1.79	2.08	2.45	2.51	0.046	0.038	1.15	0.180	0.192	0.008
JarbridgeWilderness	NV	2.95	2.60	2.08	2.12	2.21	2.17	1.58	1.40	1.35	1.63	2.44	2.80	0.046	0.038	1.14	0.179	0.190	0.008
Columbia River Gorge	OR-WA	5.03	5.03	2.59	2.59	2.59	2.11	2.11	2.11	3.51	3.51	3.51	5.03	0.569	0.231	4.85	1.05	0.217	0.205

Appendix C

CALMET Parameter Values

Appendix C
CALMET Parameter Values

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	Variable	Description	Default Value	Recommended Value
0	DIADAT	Input file: preprocessed surface temperature data (DIAG.DAT)	User Defined	
0	GEODAT	Input file: Geophysical data (GEO.DAT)	User Defined	User Define
0	LCFILES	Convert file name to lower case	User Defined	
0	METDAT	Output file (CALMET.DAT)	User Defined	
0	METLST	Output file (CALMET.LST)	User Defined	
0	MM4DAT	Input file: MM4 data (MM4.DAT)	User Defined	
0	NOWSTA	Input files: Names of NOWSTA overwater stations	User Defined	0
0	NUSTA	Number of upper air data sites	User Defined	0
0	PACDAT	Output file: in Mesopuff II format (PACOUT.DAT)	User Defined	
0	PRCDAT	Input file: Precipitation data (PRECIP.DAT)	User Defined	
0	PRGDAT	Input file: CSUMM prognostic wind data (PROG.DAT)	User Defined	
0	SEADAT	Input files: Names of NOWSTA overwater stations (SEAn.DAT)	User Defined	
0	SRFDAT	Input file: Surface data (SURF.DAT)	User Defined	
0	TSTFRD	Output file (TEST.FRD)	User Defined	
0	TSTKIN	Output file (TEST.KIN)	User Defined	
0	TSTOUT	Output file (TEST.OUT)	User Defined	
0	TSTPRT	Output file (TEST.PRT)	User Defined	
0	TSTSLP	Output file (TEST.SLP)	User Defined	
0	UPDAT	Input files: Names of NUSTA upper air data files (UPn.DAT)	UPn.DAT	
0	WTDAT	Input file: Terrain weighting factors (WT.DAT)	User Defined	
1	CLDDAT	Input file: Cloud data (CLOUD.DAT)	User Defined	Not used
1	IBDY	Beginning day	User Defined	
1	IBHR	Beginning hour	User Defined	
1	IBMO	Beginning month	User Defined	
1	IBTZ	Base time zone	User Defined	8
1	IBYR	Beginning year	User Defined	
1	IRLG	Number of hours to simulate	User Defined	User Define
1	IRTYPE	Output file type to create (must be 1 for CALPUFF)	1	1
1	ITEST	Flag to stop run after Setup Phase	2	2
1	LCALGRD	Are w-components and temperature needed?	T	T
2	DATUM	WGS-G, NWS-27, NWS-84, ESR-S,…		NWS84
2	DGRIDKM	Grid spacing	User Defined	4
2	IUTMZN	UTM Zone	User Defined	User Define
2	LLCONF	When using Lambert Conformal map coordinates - rotate winds from true north to map north?	F	F
2	NX	Number of east-west grid cells	User Defined	373
2	NY	Number of north-south grid cells	User Defined	316
2	NZ	Number of vertical layers	User Defined	10
2	RLAT0	Latitude used if LLCONF = T	User Defined	49.0N
2	RLON0	Longitude used if LLCONF = T	User Defined	121.0W
2	XLAT0	Southwest grid cell latitude	User Defined	User Define
2	XLAT1	Latitude of 1st standard parallel	User Defined	30
2	XLAT2	Latitude of 2nd standard parallel	User Defined	60
2	XORIGKM	Southwest grid cell X coordinate	User Defined	-572
2	YLON0	Southwest grid cell longitude	User Defined	-956
2	YORIGKM	Southwest grid cell Y coordinate	User Defined	User Define
2	ZFACE	Vertical cell face heights (NZ+1 values)	User Defined	0,20,40,65,120,200,400, 700,1200,2200,4000
3	IFORMO	Format of unformatted file (1 for CALPUFF)	1	1
3	LSAVE	Save met. data fields in an unformatted file?	T	T
4	ICLOUD	Is cloud data to be input as gridded fields? (0 = No)	0	0
4	IFORMC	Format of cloud data (2 = formatted)	2	2
4	IFORMP	Format of precipitation data (2 = formatted)	2	2
4	IFORMS	Format of surface data (2 = formatted)	2	2

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	Variable	Description	Default Value	Recommended Value
4	NOOBS	Use or non-use of surface, overwater, upper observations		1
4	NPSTA	Number of stations in PRECIP.DAT	User Defined	-1
4	NSSTA	Number of stations in SURF.DAT file	User Defined	115
5	ALPHA	Empirical factor triggering kinematic effects	0.1	0.1
5	BIAS	Surface/upper-air weighting factors (NZ values)	NZ*0	NZ*0
5	CRITFN	Critical Froude number	1	1
5	DIVLIM	Maximum acceptable divergence	5.00E-06	5.00E-06
5	FEXTR2	Multiplicative scaling factor for extrap surface obs to uppr layrs	NZ*0.0	
5	ICALM	Extrapolate surface calms to upper layers? (0 = No)	0	0
5	IDIOPT1	Compute temperatures from observations (0 = True)	0	0
5	IDIOPT2	Compute domain-average lapse rates? (0 = True)	0	0
5	IDIOPT3	Compute internally inital guess winds? (0 = True)	0	0
5	IDIOPT4	Read surface winds from SURF.DAT? (0 = True)	0	0
5	IDIOPT5	Read aloft winds from UPn.DAT? (0 = True)	0	0
5	IEXTRP	Extrapolate surface winds to upper layers? (-4 = use similarity theory and ignore layer 1 of upper air station data)	-4	-1
5	IFRADJ	Adjust winds using Froude number effects? (1 = Yes)	1	1
5	IKINE	Adjust winds using kinematic effects? (1 = Yes)	0	0
5	IOBR	Use O'Brien procedure for vertical winds? (0 = No)	0	0
5	IPROG	Using prognostic or MM-FDDA data? (0 = No)	0	14
5	ISLOPE	Compute slope flows? (1 = Yes)	1	1
5	ISTEPPG	Timestep (hours) of the prognostic model input data	1	1
5	ISURFT	Surface station to use for surface temperature (between 1 and NSSTA)	User Defined	98
5	IUPT	Station for lapse rates (between 1 and NUSTA)	User Defined	1
5	IUPWND	Upper air station for domain winds (-1 = 1/r**2 interpolation of all stations)	-1	-1
5	IWFCOD	Generate winds by diagnostic wind module? (1 = Yes)	1	1
5	KBAR	Level (1 to NZ) up to which barriers apply	NZ	10
5	LLBREZE	Use Lake Breeze module	F	F
5	LVARY	Use varying radius to develop surface winds?	F	F
5	METBXID	Station IDs in the region	User Defined	
5	NBAR	Number of Barriers to interpolation	User Defined	0
5	NBOX	Number of Lake Breeze regions	User Defined	0
5	NINTR2	Max number of stations for interpolations (NA values)	99	99
5	NITER	Max number of passes in divergence minimization	50	50
5	NLB	Number of stations in region	User Defined	0
5	NSMTH	Number of passes in smoothing (NZ values)	2, 4*(NZ-1)	1,2,2,3,3,4,4,4,4,4
5	R1	Relative weight at surface of Step 1 field and obs	User Defined	1.00E-06
5	R2	Relative weight aloft of Step 1 field and obs	User Defined	1.00E-06
5	RMAX1	Max surface over-land extrapolation radius (km)	User Defined	200
5	RMAX2	Max aloft over-land extrapolation radius (km)	User Defined	200
5	RMAX3	Maximum over-water extrapolation radius (km)	User Defined	200
5	RMIN	Minimum extrapolation radius (km)	0.1	0.1
5	RMIN2	Distance (km) around an upper air site where vertical extrapolation is excluded (Set to -1 if IEXTRP = ±4)	4	-1
5	RPROG	Weighting factor for CSUMM prognostic wind data	User Defined	0
5	TERRAD	Radius of influence of terrain features (km)	User Defined	12
5	XBBAR	X coordinate of Beginning of each barrier	User Defined	0
5	XBCST	X Point defining the coastline (straight line)	User Defined	0
5	XEBAR	X coordinate of Ending of each barrier	User Defined	0
5	XECST	X Point	User Defined	0
5	XG1	X Grid line 1 defining region of interest	User Defined	0
5	XG2	X Grid line 2	User Defined	0
5	YBBAR	Y coordinate of Beginning of each barrier	User Defined	0
5	YBCST	Y Point	User Defined	0
5	YEBAR	Y coordinate of Ending of each barrier	User Defined	0
5	YECST	Y Point	User Defined	0

Recommended CALMET parameters chosen by the Region 10 states for use in BART modeling				
Input Group	**Variable**	**Description**	**Default Value**	**Recommended Value**
5	YG1	Y Grid line 1	User Defined	0
5	YG2	Y Grid Line 2	User Defined	0
5	ZUPT	Depth of domain-average lapse rate (m)	200	200
5	ZUPWND	Bottom and top of layer for 1st guess winds (m)	1, 1000	1.,1000.
6	CONSTB	Neutral mixing height B constant	1.41	1.41
6	CONSTE	Convective mixing height E constant	0.15	0.15
6	CONSTN	Stable mixing height N constant	2400	2400
6	CONSTW	Over-water mixing height W constant	0.16	0.16
6	CUTP	Minimum cut off precip rate (mm/hr)	0.01	0.01
6	DPTMIN	Minimum capping potential temperature lapse rate	0.001	0.001
6	DSHELF	Coastal/shallow water length scale	0	0
6	DZZI	Depth for computing capping lapse rate (m)	200	200
6	FCORIOL	Absolute value of Coriolis parameter	1.00E-04	1.00E-04
6	HAFANG	Half-angle for looking upwind (degrees)	30	30
6	IAVET	Conduct spatial averaging of temperature? (1 = True)	1	1
6	IAVEZI	Spatial averaging of mixing heights? (1 = True)	1	1
6	ICOARE	Overwater surface fluxes method and parameters	10	10
6	ICOOL	COARE cool skin layer computation	0	0
6	ILEVZI	Layer to use in upwind averaging (between 1 and NZ)	1	1
6	ILUOC3D	Land use category ocean in 3D.DAT datasets	16	16
6	IMIXH	Method to compute the convective mixing height	1	1
6	IRAD	Form of temperature interpolation (1 = 1/r)	1	1
6	IRHPROG	3D relative humidity from observations or from prognostic data	0	1
6	ITPROG	3D temps from obs or from prognostic data?	0	2
6	ITWPROG	Option for overwater lapse rates used in convective mixing height growth	0	2
6	IWARM	COARE warm layer computation	0	0
6	JWAT1	Beginning landuse type defining water	999	55
6	JWAT2	Ending landuse type defining water	999	55
6	MNMDAV	Max averaging radius (number of grid cells)	1	1
6	NFLAGP	Method for precipitation interpolation (2 = 1/r**2)	2	2
6	NUMTS	Max number of stations in temperature interpolations	5	10
6	SIGMAP	Precip radius for interpolations (km)	100	12
6	TGDEFA	Default over-water capping lapse rate (K/m)	-0.0045	-0.0045
6	TGDEFB	Default over-water mixed layer lapse rate (K/m)	-0.0098	-0.0098
6	THRESHL	Threshold buoyancy flux required to sustain convective mixing height growth overland	0.05	0.05
6	THRESHW	Threshold buoyancy flux required to sustain convective mixing height growth overwater	0.05	0.05
6	TRADKM	Radius of temperature interpolation (km)	500	500
6	ZIMAX	Maximum over-land mixing height (m)	3000	3000
6	ZIMAXW	Maximum over-water mixing height (m)	3000	3000
6	ZIMIN	Minimum over-land mixing height (m)	50	50
6	ZIMINW	Minimum over-water mixing height (m)	50	50

Appendix D

CALPUFF Parameter Values

Appendix D
CALPUFF Parameter Values

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.

Input Group	Group Description	Sequence	Variable	Description	Default Value[a]	Recommended Value
1	Run Control	1	METRUN	Do we run all periods (1) or a subset (0)?	0	
1		2	IBYR	Beginning year	User Defined	
1		3	IBMO	Beginning month	User Defined	
1		4	IBDY	Beginning day	User Defined	
1		5	IBHR	Beginning hour	User Defined	
1		5	IRLG	Length of run (hours)	User Defined	
1		5	NSECDT	Length of modeling time step (seconds)	3600	3600
1		6	NSPEC	Number of species modeled (for MESOPUFF II chemistry)	5	
1		7	NSE	Number of species emitted	3	
1		8	ITEST	Flag to stop run after Setup Phase	2	
1		9	MRESTART	Restart options (0 = no restart) allows splitting runs into smaller segments	0	
1		10	NRESPD	Number of periods in Restart	0	
1		11	METFM	Format of input meteorology (1 = CALMET, 2 = ISC)	1	
1		12	AVET	Averaging time lateral dispersion parameters (minutes)	60	60
1		13	PGTIME	PG Averaging time	60	60
2	Tech Options	1	MGAUSS	Near-field vertical distribution (1 = Gaussian)	1	1
2		2	MCTADJ	Terrain adjustments to plume path (3 = Plume path)	3	3
2		3	MCTSG	Do we have subgrid hills? (0 = No) allows CTDM-like treatment for subgrid scale hills	0	0
2		4	MSLUG	Near-field puff treatment (0 = No slugs)	0	0
2		5	MTRANS	Model transitional plume rise? (1 = Yes)	1	1
2		6	MTIP	Treat stack tip downwash? (1 = Yes)	1	1
2		7	MBDW	Method to simulate downwash (1=ISC,2=PRIME)		not used
2		8	MSHEAR	Treat vertical wind shear? (0 = No)	0	0
2		9	MSPLIT	Allow puffs to split? (0 = No)	0	0
2		10	MCHEM	MESOPUFF-II Chemistry? (1 = Yes)	1	1
2		11	MAQCHEM	Aqueous phase transformation	0	0
2		12	MWET	Model wet deposition? (1 = Yes)	1	1
2		13	MDRY	Model dry deposition? (1 = Yes)	1	1
2		13	MTILT	Plume Tilt (gravitational settling)	0	0
2		14	MDISP	Method for dispersion coefficients (2=micromet,3 = PG)	3	3
2		15	MTURBVW	Turbulence characterization? (Only if MDISP = 1 or 5)	3	3
2		16	MDISP2	Backup coefficients (Only if MDISP = 1 or 5)	3	3
2		16	MTAULY	Method for Sigma y Lagrangian timescale	0	0
2		16	MTAUADV	Method for Advective-Decay timescale for Turbulence	0	0
2		16	MCTURB	Method to compute sigma v,w using micromet variables	1	1
2		17	MROUGH	Adjust PG for surface roughness? (0 = No)	0	0
2		18	MPARTL	Model partial plume penetration? (0 = No)	1	1
2		19	MTINV	Elevated inversion strength (0 = compute from data)	0	0
2		20	MPDF	Use PDF for convective dispersion? (0 = No)	0	0
2		21	MSGTIBL	Use TIBL module? (0 = No) allows treatment of subgrid scale coastal areas	0	0
2		22	MBCON	Boundary conditions modeled	0	0
2		23	MFOG	Configure for FOG model output	0	0
2		24	MREG	Regulatory default checks? (1 = Yes)	1	1

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
3	Species List	1	CSPECn	Names of species modeled (for MESOPUFF II must be SO2-SO4-NOX-HNO3-NO3)	User Defined	
3		2	Specie Names	Manner species will be modeled	User Defined	
3		3	Specie Groups	Grouping of species if any	User Defined	
3		4	CGRUP			
3		5	CGRUP			
4	MapProjection		XLAT1	Latitude of 1st standard parallel		
4			XLAT2	Latitude of 2nd standard parallel		
4			DATUM			NWS84
4		1	NX	Number of east-west grids of input meteorology	User Defined	
4		2	NY	Number of north-south grids of input meteorology	User Defined	
4		3	NZ	Number of vertical layers of input meteorology	User Defined	
4		4	DGRIDKM	Meteorology grid spacing (km)	User Defined	
4		5	ZFACE	Vertical cell face heights of input meteorology	User Defined	
4		6	XORIGKM	Southwest corner (east-west) of input User	Defined meteorology	
4		7	YORIGIM	Southwest corner (north-south) of input User	Defined meteorology	
4		8	IUTMZN	UTM zone	User Defined	
4		9	XLAT	Latitude of center of meteorology domain	User Defined	
4		10	XLONG	Longitude of center of meteorology domain	User Defined	
4		11	XTZ	Base time zone of input meteorology	User Defined	
4		12	IBCOMP	Southwest X-index of computational domain	User Defined	
4		13	JBCOMP	Southwest Y-index of computational domain	User Defined	
4		14	IECOMP	Northeast X-index of computational domain	User Defined	
4		15	JECOMP	Northeast Y-index of computational domain	User Defined	
4		16	LSAMP	Use gridded receptors? (T = Yes)	F	F
4		17	IBSAMP	Southwest X-index of receptor grid	User Defined	
4		18	JBSAMP	Southwest Y-index of receptor grid	User Defined	
4		19	IESAMP	Northeast X-index of receptor grid	User Defined	
4		20	JESAMP	Northeast Y-index of receptor grid	User Defined	
4		21	MESHDN	Gridded recpetor spacing = DGRIDKM/MESHDN	1	
5	Output Options	1	ICON	Output concentrations? (1 = Yes)	1	1
5		2	IDRY	Output dry deposition flux? (1 = Yes)	1	1
5		3	IWET	Output west deposition flux? (1 = Yes)	1	1
5		4	IT2D	2D Temperature	0	0
5		5	IRHO	2D Density	0	0
5		6	IVIS	Output RH for visibility calculations (1 = Yes)	1	1
5		7	LCOMPRS	Use compression option in output? (T = Yes)	T	T
5		8	ICPRT	Print concentrations? (0 = No)	0	0
5		9	IDPRT	Print dry deposition fluxes (0 = No)	0	0
5		10	IWPRT	Print wet deposition fluxes (0 = No)	0	0
5		11	ICFRQ	Concentration print interval (1 = hourly)	1	24
5		12	IDFRQ	Dry deposition flux print interval (1 = hourly)	1	24
5		13	IWFRQ	West deposition flux print interval (1 = hourly)	1	24
5		14	IPRTU	Print output units (1 = g/m**3; g/m**2/s; 3 = ug/m3, ug/m2/s)	1	3
5		15	IMESG	Status messages to screen? (1 = Yes)	1	2
5		16	LDEBUG	Turn on debug tracking? (F = No)	F	F
5		16	IPFDEB	First puff to track	1	1
5		17	NPFDEB	(Number of puffs to track)	(1)	1
5		18	NN1	(Met. Period to start output)	(1)	1

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
5		19	NN2	(Met. Period to end output)	(10)	10
7	Dry Dep Chem		Dry Gas Dep	Chemical parameters of gaseous deposition species	User Defined	defaults
8	Dry Dep Size		Dry Part. Dep	Chemical parameters of particulate deposition species	User Defined	defaults
9	Dry Dep Misc	1	RCUTR	Reference cuticle resistance (s/cm)	30	30
9		2	RGR	Reference ground resistance (s/cm)	10	10
9		3	REACTR	Reference reactivity	8	8
9		4	NINT	Number of particle-size intervals	9	9
9		5	IVEG	Vegetative state (1 = active and unstressed; 2=active and stressed)	1	1
10	Wet Dep		Wet Dep	Wet deposition parameters	User Defined	defaults
11	Chemistry	1	MOZ	Ozone background? (0 = constant background value; 1 = read from ozone.dat)	0	0
11		2	BCKO3	Ozone default (ppb) (Use only for missing data)	80	60
11		3	BCKNH3	Ammonia background (ppb)	10	17
11		4	RNITE1	Nighttime SO2 loss rate (%/hr)	0.2	0.2
11		5	RNITE2	Nighttime NOx loss rate (%/hr)	2	2
11		6	RNITE3	Nighttime HNO3 loss rate (%/hr)	2	2
11		7	MH2O2	H2O2 data input option	1	1
11		8	BCKH2O2	Monthly H2O2 concentrations	1	12*1
			BKPMF	Fine particulate concentration	12 * 1.00	not used
			OFRAC	Organic fraction of Fine Particulate	2*0.15, 9*0.20, 1*0.15	not used
			VCNX	VOC / NOX ratio	12 * 50.00	not used
12	Dispersion	1	SYTDEP	Horizontal size (m) to switch to time dependence	550	550
12		2	MHFTSZ	Use Heffter for vertical dispersion? (0 = No)	0	0
12		3	JSUP	PG Stability class above mixed layer	5	5
12		4	CONK1	Stable dispersion constant (Eq 2.7-3)	0.01	0.01
12		5	CONK2	Neutral dispersion constant (Eq 2.7-4)	0.1	0.1
12		6	TBD	Transition for downwash algorithms (0.5 = ISC)	0.5	0.5
12		7	IURB1	Beginning urban landuse type	10	10
12		8	IURB2	Ending urban landuse type	19	19
12		9	ILANDUIN	Land use type (20 = Unirrigated agricultural land)	20	20
12		10	ZOIN	Roughness length (m)	0.25	0.25
12		11	XLAIIN	Leaf area index	3.0	3.0
12		12	ELEVIN	Met. Station elevation (m above MSL)	0.0	0.0
12		13	XLATIN	Met. Station North latitude (degrees)	-999.0	-999.0
12		14	XLONIN	Met. Station West longitude (degrees)	-999.0	-999.0
12		15	ANEMHT	Anemometer height of ISC meteorological data (m)	10.0	10.0
12		16	ISIGMAV	Lateral turbulence (Not used with ISC meteorology)	1	1
12		17	IMIXCTDM	Mixing heights (Not used with ISC meteorology)	0	0
12		18	XMXLEN	Maximum slug length in units of DGRIDKM	1.0	1
12		19	XSAMLEN	Maximum puff travel distance per sampling step (units of DGRIDKM)	1.0	1
12		20	MXNEW	Maximum number of puffs per hour	99	99
12		21	MXSAM	Maximum sampling steps per hour	99	99
12		22	NCOUNT	Iterations when computing Transport Wind (Calmet & Profile Winds)	2	2
12		23	SYMIN	Minimum lateral dispersion of new puff (m)	1.0	1
12		24	SZMIN	Minimum vertical dispersion of new puff (m)	1.0	1
12		25	SVMIN	Array of minimum lateral turbulence (m/s)	6 * 0.50	6 * 0.50
12		26	SWMIN	Array of minimum vertical turbulence (m/s)	0.20,0.12,0.08, 0.06,0.03,0.016	

Recommended CALPUFF Parameters chosen by EPA Region 10 states for use in BART modeling.						
Input Group	**Group Description**	**Sequence**	**Variable**	**Description**	**Default Value[a]**	**Recommended Value**
12		27	CDIV (1), (2)	Divergence criterion for dw/dz (1/s)	0.01 (0.0,0.0)	0.0,0.0
12		28	WSCALM	Minimum non-calm wind speed (m/s)	0.5	0.5
12		29	XMAXZI	Maximum mixing height (m)	3000	3000
12		30	XMINZI	Minimum mixing height (m)	50	50
12		31	WSCAT	Upper bounds 1st 5 wind speed classes (m/s)	1.54,3.09,5.14, 8. 23,10.8	1.54,3.09,5.14,8. 23,10.8
12		32	PLX0	Wind speed power-law exponents	0.07,0.07,0.10, 0.15,0.35,0.55	0.07,0.07,0.10,0. 15,0.35,0.55
12		33	PTGO	Potential temperature gradients PG E and F (deg/km)	0.020,0.035	0.020,0.035
12		34	PPC	Plume path coefficients (only if MCTADJ = 3)	0.5,0.5,0.5,0.5, 0.35,0.35	0.5,0.5,0.5,0.5,0. 35,0.35
12		35	SL2PF	Maximum Sy/puff length	10.0	10.0
12		36	NSPLIT	Number of puffs when puffs split	3	3
12		37	IRESPLIT	Hours when puff are eligible to split	User Defined	
12		38	ZISPLIT	Previous hour’s mixing height(minimum)(m)	100.0	100.0
12		39	ROLDMAX	Previous Max mix ht/current mix ht ratio must be less then this value for puff to split	0.25	0.25
12		40	NSPLITH	Number of puffs when puffs split horizontally	5	5
12		41	SYSPLITH	Min sigma-y (grid cell units) of puff before horiz split	1.0	1.0
12	12	42	SHSPLITH	Min puff elongation rate per hr from wind shear before horiz split	2.0	2.0
12		43	CNSPLITH	Min conc g/m3 before puff may split horizontally	1.0E-07	1.0E-07
12		44	EPSSLUG	Convergence criterion for slug sampling integration	1.00E-04	1.00E-04
12		45	EPSAREA	Convergence criterion for area source integration	1.00E-06	1.00E-06
12		46	DSRISE	Step length for rise integration	1.0	1.0
12		47	HTMINBC		500.0	500.0
12		48	RSAMPBC		10.0	10.0
12		49	MDEPBC		1	1
13	Point Source	1	NPT1	Number of point sources	User Defined	
13		2	IPTU	Units of emission rates (1 = g/s)	1	
13		3	NSPT1	Number of point source-species combinations	0	
13		4	NPT2	Number of point sources with fully variable emission rates	0	
13			Point Sources	Point sources characteristics	User Defined	
14	Area Source		Area Sources	Area sources characteristics	User Defined	
15	Volume Source		Volume	Volume sources characteristics	User Defined Sources	
16	Line Source		Line Sources	Buoyant lines source characteristics	User Defined	
17	Receptors		NREC	Number of user defined receptors	User Defined	
17			Receptor Data	Location and elevation (MSL) of receptors	User Defined	

Appendix E

CALPOST Parameter Values

Appendix E
CALPOST Parameter Values

Table F-1. Recommended CALPOST parameter values chosen by the Region 10 states for use in BART modeling

Input Group	Variable	Description	Default Value	Recommended Value
1	ASPEC	Species to process	VISIB	VISIB
1	ILAYER	Layer/deposition code (1 = CALPUFF concentrations; -3 = wet+dry deposition fluxes)	1	1
1	LBACK	Add Hourly Background Concentrations/Fluxes?	F	F
1	MFRH	Particle growth curve for hygroscopic species	2	2
2	RHMAX	Maximum relative humidity (%) used in particle growth curve	98	95
2	LDRING	Report results by Discrete receptor Ring, if Discrete Receptors used. (T = true)	T	
		Modeled species to be included in computing the light extinction		
2	LVSO4	Include SO4?	T	T
2	LVNO3	Include NO3?	T	T
2	LVOC	Include Organic Carbon?	T	T
2	LVPMC	Include Coarse Particles?	T	T
2	LVPMF	Include Fine Particles?	T	T
2	LVEC	Include Elemental Carbon?	T	T
2	LVBK	when ranking for TOP-N, TOP-50, and Exceedance tables Include BACKGROUND?	T	T
2	SPECPMC	Species name used for particulates in MODEL.DAT file: COARSE =	PMC	PMC
2	SPECPMF	Species name used for particulates in MODEL.DAT file: FINE =	PMF	PMF
		Extinction Efficiencies (1/Mm per ug/m**3)		
2	EEPMC	PM COARSE =	0.6	0.6
2	EEPMF	PM FINE =	1.0	1.0
2	EEPMCBK	Background PM COARSE	0.6	0.6
2	EESO4	SO4 =	3.0	3.0
2	EENO3	NO3 =	3.0	3.0
2	EEOC	Organic Carbon =	4.0	4.0
2	EESOIL	Soil =	1.0	1.0
2	EEEC	Elemental Carbon =	10.0	10.0
2	LAVER	Method used for 24-hr avg % change light extinction	F	F
2	MVISBK	Method used for background light extinction (2 = Hourly RH adjustment; 6 = FLAG seasonal f(RH))	2 or 6	6
2	RHFAC	Monthly RH adjustment factors from FLAG (unique for each Class I area)	Yes if 6	EPA
		Background monthly extinction coefficients (FLAG) unique for each Class I area		
2	BKSO4	Assume all hygroscopic species as SO4 (raw extinction value without scattering efficiency adjustment)		*see table*
2	BKNO3			*see table*
2	BKPMC			*see table*
2	BKOC			*see table*
2	BKSOIL	Assume all non-hygroscopic species as Soil		*see table*
2	BKEC			*see table*
2	BEXTRAY	Extinction due to Rayleigh scattering	10.0	10.0
		Averaging time(s) reported		
3	L1PD	Averaging period of model output	F	F
3	L1HR	1-hr averages	F	F
3	L3HR	3-hr averages	F	F
3	L24HR	24-hr averages	T	T
3	LRUNL	Run lengtyh (annual)	F	F
3	LT50	Top 50 table for each averaging time selected	T	F
3	LTOPN			1
3	NTOP			1
3	ITOP			