

**Appendix 9d - Discussions and Data for
ArcelorMittal Burns Harbor, ESSROC - Speed and SABIC CALPUFF Results
using Bondville Ammonia Monitoring Results 2003-2005**

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Concerns with BART eligibility modeling presented to Indiana DEM by sources:

Huffman, 2009.09.11

ArcelorMittal – Burns Harbor

- **The source used the new IMPROVE eqn. for light extinction – while this is generally acceptable the impacts on the modeled light extinction appears to be much greater than would be expected by this change alone. Most of the reduction in days over the thresholds for change in light extinction was accredited to this change.**

IDEM Response: Burns Harbor used the most current regulatory versions of CALPUFF/CALMET/CALPOST versions 5.8, Level 070623. Burns Harbor requested the use of the new IMPROVE equation upon its release. Burns Harbor included a letter, dated October, 2006 from Dr. Ivar Tombach regarding the use of CALPOST outputs with the new IMPROVE equation. Burns Harbor completed their CALPUFF modeling in mid August of 2008. U.S. EPA Region 5 forwarded an email, dated July 28, 2008 from the National Parks Service that states since Dr. Scire had posted a new version of CALPOST, NPS would no longer be recommending Dr. Tombach's new IMPROVE spreadsheet. Burns Harbor submitted their CALPUFF modeling results soon after this email release, in part due to the uncertainty of U.S. EPA approved CALPUFF version to be used for BART modeling. Therefore, IDEM reviewed and accepted the Burns Harbor results.

The "Revised IMPROVE Algorithm for Estimating Light Extinction from Particle Speciation Data"¹ includes studies that were conducted to determine the impact of the new IMPROVE equation on light extinction compared with the old IMPROVE equation and measured values. Class 1 areas with nephelometers were analyzed. There are seven Class 1 areas within the MRPO modeling domain that have nephelometers. Modeled results on the 20% best days showed new IMPROVE equation results for light scattering was slightly lower at most Class 1 areas than the old IMPROVE equation yet would be considered conservative as the modeled results were greater than measured light scattering. A summary of the results are below in Table 1:

Table 1: Mean Light Scattering (BSP) Results for 20% Best Days

Class 1 Area	Measured BSP Value (Mm-1)	Old IMPROVE BSP value (Mm-1)	New IMPROVE BSP value (Mm-1)
Boundary Waters	5.4	7.7	6.6
Dolly Sods	15	20	19
Great Gulf	5.4	8.0	6.8
Great Smokey Mountains	15	20	20
Lye Brook	5.3	8.2	7.0
Mammoth Cave	18	22	19
Shenandoah	11	14	13

Variations in the speciation results were due to slight increases or decreases in ammonia sulfate, ammonia nitrate and organic carbon. The light scattering calculations using the new IMPROVE equation were similar to the old IMPROV

E equation results and still higher than the measured light scattering values. IDEM finds no reason to dispute the results from the new IMPROVE equation and accepts the Burns Harbor CALPUFF modeling results.

- **The source used the average annual values instead of the 20% best days for comparison. This will result in the appearance of less impact on light extinction from the source emissions. This reduction in impact may not be accurate. (“Natural visibility conditions, the 20% best days,...” - LADCO BART modeling protocol).**

IDEM Response: Burns Harbor used 6 kilometer CALPUFF and CALMET grids, thus allowing for use of the less conservative average annual background. U.S. EPA approved the use of 20% best day annual background concentrations for MRPO states when using the MRPO 36 kilometer grid CALMET without meteorological station observational data. The more refined VISTAS 6 kilometer CALMET data used by Burns Harbor included observational data and therefore, use of the average annual background concentrations was warranted per U.S. EPA.

- **The source used background ammonia values of 0.3 ppb in January through March with 0.5 ppb the rest of the year. This does follow LADCO protocol for BART modeling but it appears very low given the source emission may travel over long stretches of agricultural land where ammonia values are likely much higher.**

IDEM Response: As mentioned, information from the LADCO MRPO protocol was used in the modeling. The protocol was approved by U.S. EPA which included the domain seasonal ammonia values, taken from annual 2002 CAMx simulations, which represented the best available information to conduct CALPUFF modeling for the MRPO states.

In response to this comment, IDEM conducted additional CALPUFF runs, using Bondville ammonia data collected from November 2003 through October 2005. This data was not available at the time the LADCO MRPO BART modeling protocol was created and distributed to the LADCO states in early 2006. Below in Table 2 is the comparison of the 2002 seasonal averages with the 2003 to 2005 Bondville average monitored monthly ammonia data.

Table 2 Comparison of Ammonia Concentrations (ppb) for CALPUFF modeling for ArcelorMittal

Data Source	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
CAMx 2002	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bondville 03-05	0.43	0.57	2.16	2.31	1.69	1.45	1.5	1.7	1.58	1.81	2.17	0.57

Comparison of the Burns Harbor CALPUFF modeling results using the MRPO background ammonia concentrations and the 2003 – 2005 Bondville data showed only slight increases in overall light extinction and the delta deciview changes. The largest light extinction change was 1.06% and the delta deciview change was 0.084 dv at Seney. There was an increase in the number of days compared to the BART threshold using the revised ammonia background at Mingo and Seney National Wildlife Refuges, however the results when calculated using the new IMPROVE model did not change. A summary of results can be found in Appendix A. The new IMPROVE equation spreadsheet results for Burns Harbor are included.

- **The source didn't model to Dolly Sods (Q/d~40), Otter Creek, or other “eastern” Class I areas as was done in the IDEM protocol. These Class I areas are not the closest Class I**

areas but they are directly "downwind" (east) of the facilities. For example, Otter Creek (691 km) is closer and downwind of the facility than Isle Royale (700 km) which was modeled as a receptor for the source emissions. This leaves in question the actual impacts of the emissions.

IDEM Response: It was IDEM's understanding that analyzing BART-eligible sources using the Q/d method was a crude screening method that was discouraged by U.S. EPA. IDEM does understand the concern for visibility impacts on eastern Class 1 areas. Burns Harbor modeled the four nearest Class 1 areas of Seney Wilderness, Isle Royale National Park, Mammoth Cave National Park and Mingo Wilderness. IDEM modeled sixteen Class 1 areas and determined the highest visibility impacts from Burns Harbor occurred at Seney, Isle Royale, Mammoth and Mingo Class 1 areas. While Burns Harbor did impact visibility at the eastern Class 1 areas mentioned, the visibility impacts from Burns Harbor on Dolly Sods, James River Face, Linville Gorge and Shenandoah National Park were found to be much less than the impacts at the four nearest Class 1 areas. The highest number of days at the four eastern Class 1 areas modeled above the BART threshold was 4 at Dolly Sods and 3 days at Shenandoah, both occurring in 2003. All other areas were modeled at one day or none.

- **"Burns Harbor's use of a more refined 6-km grid warranted the use of the average natural background concentrations for Class I areas in the eastern United States" (rather than the 20% best days as a natural background). A smaller grid does not necessarily imply more accurate, or precise, data so there is no real justification for opting to utilize a less stringent comparison.**

IDEM Response: Using the average annual natural background concentrations follows U.S. EPA guidance for refined CALPUFF/CALMET grid analysis and has been accepted in previous submittals throughout the country. The 20% best days was a result of MRPO using less refined grids (36 km compared to 12 km, 6 km or 4 km grid resolution and no meteorological observations blended into the CALMET files). IDEM has discouraged sources from conducting CALPUFF modeling for BART purposes using refined grids of less than a 4 kilometer grid resolution.

- **Total natural background extinction coefficients used by Burns Harbor were allocated to soils instead of distributing among sulfates, nitrates, organic and elemental carbon, coarse mass and soil (pages 4-2 through 4-4). – BH says it did not significantly affect results, however, the point of the new IMPROVE equations appears to be that it uses the speciated particulates and they impact visibility (light extinction) differently. It appears that not including the speciated particulates would limit, or hinder, the benefits gained through the use of the new IMPROVE equations.**

IDEM Response: This issue was raised by IDEM in March of 2009 and addressed by Burns Harbor in Attachment 4 in the hardcopy of the IDEM review document submitted for review in May of 2009. Burns Harbor explained that whether allocating the total background as soils or speciated components of ammonia sulfate, ammonia nitrate, organic carbon, elemental carbon and coarse mass, the resulting background extinction values are the same. Resulting modeling showed that the allocation of the total natural background extinction coefficients did not impact the light extinction results.

- **Burn Harbor uses a grid resolution of 6 km rather than the 36 km grid from IDEM but uses the same MM5 databases from the LADCO/MWRPO 36-km CALMET database. i.e. How**

does the use of met data with a 36-km resolution with a 6-km grid improve the modeling? There do not appear to be any actual improvements gained by using a smaller grid. The improvements appear to be limited to the addition of observations in the meteorological data.

- **IDEM Response:** Burns Harbor refined the CALMET data using the latest U.S. EPA approved versions of CALPUFF and CALMET (pg. 3-1 of “Source Specific BART Modeling Report: ArcelorMittal Burns Harbor LLC, August 2008). The modeling domain included the four nearest Class 1 areas and had a 6 km grid resolution. The CALPUFF and CALMET data was processed with the 6 km grid terrain and land use data as well as the hourly observations and Table 3-1 lists the CALMET user-defined field for Meteorology grid spacing (DGRIDKM) at 6 km. Initial wind fields were produced using MM5 data sets at 36 km from CENRAP and MRPO but were processed at 6 km to characterize wind flow for the area.

ESSROC-Speed

- **ESSROC did not model particulate matter (PM10) emissions.**

IDEM Response: At the time of the initial review, IDEM was not requiring PM₁₀ emissions to be modeled. However, IDEM’s review of ESSROC Speed’s modeling included PM₁₀ emissions which ESSROC-Speed provided estimates. IDEM’s CALPUFF results showed NO_x, SO₂ and PM₁₀ emissions did not cause visibility impacts that exceeded the subject to BART threshold in its submittal in October of 2008.

- **ESSROC modeling used 4 KM CALMET data (2001-2003) and 4 km CALPUFF grid from VISTAS but MM5 data is only available in 12 km resolution. This would limit the stated benefit of using a smaller grid size.**

IDEM Response: ESSROC utilized the VISTAS’s 4 km sub-regional Domain 3 meteorological data, as detailed in ESSROC-Speed’s “BART Applicability Analysis, Air Quality Modeling Report” Section 3.2. IDEM’s review used the emissions and stack parameter data modeled by ESSROC and modeled those using IDEM’s original CALPUFF model set-up to make the subject to BART determination. This was done in order to compare visibility results from the U.S. EPA approved MRPO BART modeling protocol for the Midwest states, including Indiana.

- **No cumulative impacts to Class I areas as a whole were analyzed. The source only modeled change in light extinction to Mammoth Cave. There are 11 Class I areas within 600 km of ESSROC and IDEM originally modeled impacts to 16 Class I areas in the eastern United States.**

- **IDEM Response:** ESSROC-Speed requested modeling only the nearest Class 1 area due to limited resources and amount of time to model using a more refined modeling grid domain. IDEM’s review included modeling the sixteen nearby Class 1 areas and determined that the highest deciviews impact from ESSROC-Speed occurred at the Mammoth Cave Class 1 area with no other Class 1 areas beside Mammoth Cave recording delta deciview above the BART threshold. Cumulative impacts to Class 1 areas as a whole were used to determine whether a source was BART-eligible, however to make subject to BART determinations, visibility impacts on each individual Class 1 areas were analyzed.

- **Background ammonia used by ESSROC (0.3 Jan-Mar and 0.5 ppb the rest of the year) is likely too low to represent the land use around the source and the potentially impacted Class I areas.**

IDEM Response: As mentioned, information from the LADCO MRPO protocol was used in the modeling. The protocol was approved by U.S. EPA which included the domain seasonal ammonia values, taken from annual 2002 CAMx simulations.

IDEM has conducted further CALPUFF runs, using Bondville ammonia data collected from November 2003 through October 2005. This data was not available at the time the LADCO MRPO BART modeling protocol was created and distributed to the LADCO states in early 2006. Below in Table 3 is the comparison of the 2002 seasonal averages with the 2003 to 2005 Bondville average monthly data.

Table 3 Comparison of Ammonia Concentrations (ppb) for CALPUFF modeling for ESSROC-Speed

Data Source	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
CAMx 2002	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bondville 03-05	0.43	0.57	2.16	2.31	1.69	1.45	1.5	1.7	1.58	1.81	2.17	0.57

Comparison of the ESSROC-Speed CALPUFF modeling results using the MRPO background ammonia concentrations and the 2003 – 2005 Bondville data showed only slight increases in overall light extinction and the largest deciviews changes. The largest light extinction change was 0.15% and the largest deciviews change was 0.015 dv at Dolly Sods. There was an increase in the number of days above the BART threshold using the revised ammonia background at Mammoth Caves, however this increase was by one day and the total days for the year remained below the BART threshold. A summary of results can be found in Appendix B.

SABIC

- **SABIC modeling used 4 KM CALMET data (2001-2003) and 4 km CALPUFF grid from VISTAS but MM5 data is only available in 12 km resolution. This would limit the stated benefit of using a smaller grid size.**

IDEM Response: SABIC utilized the VISTAS’s 4 km sub-regional Domain 3 meteorological data. IDEM’s review used the emissions and stack parameter data modeled by SABIC and modeled those using IDEM’s original CALPUFF model set-up to make a subject to BART determination. This was done in order to compare visibility results from the U.S. EPA approved MRPO BART modeling protocol for the Midwest states, including Indiana.

- **The source used the average annual values instead of the 20% best days for comparison. This will result in the appearance of less impact on light extinction from the source emissions. This reduction in impact may not be accurate. (“Natural visibility conditions, the 20% best days,...” - LADCO BART modeling protocol).**

IDEM Response: SABIC used 4 kilometer CALPUFF and CALMET grids, thus allowing for use of the less conservative average annual background. U.S. EPA approved the use of 20% best day annual background concentrations for MRPO states when using the MRPO 36 kilometer grid CALMET without meteorological station observational data. The VISTAS’s 4 kilometer CALMET data used by SABIC included observational data and therefore, use of the average annual background concentrations was warranted.

- **SABIC - Chose a modeling domain for refined 4 km modeling and then based the Class I areas to model to base on the domain rather than the other way around. In doing so SABIC left off Hercules Glades Class I Wilderness area and included many Class I receptors further away.**

IDEM Response: SABIC used the pre-determined sub domain grid taken from the VISTAS BART modeling protocol and modeled all Class 1 areas within the sub domain grid. IDEM’s review modeled the sixteen nearby Class 1 areas as were modeled in the initial subject to BART determination modeling. This review showed all nearby Class 1 areas would not be impacted by SABIC above the BART threshold.

- **Background ammonia used by ESSROC (0.3 Jan-Mar and 0.5 ppb the rest of the year) is likely too low to represent the land use around the source and the potentially impacted Class I areas.**

IDEM Response: As mentioned, information from the LADCO MRPO protocol was used in the modeling. The protocol was approved by U.S. EPA which included the domain seasonal ammonia values, taken from annual 2002 CAMx simulations.

IDEM has conducted further CALPUFF runs, using Bondville ammonia data collected from November 2003 through October 2005. This data was not available at the time the LADCO MRPO BART modeling protocol was created and distributed to the LADCO states in early 2006. Below in Table 4 is the comparison of the 2002 seasonal averages with the 2003 to 2005 Bondville average monthly data.

Table 4 Comparison of Ammonia Concentrations (ppb) for CALPUFF modeling for SABIC

Data Source	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
CAMx 2002	0.3	0.3	0.3	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bondville 03-05	0.43	0.57	2.16	2.31	1.69	1.45	1.5	1.7	1.58	1.81	2.17	0.57

Comparison of the SABIC CALPUFF modeling results using the MRPO background ammonia concentrations and the 2003 – 2005 Bondville data showed only slight increases in overall light extinction and the largest deciview changes. The largest light extinction change was 0.17% and the largest deciview change was 0.016 dv at Sipsey Wilderness. There was an increase in the number of days above the BART threshold using the revised ammonia background at Hercules Glades Wilderness, however this increase was by one day and the total days for the year remained below the BART threshold. A summary of results can be found in Appendix C.

- **SABIC utilized the ammonia limiting technique (ALM) which does not appear to be a valid switch in CALPUFF**

IDEM Response: Discussion between IDEM, EPA and Federal Land Managers, held on a conference call on September 16, 2009, brought this issue to light. IDEM understands that if the MNITRATE switch is set to 1, this option does not affect light extinction and delta deciview calculations. Review of the input file shows the MNITRATE switch in the CALPOST input file

was set to 1 and therefore the ALM option was used correctly. SABIC verified this result by email on November 11, 2009.

References:

1

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

**Appendix 9d - ArcelorMittal Burns Harbor CALPUFF Results using Bondville
Ammonia Monitoring Results 2003-2005**

CALPUFF Results for Mittal - Comparing Ammonia background

Class 1 Areas	With MRPO NH3			With Bondville NH3			Difference		
	Extinction Change			Extinction Change			Extinction Change		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Boundary Waters - MN	11.94%	7.55%	10.58%	12.07%	7.64%	11.33%	0.13%	0.09%	0.75%
Brigantine Wild. - NJ	3.38%	5.82%	5.17%	3.45%	6.08%	5.58%	0.07%	0.26%	0.41%
Dolly Sods - WV	7.89%	5.61%	5.31%	8.31%	5.81%	5.51%	0.42%	0.20%	0.20%
Great Gulf Wild - NH	6.08%	4.47%	12.92%	6.24%	4.63%	13.59%	0.16%	0.16%	0.67%
Great Smokey Mount - TN	5.50%	5.44%	4.58%	5.60%	5.56%	4.86%	0.10%	0.12%	0.28%
Hercules - Glades Wild. - MO	10.54%	4.58%	13.77%	10.68%	4.73%	14.24%	0.14%	0.15%	0.47%
Isle Royale - MI	7.22%	13.77%	9.17%	7.32%	14.25%	9.80%	0.10%	0.48%	0.63%
James River Face - VA	2.70%	3.92%	2.73%	2.76%	4.07%	2.89%	0.06%	0.15%	0.16%
Linville Gorge - NC	4.23%	2.37%	2.34%	4.36%	2.41%	2.48%	0.13%	0.04%	0.14%
Lye Brook Wild. - VT	5.49%	5.30%	8.01%	5.67%	5.37%	8.47%	0.18%	0.07%	0.46%
Mammoth Caves - KY	10.55%	5.62%	6.66%	10.77%	5.90%	7.32%	0.22%	0.28%	0.66%
Mingo Wild. - MO	9.14%	7.23%	8.91%	9.35%	7.34%	9.27%	0.21%	0.11%	0.36%
Seney Wild. - MI	14.72%	20.36%	26.29%	15.47%	21.31%	27.35%	0.75%	0.95%	1.06%
Shenandoah N.P. - VA	4.95%	6.16%	4.68%	5.14%	6.25%	4.86%	0.19%	0.09%	0.18%
Sipsey Wild. - AL	4.12%	2.01%	3.12%	4.23%	2.06%	3.31%	0.11%	0.05%	0.19%
Voyageurs N.P. - MN	4.47%	12.21%	9.91%	4.54%	12.37%	10.29%	0.07%	0.16%	0.38%
Class 1 Areas	Largest Delta Deciview			Largest Delta Deciview			Largest Delta Deciview		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
	Boundary Waters - MN	1.128	0.728	1.006	1.14	0.736	1.073	0.012	0.008
Brigantine Wild. - NJ	0.333	0.565	0.504	0.34	0.59	0.543	0.007	0.025	0.039
Dolly Sods - WV	0.759	0.546	0.517	0.798	0.565	0.536	0.039	0.019	0.019
Great Gulf Wild - NH	0.54	0.437	1.215	0.606	0.453	1.275	0.066	0.016	0.06
Great Smokey Mount - TN	0.535	0.53	0.448	0.545	0.541	0.474	0.01	0.011	0.026
Hercules - Glades Wild. - MO	1.002	0.448	1.29	1.015	0.462	1.332	0.013	0.014	0.042
Isle Royale - MI	0.697	1.29	0.877	0.706	1.332	0.935	0.009	0.042	0.058
James River Face - VA	0.267	0.384	0.269	0.273	0.399	0.285	0.006	0.015	0.016
Linville Gorge - NC	0.414	0.234	0.231	0.427	0.238	0.245	0.013	0.004	0.014
Lye Brook Wild. - VT	0.534	0.516	0.771	0.552	0.523	0.813	0.018	0.007	0.042
Mammoth Caves - KY	1.003	0.547	0.645	1.023	0.573	0.707	0.02	0.026	0.062
Mingo Wild. - MO	0.875	0.698	0.854	0.894	0.708	0.886	0.019	0.01	0.032
Seney Wild. - MI	1.373	1.854	2.334	1.439	1.932	2.418	0.066	0.078	0.084
Shenandoah N.P. - VA	0.483	0.597	0.457	0.501	0.606	0.475	0.018	0.009	0.018
Sipsey Wild. - AL	0.404	0.199	0.307	0.414	0.203	0.325	0.01	0.004	0.018
Voyageurs N.P. - MN	0.438	1.152	0.945	0.444	1.167	0.979	0.006	0.015	0.034
Class 1 Areas	Days above 0.5 DV			Days above 0.5 DV			Days above 0.5 DV		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
	Boundary Waters - MN	1	2	4	1	3	4	0	1
Brigantine Wild. - NJ	0	1	1	0	1	1	0	0	0
Dolly Sods - WV	1	3	1	1	4	1	0	1	0
Great Gulf Wild - NH	1	0	2	1	0	2	0	0	0
Great Smokey Mount - TN	2	0	0	2	1	0	0	1	0
Hercules - Glades Wild. - MO	2	0	1	2	0	1	0	0	0
Isle Royale - MI	2	4	4	2	4	4	0	0	0
James River Face - VA	0	0	0	0	0	0	0	0	0
Linville Gorge - NC	0	0	0	0	0	0	0	0	0
Lye Brook Wild. - VT	1	1	4	1	1	4	0	0	0
Mammoth Caves - KY	6	1	4	7	1	4	1	0	0
Mingo Wild. - MO	5	3	2	5	3	4	0	0	2
Seney Wild. - MI	9	17	16	10	17	19	1	0	3
Shenandoah N.P. - VA	1	3	0	1	3	0	0	0	0
Sipsey Wild. - AL	0	0	0	0	0	0	0	0	0
Voyageurs N.P. - MN	0	1	1	0	1	1	0	0	0

**Appendix 9d - ESSROC - Speed CALPUFF Results using Bondville Ammonia
Monitoring Results 2003-2005**

CALPUFF Results for ESSROC - Speed - Comparing Ammonia background

Class 1 Areas	With MRPO NH3			With Bondville NH3			Difference		
	Extinction Change			Extinction Change			Extinction Change		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Boundary Waters - MN	0.14%	0.67%	0.47%	0.14%	0.69%	0.54%	0.00%	0.02%	0.07%
Brigantine Wild. - NJ	1.52%	0.92%	0.59%	1.53%	0.92%	0.60%	0.01%	0.00%	0.01%
Dolly Sods - WV	1.12%	1.11%	1.93%	1.18%	1.26%	2.02%	0.06%	0.15%	0.09%
Great Gulf Wild - NH	0.95%	0.55%	0.73%	0.97%	0.55%	0.73%	0.02%	0.00%	0.00%
Great Smokey Mount - TN	1.35%	2.56%	4.58%	1.45%	2.58%	4.58%	0.10%	0.02%	0.00%
Hercules - Glades Wild. - MO	0.57%	0.49%	0.39%	0.58%	0.49%	0.39%	0.01%	0.00%	0.00%
Isle Royale - MI	0.20%	1.30%	0.79%	0.20%	1.35%	0.90%	0.00%	0.05%	0.11%
James River Face - VA	0.96%	1.51%	1.34%	1.00%	1.52%	1.35%	0.04%	0.01%	0.01%
Linville Gorge - NC	2.50%	1.43%	1.61%	2.51%	1.44%	1.61%	0.01%	0.01%	0.00%
Lye Brook Wild. - VT	1.20%	1.11%	1.61%	1.24%	1.12%	1.62%	0.04%	0.01%	0.01%
Mammoth Caves - KY	6.08%	8.21%	10.36%	6.11%	8.23%	10.50%	0.03%	0.02%	0.14%
Mingo Wild. - MO	4.05%	3.18%	1.87%	4.08%	3.22%	1.87%	0.03%	0.04%	0.00%
Seney Wild. - MI	0.74%	1.45%	0.67%	0.74%	1.47%	0.68%	0.00%	0.02%	0.01%
Shenandoah N.P. - VA	1.45%	1.90%	1.36%	1.46%	1.92%	1.37%	0.01%	0.02%	0.01%
Sipsey Wild. - AL	1.85%	1.44%	3.95%	1.86%	1.45%	3.97%	0.01%	0.01%	0.02%
Voyageurs N.P. - MN	0.11%	0.21%	0.10%	0.11%	0.21%	0.10%	0.00%	0.00%	0.00%
Class 1 Areas	Largest Delta Deciview			Largest Delta Deciview			Largest Delta Deciview		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Boundary Waters - MN	0.014	0.068	0.047	0.014	0.069	0.054	0	0.001	0.007
Brigantine Wild. - NJ	0.151	0.091	0.058	0.152	0.091	0.059	0.001	0	0.001
Dolly Sods - WV	0.111	0.11	0.191	0.117	0.125	0.2	0.006	0.015	0.009
Great Gulf Wild - NH	0.095	0.055	0.073	0.096	0.055	0.073	0.001	0	0
Great Smokey Mount - TN	0.134	0.253	0.447	0.144	0.254	0.448	0.01	0.001	0.001
Hercules - Glades Wild. - MO	0.057	0.049	0.039	0.058	0.049	0.039	0.001	0	0
Isle Royale - MI	0.02	0.129	0.079	0.02	0.134	0.09	0	0.005	0.011
James River Face - VA	0.095	0.15	0.133	0.1	0.151	0.134	0.005	0.001	0.001
Linville Gorge - NC	0.247	0.142	0.16	0.248	0.143	0.16	0.001	0.001	0
Lye Brook Wild. - VT	0.119	0.11	0.16	0.124	0.112	0.161	0.005	0.002	0.001
Mammoth Caves - KY	0.59	0.789	0.985	0.593	0.791	0.999	0.003	0.002	0.014
Mingo Wild. - MO	0.397	0.313	0.183	0.4	0.317	0.185	0.003	0.004	0.002
Seney Wild. - MI	0.073	0.144	0.067	0.074	0.146	0.068	0.001	0.002	0.001
Shenandoah N.P. - VA	0.144	0.189	0.135	0.145	0.19	0.136	0.001	0.001	0.001
Sipsey Wild. - AL	0.183	0.143	0.388	0.184	0.144	0.39	0.001	0.001	0.002
Voyageurs N.P. - MN	0.011	0.021	0.01	0.011	0.021	0.01	0	0	0
Class 1 Areas	Days above 0.5 DV			Days above 0.5 DV			Days above 0.5 DV		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Boundary Waters - MN	0	0	0	0	0	0	0	0	0
Brigantine Wild. - NJ	0	0	0	0	0	0	0	0	0
Dolly Sods - WV	0	0	0	0	0	0	0	0	0
Great Gulf Wild - NH	0	0	0	0	0	0	0	0	0
Great Smokey Mount - TN	0	0	0	0	0	0	0	0	0
Hercules - Glades Wild. - MO	0	0	0	0	0	0	0	0	0
Isle Royale - MI	0	0	0	0	0	0	0	0	0
James River Face - VA	0	0	0	0	0	0	0	0	0
Linville Gorge - NC	0	0	0	0	0	0	0	0	0
Lye Brook Wild. - VT	0	0	0	0	0	0	0	0	0
Mammoth Caves - KY	2	5	3	2	5	4	0	0	1
Mingo Wild. - MO	0	0	0	0	0	0	0	0	0
Seney Wild. - MI	0	0	0	0	0	0	0	0	0
Shenandoah N.P. - VA	0	0	0	0	0	0	0	0	0
Sipsey Wild. - AL	0	0	0	0	0	0	0	0	0
Voyageurs N.P. - MN	0	0	0	0	0	0	0	0	0

**Appendix 9d - SABIC CALPUFF Results using Bondville Ammonia
Monitoring Results 2003-2005**

CALPUFF Results for Sabic - Comparing Ammonia background

Class 1 Areas	With MRPO NH3			With Bondville NH3			Difference		
	Extinction Change			Extinction Change			Extinction Change		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
Boundary Waters - MN	0.35%	1.65%	0.43%	0.35%	1.66%	0.44%	0.00%	0.01%	0.01%
Brigantine Wild. - NJ	1.57%	0.83%	1.17%	1.57%	0.83%	1.18%	0.00%	0.00%	0.01%
Dolly Sods - WV	0.82%	0.95%	1.14%	0.83%	0.95%	1.15%	0.01%	0.00%	0.01%
Great Gulf Wild - NH	1.01%	1.20%	1.22%	1.01%	1.20%	1.22%	0.00%	0.00%	0.00%
Great Smokey Mount - TN	1.07%	1.95%	2.93%	1.07%	1.95%	2.94%	0.00%	0.00%	0.01%
Hercules - Glades Wild. - MO	1.76%	4.67%	6.23%	1.78%	4.67%	6.23%	0.02%	0.00%	0.00%
Isle Royale - MI	1.02%	2.03%	0.89%	1.02%	2.03%	0.90%	0.00%	0.00%	0.01%
James River Face - VA	0.61%	1.49%	2.36%	0.61%	1.49%	2.37%	0.00%	0.00%	0.01%
Linville Gorge - NC	1.05%	1.80%	5.73%	1.06%	1.80%	5.75%	0.01%	0.00%	0.02%
Lye Brook Wild. - VT	1.68%	1.57%	2.54%	1.69%	1.59%	2.54%	0.01%	0.02%	0.00%
Mammoth Caves - KY	6.68%	9.52%	6.67%	6.68%	9.53%	6.69%	0.00%	0.01%	0.02%
Mingo Wild. - MO	11.93%	11.03%	6.26%	11.95%	11.04%	6.31%	0.02%	0.01%	0.05%
Seney Wild. - MI	1.45%	2.28%	1.69%	1.45%	2.28%	1.69%	0.00%	0.00%	0.00%
Shenandoah N.P. - VA	1.24%	1.40%	1.67%	1.24%	1.41%	1.68%	0.00%	0.01%	0.01%
Sipsey Wild. - AL	5.17%	1.73%	3.48%	5.34%	1.73%	3.49%	0.17%	0.00%	0.01%
Voyageurs N.P. - MN	0.16%	0.98%	0.21%	0.16%	0.98%	0.21%	0.00%	0.00%	0.00%
Class 1 Areas	Largest Delta Deciview			Largest Delta Deciview			Largest Delta Deciview		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
	0.035	0.164	0.043	0.035	0.164	0.044	0	0	0.001
Boundary Waters - MN	0.035	0.164	0.043	0.035	0.164	0.044	0	0	0.001
Brigantine Wild. - NJ	0.155	0.082	0.117	0.155	0.083	0.117	0	0.001	0
Dolly Sods - WV	0.082	0.095	0.113	0.082	0.095	0.115	0	0	0.002
Great Gulf Wild - NH	0.101	0.119	0.122	0.101	0.119	0.122	0	0	0
Great Smokey Mount - TN	0.107	0.193	0.289	0.107	0.193	0.29	0	0	0.001
Hercules - Glades Wild. - MO	0.174	0.456	0.604	0.176	0.456	0.605	0.002	0	0.001
Isle Royale - MI	0.102	0.201	0.088	0.102	0.201	0.09	0	0	0.002
James River Face - VA	0.061	0.148	0.233	0.061	0.148	0.234	0	0	0.001
Linville Gorge - NC	0.105	0.179	0.557	0.105	0.179	0.559	0	0	0.002
Lye Brook Wild. - VT	0.166	0.156	0.25	0.167	0.158	0.251	0.001	0.002	0.001
Mammoth Caves - KY	0.647	0.91	0.646	0.647	0.91	0.648	0	0	0.002
Mingo Wild. - MO	1.127	1.046	0.607	1.129	1.047	0.612	0.002	0.001	0.005
Seney Wild. - MI	0.144	0.225	0.168	0.144	0.225	0.168	0	0	0
Shenandoah N.P. - VA	0.123	0.139	0.166	0.124	0.14	0.167	0.001	0.001	0.001
Sipsey Wild. - AL	0.504	0.171	0.343	0.52	0.171	0.343	0.016	0	0
Voyageurs N.P. - MN	0.016	0.097	0.021	0.016	0.097	0.021	0	0	0
Class 1 Areas	Days above 0.5 DV			Days above 0.5 DV			Days above 0.5 DV		
	2002	2003	2004	2002	2003	2004	2002	2003	2004
	0	0	0	0	0	0	0	0	0
Boundary Waters - MN	0	0	0	0	0	0	0	0	0
Brigantine Wild. - NJ	0	0	0	0	0	0	0	0	0
Dolly Sods - WV	0	0	0	0	0	0	0	0	0
Great Gulf Wild - NH	0	0	0	0	0	0	0	0	0
Great Smokey Mount - TN	0	0	0	0	0	0	0	0	0
Hercules - Glades Wild. - MO	0	0	0	0	0	1	0	0	1
Isle Royale - MI	0	0	0	0	0	0	0	0	0
James River Face - VA	0	0	0	0	0	0	0	0	0
Linville Gorge - NC	0	0	1	0	0	1	0	0	0
Lye Brook Wild. - VT	0	0	0	0	0	0	0	0	0
Mammoth Caves - KY	1	6	2	1	6	2	0	0	0
Mingo Wild. - MO	1	2	1	1	2	1	0	0	0
Seney Wild. - MI	0	0	0	0	0	0	0	0	0
Shenandoah N.P. - VA	0	0	0	0	0	0	0	0	0
Sipsey Wild. - AL	1	0	0	1	0	0	0	0	0
Voyageurs N.P. - MN	0	0	0	0	0	0	0	0	0

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