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Air Quality Modeling Technical Support Document: NJ 126 Petition of September 17, 2010 Final Rule

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Air Quality Assessment Division
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I. Introduction

On September 17, 2010, the New Jersey Department of Environmental Protection (NJDEP) submitted to EPA a section 126 petition which asserts that Sulfur Dioxide (SO_2) emissions from the Portland Generating Station (Portland Plant or PGS) in Upper Mount Bethel Township, Northampton County, Pennsylvania significantly contribute to nonattainment and/or interfere with maintenance of the 1-hour SO_2 National Ambient Air Quality Standards (NAAQS)[1] in New Jersey (NJ). The petition included both CALPUFF[2] and AERMOD[3] dispersion modeling for the 1-hour SO_2 NAAQS which shows violations of the NAAQS in New Jersey based on impacts from the Portland Plant. NJDEP specifically petitioned the USEPA to "directly regulate the Portland Plant to abate the significant contribution to nonattainment and interference with New Jersey's maintenance of, the more stringent 1-hour SO2 NAAQS." See page 7, September 17, 2010 petition.

Dispersion modeling results of ambient impacts from Portland submitted by NJDEP show modeled SO2 concentrations from ~7 times higher than the 1-hour SO2 NAAQS based on AERMOD modeling, to ~17 times higher based on CALPUFF modeling. As summarized in Section IV of the final rule preamble, and documented in detail in the air quality modeling TSD for the proposed rule[4] (proposed rule Modeling TSD), the EPA determined that NJDEP had not adequately demonstrated that CALPUFF performs better for this application than AERMOD, and therefore the EPA finding and final remedy for Portland to eliminate significant contribution to nonattainment and interference with maintenance of the 1-hour SO2 NAAQS in New Jersey was based on the AERMOD model. As part of the review of the NJDEP modeling, EPA also concluded that it was necessary to make technical adjustments to the modeling. We therefore conducted an independent modeling analysis based on AERMOD that incorporated appropriate adjustments to the Portland site specific meteorological data to support the determination of an appropriate remedy.

In response to public comments on the proposed rule, the EPA has conducted additional dispersion modeling, based on AERMOD. The EPA AERMOD setup was run for the final rule with slightly revised stack parameters submitted by GenOn. The final rule AERMOD results continue to show violations of the 1-hour SO_2 NAAQS in New Jersey from Portland SO_2 emissions. EPA calculated the emissions limit needed to eliminate SO2 violations in New Jersey and ran AERMOD with the final emissions limits to ensure that no violations were predicted.

[1] USEPA promulgated a new 1-hr SO2 NAAQS on June 3, 2010. The NAAQS was set at 75 ppb (about 196 $\mu g/m^3$). A violation occurs if the 3 year average of the annual 99th percentile of daily maximum 1 hour average values exceeds the level of the NAAQS.

[2] CALPUFF is a non-steady-state puff dispersion model that was originally developed for the California Air Resources Board.

[3] AERMOD stands for the American Meteorological Society/Environmental Protection Agency Regulatory Model.

[4] Docket ID EPA–HQ–OAR–2011–0081-0026

As a result of comments on the proposed rule, EPA also performed numerous AERMOD runs to inform our assessment of the section 126 remedy under reduced load operations at Portland. EPA also investigated the potential contribution from meteorological variability in terms of Portland's interference with maintenance of the 1-hour SO2 NAAQS in New Jersey, the viability of establishing a combined emission limit for Portland units 1 and 2, and assessed model-to-monitor comparisons of ambient SO_2 data from the Columbia, New Jersey monitor. The final rule AERMOD runs including the additional modeling analyses are documented in the following sections and appendices of this final rule Modeling TSD.

Section II of this final rule Modeling TSD summarizes EPA's modeling for purposes of determining an appropriate final remedy for Portland. Section III describes the basis for calculating the final remedy for Portland. Section IV describes the modeling conducted to demonstrate the adequacy of the final remedy at full and reduced operating loads, as well as the viability of a final remedy based on a combined emission limit for units 1 and 2.

Additional modeling analyses and model evaluations are included in Appendices. These include a more detailed analysis of CALPUFF model performance based on inclusion of the PRIME building downwash option in CALPUFF for the Martin's Creek field study evaluation (Appendix A), analysis of model-to-monitor comparisons for the Columbia, New Jersey ambient SO2 monitor which further corroborate the EPA adjustments to the Portland site-specific meteorological data and assessment of CALPUFF model performance (Appendix B), and an analysis of meteorological variability for purposes of assessing the potential for Portland to interfere with maintenance of the 1-hour SO2 NAAQS in New Jersey (Appendix C).

II. EPA Modeling of Portland Plant for 1-Hour SO2 NAAQS for Determination of Remedy

In the proposed rule Modeling TSD we determined that the NJDEP AERMOD modeling was sufficient to make a finding that SO2 emissions from the Portland Plant significantly contribute to nonattainment or interfere with maintenance of the 1-hr SO2 NAAQs in New Jersey. However, we noted some technical concerns with the NJDEP modeling which may affect the degree to which emissions need to be reduced to be able to meet the 1-hour SO_2 NAAQS in New Jersey. Therefore, EPA conducted an independent AERMOD modeling assessment to help determine the necessary and appropriate emissions limit for Portland units 1 and 2.

For the final rule, EPA has made minor updates to the AERMOD modeling used to set the final emissions limits for Portland units 1 and 2. This section describes the final rule independent analyses conducted by EPA to determine an appropriate remedy to mitigate the ambient impacts from the Portland Plant to New Jersey. The data, methods and conclusions from the study are summarized below.

A. Emissions and Source Characteristics

This section documents the emissions and source characteristics used by EPA in the dispersion modeling conducted to determine the final rule remedy in response to the September 17, 2010 petition. The discussion below also addresses the issue of whether other nearby emissions sources and/or whether background concentrations based on representative monitoring data should be included in the modeling analysis.

As explained in the proposed rule preamble, EPA believes it appropriate to model allowable emissions when determining the appropriate remedy to eliminate the source's significant contribution to nonattainment and interference with maintenance. In addition, as a practical matter, it would be difficult to determine an appropriate remedy under a section 126 petition based on actual emissions given the potential variability of actual emissions. Because the question posed is what additional limits must be placed on the source's emissions to eliminate its significant contribution to nonattainment and interference with maintenance, it is appropriate to consider what its emissions could be in the absence of such limits.

<u>Portland Emissions</u>

The dispersion modeling submitted by NJDEP only included emissions from the coal-fired units 1 and 2 at the Portland Plant. There is also an auxiliary boiler which burns oil and 3 small turbines (units 3, 4, and 5) which all burn oil and natural gas, and have very small emissions.

Units 1, 2, and 5 utilize continuous emissions monitoring system (CEMS). In 2010, SO2 emissions combined from units 1 and 2 at the plant were 22,071 tons and emissions from unit 5 were 0.4 tons. The auxiliary boiler, unit 3, and unit 4 SO2 annual emissions reported in the 2008 NEI for the auxiliary boiler, unit 3, and unit 4 were 0.01, 0.02, and 0.03 tons, respectively.

Based on the emissions information summarized above, it is necessary to model emissions from units 1 and 2. Since unit 5 has CEMS data and an easily obtainable allowable emissions rate, EPA also chose to include unit 5 emissions in our modeling analysis. The auxiliary boiler and units 3 and 4 have very small emissions and they also do not have an easily discernable allowable SO2 emissions rate. Therefore, EPA's modeling is based only on allowable emissions from units 1, 2 and 5 at the Portland Plant. Table 1 shows the allowable emissions from units 1 and 2 in lbs/hr (which were derived from a tons per 3 hours permit limit). Table 2 shows the emissions and stack parameters used in EPA's AERMOD modeling[5].

Table 1. Allowable SO2 Emissions for the Portland Plant

Portland Unit	Allowable SO2 Rate	Maximum 3-hr permit limit
1	5,820 lb/hr	8.73 tons per 3 hours
2	8,900 lb/hr	13.35 tons per 3 hours

Table 2. SO2 Emissions and stack parameters used in EPA's AERMOD modeling

Source	**Permitted Emission Rate (g/s)**	**Stack Height (m)**	**Stack Diameter (m)**	**Stack Temperature (K)**	**Stack Velocity (m/s)**
Portland Plant Coal Unit 1	733.3	121.31	3.15	418.1	32.86
Portland Plant Coal Unit 2	1,121.0	121.82	3.84	406.0	34.19
Portland Plant Turbine 5	12.0	42.67	6.1	821.5	36.6

Background SO2 Concentrations

Section 8.2 of Appendix W provides guidance regarding the inclusion of background concentrations in dispersion modeling demonstrations of compliance with the NAAQS under PSD regulations. Appendix W defines "background air quality" as including "pollutant

[5] These stack parameters were updated from the proposed rule based on comments submitted by GenOn, the current owner of Portland.

concentrations due to: (1) Natural sources; (2) nearby sources other than the one(s) currently under consideration; and (3) unidentified sources." See 40 CFR Part 51, App. W Section 8.2.1a. EPA recently issued additional clarification regarding application of Appendix W guidance for the 1-hour NO_2 NAAQS[6], indicating that portions of that guidance are equally applicable to the 1-hour SO_2 NAAQS. Two topics addressed in the March 1, 2011 guidance that are relevant here are the determination of background concentrations and combining modeled results with monitored background concentrations to determine cumulative impacts. While the guidance does not explicitly address dispersion modeling analyses in the context of a section 126 petition, we believe that the guidance provides an appropriate basis for the modeling conducted for the Portland Plant in support of this action.

For the proposed rule modeling, EPA used ambient SO_2 data from the Chester, NJ monitor to derive background concentrations. The monitor is located ~36km southeast of Portland. It is not the closet monitor to the source, but it was found to be most representative of background concentrations in the area. Additionally, the "Columbia monitor" began operation in September 2010, located ~2km to the northeast of Portland (in New Jersey). Since the Columbia monitor has barely one year of data at this time, it was not used to determine background concentrations for the modeling analysis. For the final rule AERMOD modeling, EPA continues to use background concentrations derived from the Chester, New Jersey monitor. The proposed rule Modeling TSD contains details on the analysis of potential background sources to include in the modeling.

Consistent with the March 1, 2011 guidance, we included monitored concentrations based on the 99th-percentile by season and hour-of-day from the Chester data for 2007 through 2009 to account for background concentrations. These background SO_2 concentrations by season and hour-of-day varied from 13 ug/m^3 to 60 ug/m^3. Examination of hourly SO_2 concentrations for both the Chester monitor and the available data from the Columbia monitor indicates very low concentrations (less than 3 ppb) during the majority of the hours. However, we consider the background concentrations used in our analysis (13 ug/m^3 to 60 ug/m^3) to be appropriate for this application given that no other emission sources were explicitly modeled. In addition, as discussed in final rule Preamble, we believe that some degree of conservatism in the monitored background contribution is appropriate for this analysis in order to account for the potential contribution of meteorological variability to Portland's interference with maintenance of the 1-hour SO2 NAAQS in New Jersey given the fact that we have only one year of site-specific meteorological data available for the modeling analysis. The temporally-varying background monitored concentrations incorporated in EPA's modeling analysis are shown in Figure 1.

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[6] "Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 National Ambient Air Quality Standard." Memorandum from Tyler Fox, OAQPS/AQAD, dated March 1, 2011.

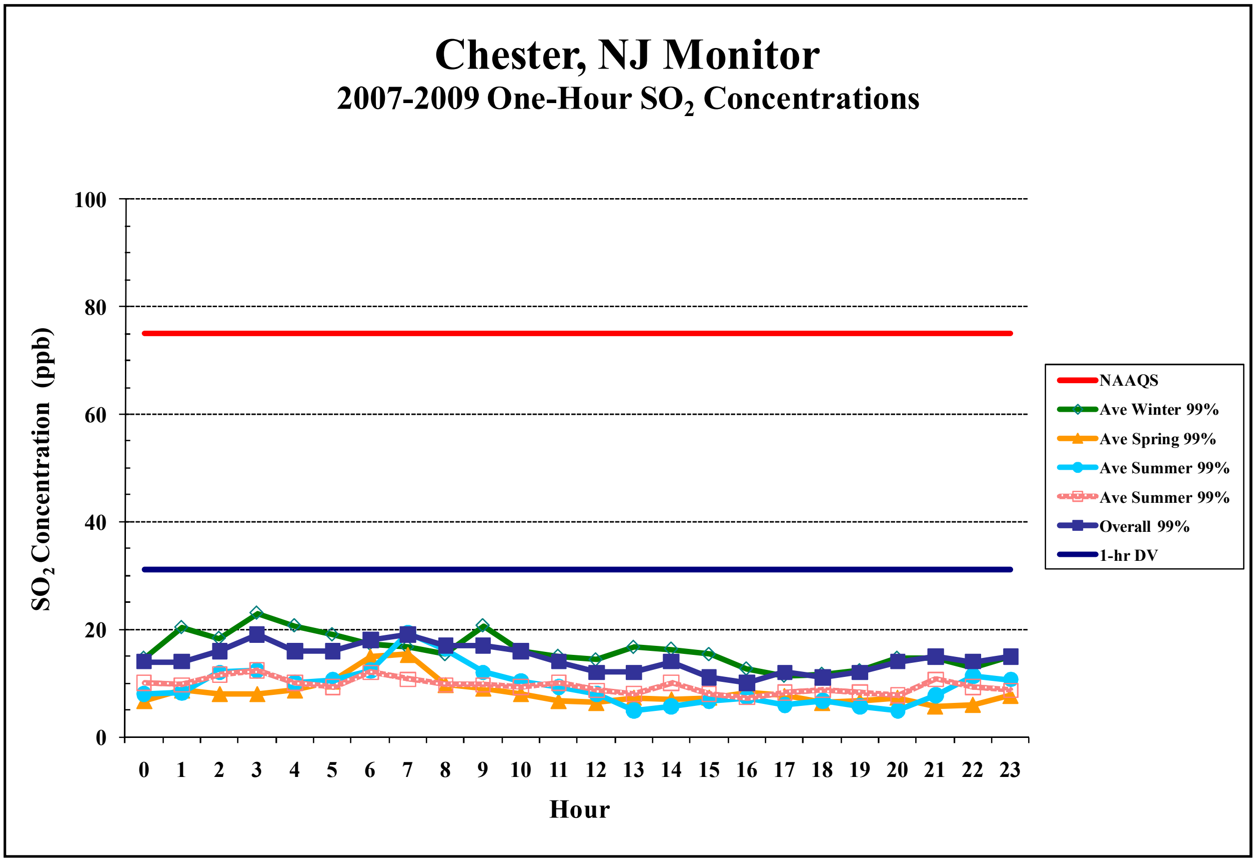

Figure 1. Background SO2 monitored concentrations by season and hour-of-day included in the AERMOD cumulative modeling analysis for the Portland Plant.

B. Meteorological Data

Aside from emissions data, meteorological data is the other key input to dispersion models. The AERMOD modeling was based on one year of site-specific meteorological data collected for from a 100m instrumented tower and SODAR located about 2.2km west of the PGS plant, as shown in Figure 2, for the period July 1993 through June 1994.

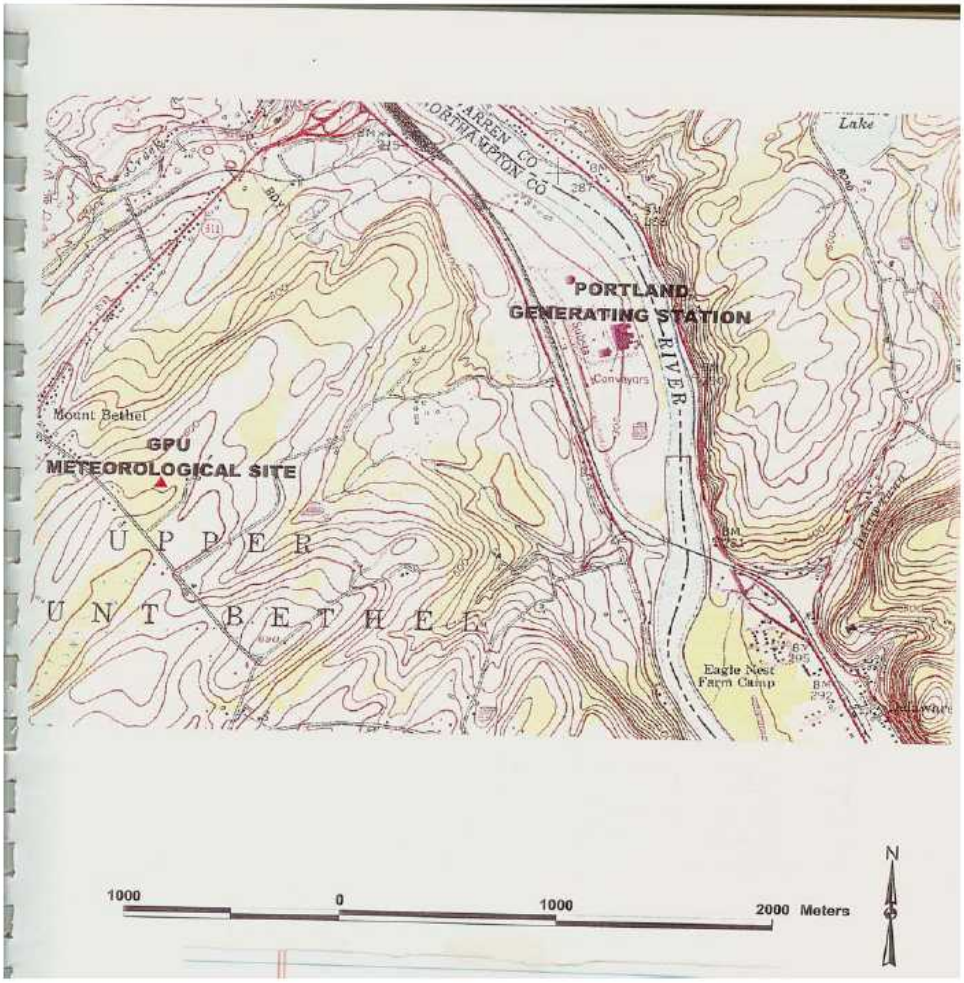

Figure 3.1 Location of the Meteorological Site relative to Portland Power Plant

Figure 2. Location of Portland Meteorological Tower[7]

While EPA accepts the use of site-specific meteorological data collected for the Portland Plant from 1993-94 as generally appropriate for dispersion modeling of emissions from the Portland Plant Units 1 and 2, the 100 meter difference in base elevation between the meteorological tower and stack base raises questions regarding the representativeness of the wind data. In the proposed rule Modeling TSD, EPA concluded that the representativeness of the Portland Plant meteorological data could be improved by some adjustments to the measurement heights from the SODAR data and the inclusion of the sigma-w[8] (σ_w) data collected from the SODAR, which

[7] Figure 2 was taken from Appendix A of Exhibit 11 to NJDEP's May 12, 2010 petition, which was taken from the document: *SO2 NAAQS Compliance Modeling Protocol for GPU's Portland Generating Station*, prepared for GPU Genco, prepared by ENSR Corporation, April 1999.
[8] Sigma-w is a measure of vertical turbulence.

was not included in NJDEP's AERMOD modeling. We continue to use these same adjustments to the meteorological data for the final rule modeling.

C. Receptor and Terrain Data

Proper treatment of terrain information is important for this analysis given the potential influence of elevated and complex terrain on the modeling results. The NJDEP analysis was based on an initial grid of coarsely spaced receptor locations across a large domain covering all potentially important impact area associated with emissions from the Portland Plant, followed by a much smaller grid of more closely spaced receptors focused on the area of expected worst-case impacts from the plant. The initial grid included spacing of 250 meters in areas of expected high impacts with receptors spaced at 1,000 meter intervals covering the gaps between the 250m grids. The initial coarse receptor grid included a total of 5,189 receptors. The subsequent fine grid used by NJDEP in determining the controlling impact from Portland for purposes of this petition included a total of 121 receptors in a 10x10 array spaced at 100m intervals covering a portion of the Kittatinny Ridge on the New Jersey side of the Delaware Water Gap, where the highest impacts from the coarse grid run occurred. The results of EPA's coarse grid modeling with the adjusted meteorological data showed the highest impacts closer to the Portland Plant, about 3km northeast of the plant. Based on these coarse grid results, EPA's fine receptor grids included two 100m grids, one located near the Kittatinny Ridge similar to NJDEP's fine grid, and the other focused on the area around and toward the northeast of the plant to encompass the location of peak impacts from the coarse grid. Figures 2 and 3 depict the location of the initial coarse grid and the final fine grid, respectively.

NJDEP applied the AERMAP terrain processor with sixteen 7.5-minute USGS Digital Elevation Model (DEM) terrain files at 30m horizontal resolution covering most of the modeling domain and four 1-degree DEM files at 90m horizontal resolution covering the remainder of the domain. NJDEP also used the NAD27 horizontal datum for all receptor and source coordinates. Consistent with the proposed rule EPA modeling, EPA processed the terrain data for the NJDEP modeling domain using 1-second NED data (approximately 10m horizontal resolution). The source and receptor coordinates were also converted to the NAD83 horizontal datum. As noted in the proposed rule Modeling TSD, the terrain elevations and hill height scales generated by AERMAP based on the NED data were nearly identical to the corresponding values used in the NJDEP analysis.

D. EPA Remedy Modeling Results

The EPA AERMOD modeling results based on the initial coarse receptor grid described above indicated a maximum 99^{th}-percentile (4^{th}-highest) daily maximum 1-hour SO2 concentration (including monitored background) of 845 $\mu g/m^3$ (about 323 ppb) at a receptor located about 3 kilometers north-northeast of the Portland plant (494500m E; 4531500m N). Results from this initial analysis are shown in Figure 3.

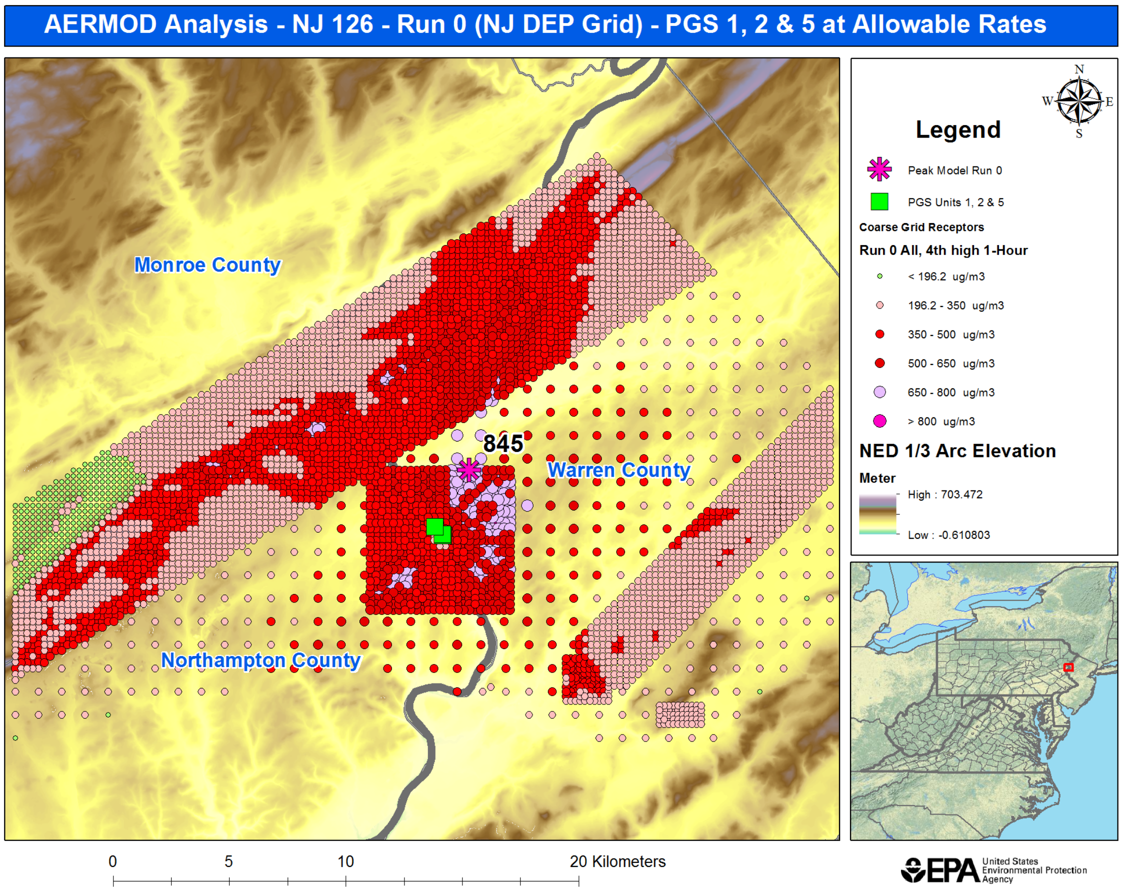

Figure 3. EPA modeling results for initial coarse receptor grid.

Compared to the initial coarse grid analysis conducted by NJDEP, EPA's modeled design value is about 32% lower (compared to 1,236 μg/m^3) and occurs at a different location within the modeling domain. While EPA's modeling showed peak impacts much lower than NJDEP's peak design value, we note that EPA's modeled design value of 845 μg/m^3 is about 90% higher than NJDEP's modeled impact at the controlling receptor from EPA's modeling. These differences are likely due primarily to the adjustments in the processing of meteorological data input to the model. The adjustments to the measurement heights could result in significant differences in the transport direction for particular hours, as well as somewhat lower wind speeds. Both of these factors could shift the modeled impact area away from the higher terrain around the Delaware Water Gap toward a different part of the domain. The inclusion of observed σ_w data from the SODAR in the EPA modeling could also account for this shift in the maximum impact area from Portland. If observed σ_w values are higher than the reference values used in AERMOD in the absence of observations, then modeled impacts near the Delaware Water Gap, which are associated with direct plume impaction on the complex terrain, could be significantly lower. In contrast, larger σ_w values would tend to increase concentrations in the lower terrain toward the northeast by mixing the plume to the ground faster.

Based on the results from the initial coarse grid analysis, EPA developed a finer resolution receptor network which included two separate grids with 100m horizontal resolution, shown in Figure 4.

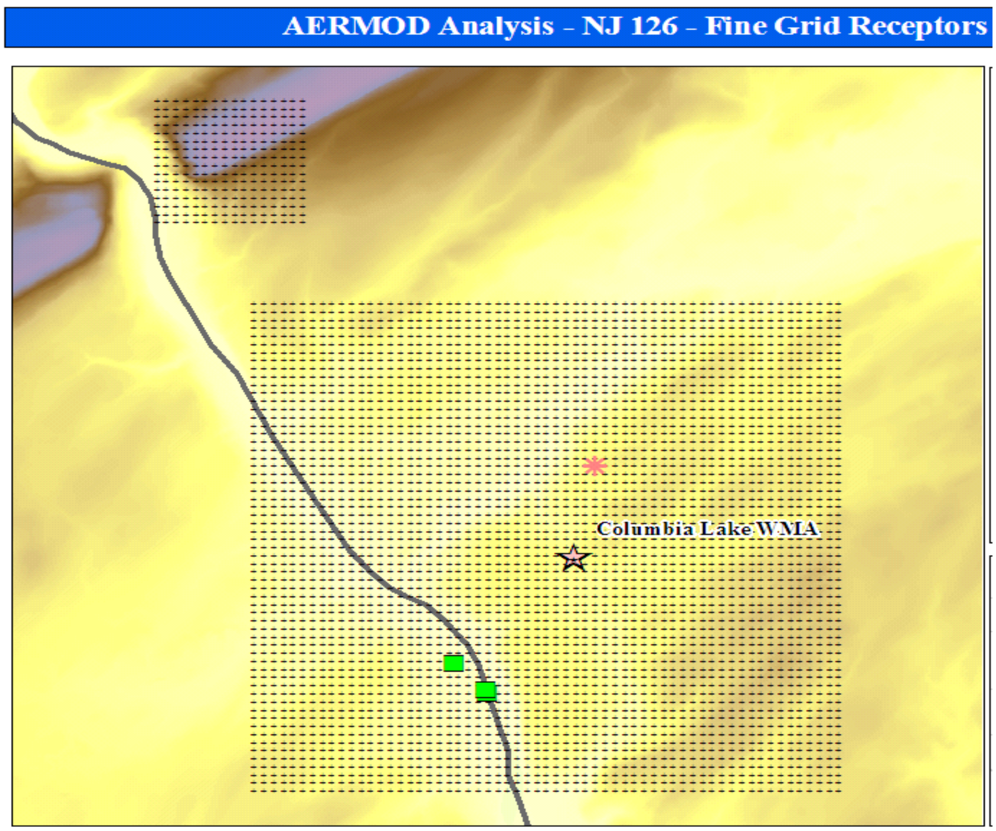

Figure 4. Fine-resolution (100m) receptor grids used in EPA modeling

The smaller of the two fine resolution grids covers the impact area near the Delaware Water Gap to the northwest, and is similar to NJDEP's 100m fine grid, but is extended an additional 500 meters to the north and east. The larger fine resolution grid is focused on the area surrounding the maximum design value from the initial coarse grid, and extends about 5km north, 4 km east, 1km south and 2km west of the Portland plant. The location of the modeled peak from the coarse grid analysis and the recently implemented Columbia Lake monitor are also displayed in Figure 4.

EPA's modeling based on the 100m fine receptor grids resulted in modeled design value (including background) of 860.8 μg/m^3 (about 329 ppb). This result is only slightly higher than and near the location of the controlling coarse grid result. Figure 5 displays the 99th-percentile (4th-highest) 1-hour SO2 concentrations (including background) based on the fine grid analysis.

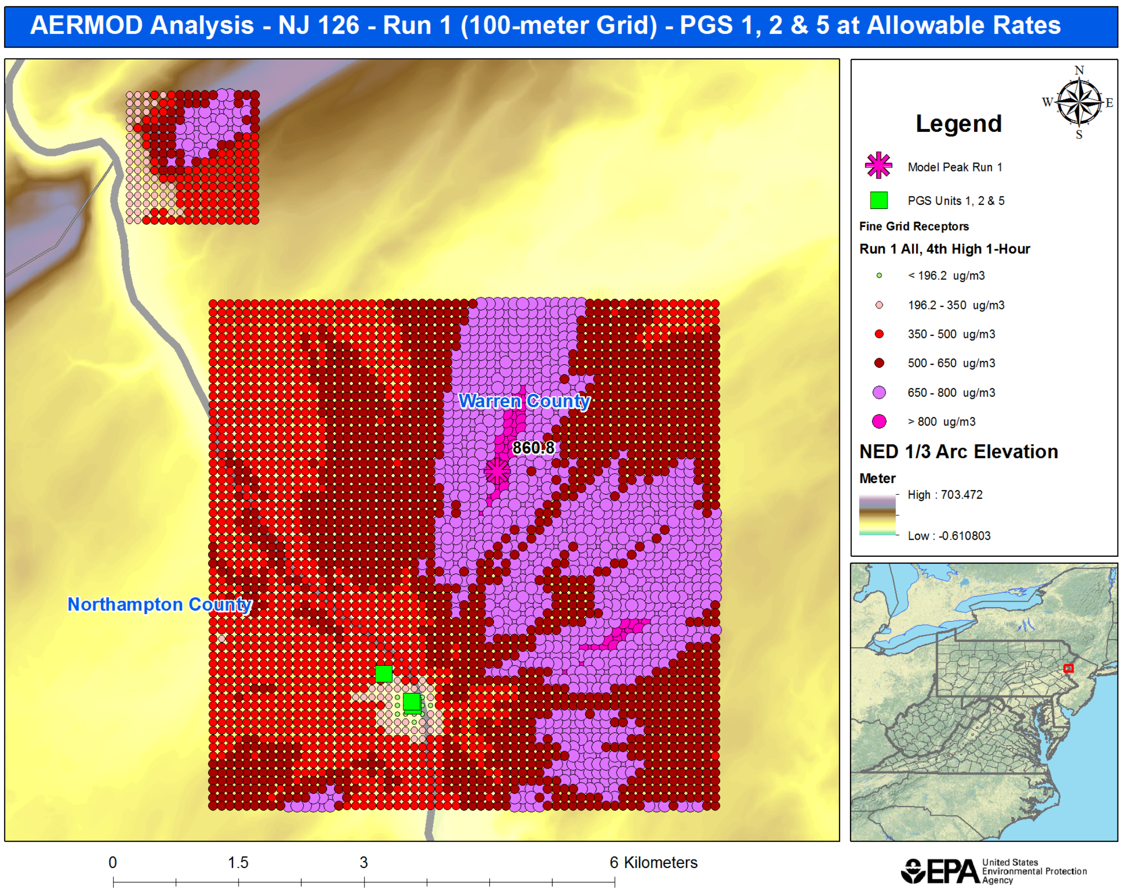

Figure 5. EPA modeling results for fine-resolution (100m) receptor grid

III. Portland Generating Station Emissions Limits

As detailed above (and shown in Figure 5), the modeled maximum 99th percentile (4th-highest) daily maximum 1-hour SO_2 concentration (including monitored background) from the Portland Plant in New Jersey was 860.8 ug/m^3. Table 3 shows the contribution from each of the Portland Plant units to the top 5 design value concentrations at receptors in New Jersey.

Table 3. Contributions from Portland Plant's units 1, 2, and 5 to modeled design value

Unit 1	**Unit 2**	**Unit 5**	**Background**	**Total**
380.4 ug/m^3	466.9 ug/m^3	0.4 ug/m^3	13.1 ug/m^3	860.8 ug/m^3
367.4	447.6	1.1	39.3	855.4
384.0	447.1	2.6	30.0	854.7
379.9	460.5	0.3	13.1	853.7
363.1	443.1	1.3	39.3	846.8

Based on this result, EPA calculated the emissions reduction needed to eliminate the Portland Plant's significant contribution to nonattainment in New Jersey. The calculation is relatively simple in this case because emissions from the Portland Plant alone cause violations of the 1-hour SO_2 NAAQS in New Jersey and background levels of SO_2 are very low. If the modeled concentration from the Portland Plant plus background is reduced to a level that is below the 1-hour SO_2 NAAQS, then there will be no modeled violations of the NAAQS in New Jersey.

The following equation was used to calculate the percent emissions reduction needed to reduce modeled design values below the NAAQS.

((Total modeled concentration) – (NAAQS – background))/(total modeled concentration).

This calculation recognizes that the assumed background concentration cannot be reduced. Since the background concentration can vary by receptor and hour, the highest total modeled design value may not correspond to the impact that is controlling from the standpoint of emissions reductions needed at Portland units 1 and 2. This can be seen when the calculation is applied to the 5 high design value receptors from Table 3. The highest design value receptor has a relatively low background concentration compared to the 2nd highest receptor. The percent reduction from allowable emissions for the 1st high receptor is 78.4%. Due to a higher background concentration, the reduction requirement for the 2nd highest receptor is 80.9%. Applying the same calculation to the next highest receptors shows that the highest emissions reduction remains at 80.9% (which we round to 81%). Therefore, the "controlling receptor" is the 2nd highest receptor[9] with a total concentration of 855.4 ug/m3.

The actual calculation based on Table 5 is ((815.0)-(196.2-40.4[10]))/815.0. Therefore, based on the EPA modeling results, an 81 percent reduction in allowable SO_2 emissions from Portland

[9] The 2nd highest receptor (the controlling receptor) is located 100 m north of the 1st high receptor that is plotted (with an asterisk) on figure 5.

[10] The contribution from unit 5 is only 0.1 percent of the total contribution (1.1 ug/m^3 contribution to the design value). A reduction in the unit 5 contribution would provide a negligible reduction to the modeled

Plant units 1 and 2 is needed to reduce the Portland Plant contribution plus background to below the NAAQS. Therefore we are finalizing an emissions limit based on an 81 percent reduction in allowable emissions at both units 1 and 2. This leads to a final SO_2 emissions limit for unit 1 of 1,105 lbs/hr (5820*0.19) and a final SO_2 emissions limit for unit 2 of 1,691 lbs/hr (8900*0.19).

IV. Demonstration of Adequacy of Remedy at Full and Reduced Operating Loads

Full Operating Load Modeling Analysis

As a final check on the emission limit calculations, EPA ran AERMOD again with the above final remedy emission limits on the Portland Plant's units 1 and 2 (including monitored background plus current allowable emissions from unit 5). At these final emission levels at full load, all receptors in New Jersey were below the 1-hour SO_2 NAAQS. The modeled 99th percentile (4th-highest) daily maximum 1-hour SO_2 concentration was 193.7 ug/m^3, about 2.5 ug/m3 below the NAAQS. Figure 6 shows the results of the 81% remedy run, indicating that the maximum impact after implementation of the final remedy is shifted to a more easterly trajectory from Portland and slightly closer to Portland than the peak impact based on current allowable emissions.

design value. Therefore, it can be assumed that unit 5 emissions do not need to be reduced and should be added to the irreducible background value.

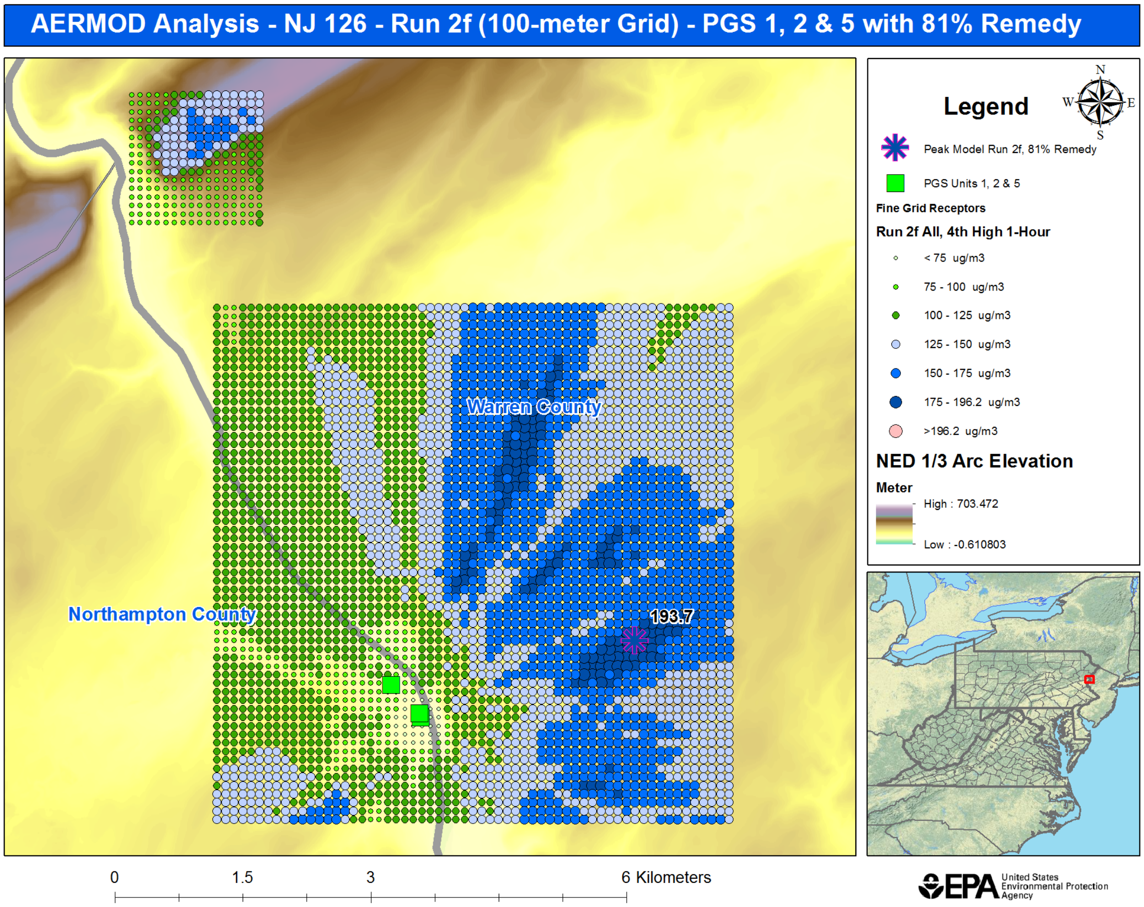

Figure 6. EPA modeling results for the fine resolution (100m) receptor grid with an 81% reduction in allowable emissions at Portland units 1 and 2

<u>Reduced Operating Load Modeling Analysis</u>

Although the level of the final remedy, based on an 81% reduction from allowable emissions for units 1 and 2, has not changed from the proposed remedy, several additional modeling analyses were performed to examine the adequacy of the final remedy at reduced operating loads. In the proposed rule, the EPA did not take into account the effect of operating load on stack parameters. However, the exit velocity is reduced when the plant is operating below full load. Based on information submitted by GenOn as part of its comments (docket ID EPA-HQ-OAR-2011-0081-0127), the exit velocity could be reduced by as much as 50 percent when operating at or below 50 percent operating load (defined as percent of maximum heat input for each unit). To account for potential reduced plume rise and dispersion due to reduced load or control devices, we simulated the proposed remedy emissions rate for units 1 and 2 (1,105 lb/hr unit 1 limit and 1,691 lb/hr unit 2 limit) at reduced loads of 75 percent, 50 percent, and 25 percent. The exit velocity for the reduced load runs was reduced based on information submitted by GenOn. The reduced exit velocity led to reduced plume rise and dispersion and higher downwind maximum concentration impacts.

The maximum concentrations at 100 percent operating load is 193.7 ug/m3 as shown in Figure 6 above. The maximum concentration at 75 percent, 50 percent, and 25 percent load were 227.3 ug/m^3, 264.3 ug/m^3, and 300.3 ug/m^3 respectively (as shown in table 4 below). These impacts all exceed the 1-hour SO_2 NAAQS.

Table 4. Design value concentrations with emissions at the final lbs/hr limit at 100% operating load, 75% load, 50% load, and 25% load

Unit 1 Emissions Rate (lbs/hr)	**Unit 2 Emissions Rate (lbs/hr)**	**4th High Concentration at 100% Load**	**4th High Concentration at 75% Load**	**4th High Concentration at 50% Load**	**4th High Concentration at 25% Load**
1,106	1,691	193.7 ug/m3	227.3 ug/m3	264.3 ug/m3	300.3 ug/m3

Based on this information the form of the final remedy also includes emission limits in terms of pounds per million British thermal units (lb/mmBtu), based on a 30 boiler operating day rolling average, in order to ensure that the final remedy is protective of the NAAQS at reduced operating loads. The final remedy lb/mmBtu limit is set at 0.67 lb/mmBtu, which is equivalent to the final remedy lb/hr limits at full load. The lb/mmBtu limit will become the controlling limit at reduced loads, effectively imposing more stringent load-dependent lb/hr limits under those conditions. This revision to the final remedy was necessary in order to account for the fact that plume rise is reduced under reduced load, resulting in higher ambient impacts under reduced load as compared to full load for a specific lb/hr emission rate.

Additional modeling results are summarized in Table 5 showing predicted ambient SO_2 impacts in New Jersey at full and reduced operating loads, accounting for the corresponding reductions in lb/hr emissions based on the final remedy lb/mmBtu limit. The modeled design value concentrations at the reduced loads (with a 0.67 lb/mmBtu limit) are all less than the 1-hour SO2 NAAQS. These additional results confirm that the additional component of the final remedy based on a lb/mmBtu limit ensures that emissions from Portland will comply with the NAAQS under all load conditions.

Table 5. Design value concentrations with a 0.67 lbs/mmBtu emissions limit at 100% operating load, 75% load, 50% load, and 25% load

Scenario	4th High Concentration at 100% Load	4th High Concentration at 75% Load	4th High Concentration at 50% Load	4th High Concentration at 25% Load
Final emissions limit without lb/mmBtu limit[11]	193.7	227.3	264.3	300.3
Final emissions limit with 0.67 lb/mmBtu limit[12]	193.7	178.8	146.0	93.7

Combined Emissions Limit Modeling Analysis

In comments, GenOn had requested a combined limit for units 1 and 2. EPA performed an AERMOD analysis which emitted the total emissions limit of 2,796 lbs/hr (1,105 + 1,691 lbs/hr) through either unit 1 or unit 2. We found that the total emissions emitted through unit 2 were protective of the NAAQS, but due to slightly different stack parameters, the total emissions emitted through unit 1 were not protective of the NAAQS. Table 6 shows that the design value concentration would be 225.2 ug/m3 if all of the emissions (2,796 lbs/hr) were emitted through unit 1 (at 100% operating load[13]). Therefore, we continue to require individual emissions limits at both units 1 and 2.

Table 6. Design value concentrations with all of the combined unit 1 and 2 emissions emitted through a single unit.

Unit 1 Emissions Rate (lbs/hr)	Unit 2 Emissions Rate (lbs/hr)	4th High Concentration at 100% Load
2,796	-	225.2
-	2,796	189.1

[11] The AERMOD modeling runs without a 0.67 lb/mmBtu limit used the full load lb/hr emissions limits. The reduced load scenarios also included proportionally lower exit velocities.
[12] The AERMOD modeling runs with a 0.67 lb/mmBtu limit used the lb/hr emissions limits that were scaled by 25%, 50%, and 75% respectively to represent emissions rates at 75%, 50%, and 25% operating loads. The reduced load scenarios also included proportionally lower exit velocities.
[13] The modeled concentrations would be even higher (and also not protective of the NAAQS) at reduced operating loads).

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Appendix A.

Analysis of CALPUFF Model Performance Based on Inclusion of PRIME Downwash Option for Martin's Creek

As part of our reassessment of the NJDEP CALPUFF validation results following the methodology recommended in the Cox-Tikvart protocol (EPA, 1992) for determining the best performing model, we also evaluated CALPUFF model performance based on the use of the PRIME downwash option. Figure 1 shows the MCM values for Martin's Creek based on inclusion of the PRIME downwash option within CALPUFF, and based on inclusion of the AMS8 monitor, with NJDEP's meteorological categories, for values of N=26, 15, and 8 in calculating RHCs. With PRIME downwash included in CALPUFF, the MCM values show larger differences in performance between the two models, as compared to results presented in Figure 1 without the use of PRIME in CALPUFF. AERMOD performs "better" than CALPUFF for all three values of N, but the confidence intervals are also larger than the results presented in Figure 1 and the differences in model performance are still not statistically significant at the 90% confidence level. To further illustrate the effect of the PRIME option on CALPUFF results, Figure 2 shows an updated 1-hour Q-Q plot that includes CALPUFF results with and without PRIME downwash. These figures show that CALPUFF exhibits a greater tendency to overestimate concentrations at Martin's Creek with the PRIME downwash option as compared to the ISC-Type downwash option, with some deterioration in the model performance metrics.

To examine the potential contribution of another issue that the EPA raised regarding the NJDEP validation study, Figure 3 compares the MCM values for AERMOD and CALPUFF (with PRIME) excluding the AMS8 stack top monitor, which was used only to determine background SO2 concentrations in EPA's evaluation of the AERMOD model using Martin's Creek. Similar to the results shown in Figure 1, AERMOD is shown to perform "better" for all values of N, but in this case the difference in performance is statistically significant at the 90% confidence level (i.e., the confidence interval does not cross zero) for the cases with N=15 and N=8.

This reassessment of the CALPUFF validation study based on a full implementation of the Cox-Tikvart protocol, using the modeled and monitored data provided by NJDEP from their validation study, supports EPA's initial assessment that the NJDEP CALPUFF validation study did not adequately justify the use of CALPUFF in this application under either conditions (2) or (3) of Section 3.2.2(b) of Appendix W. 40 CFR Part 51, App. W 3.2.2(b). This assessment also highlights the importance of NJDEP's use of the "ISC-Type" building downwash option in CALPUFF, instead of the PRIME downwash option.

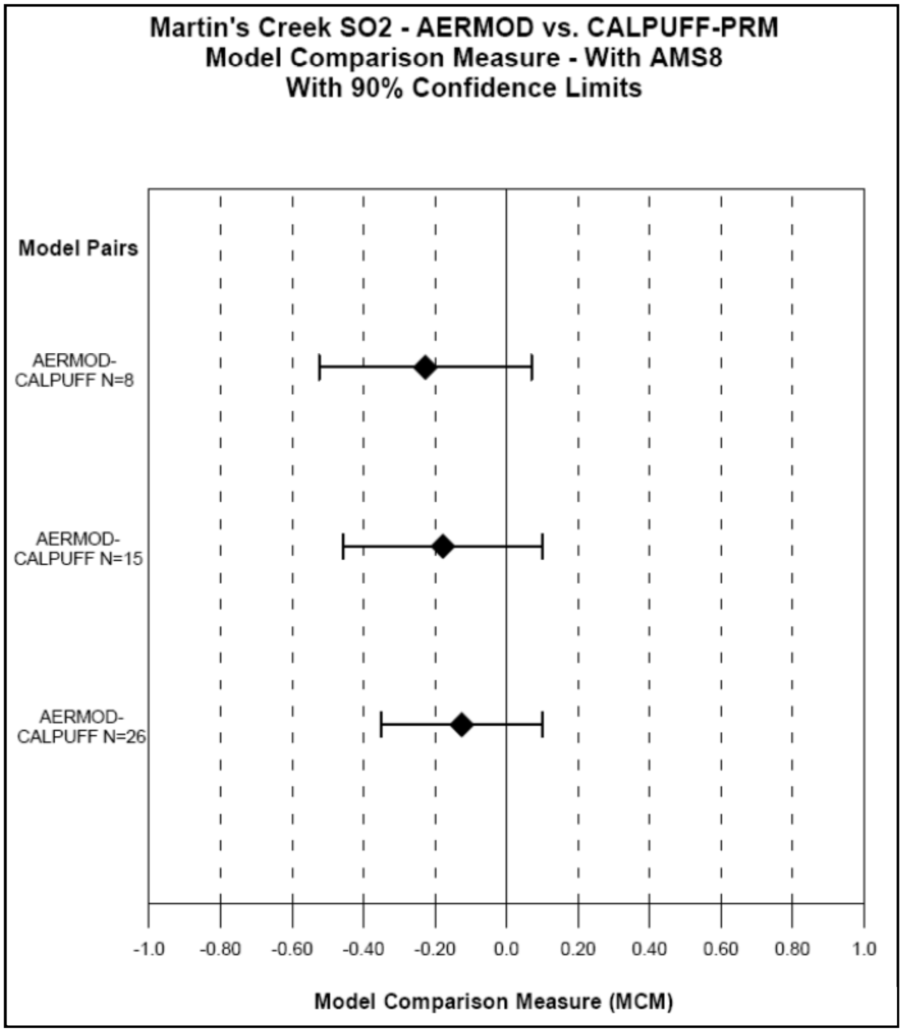

Figure 1. Model Comparison Measure for Martin's Creek Evaluation with PRIME Downwash in CALPUFF

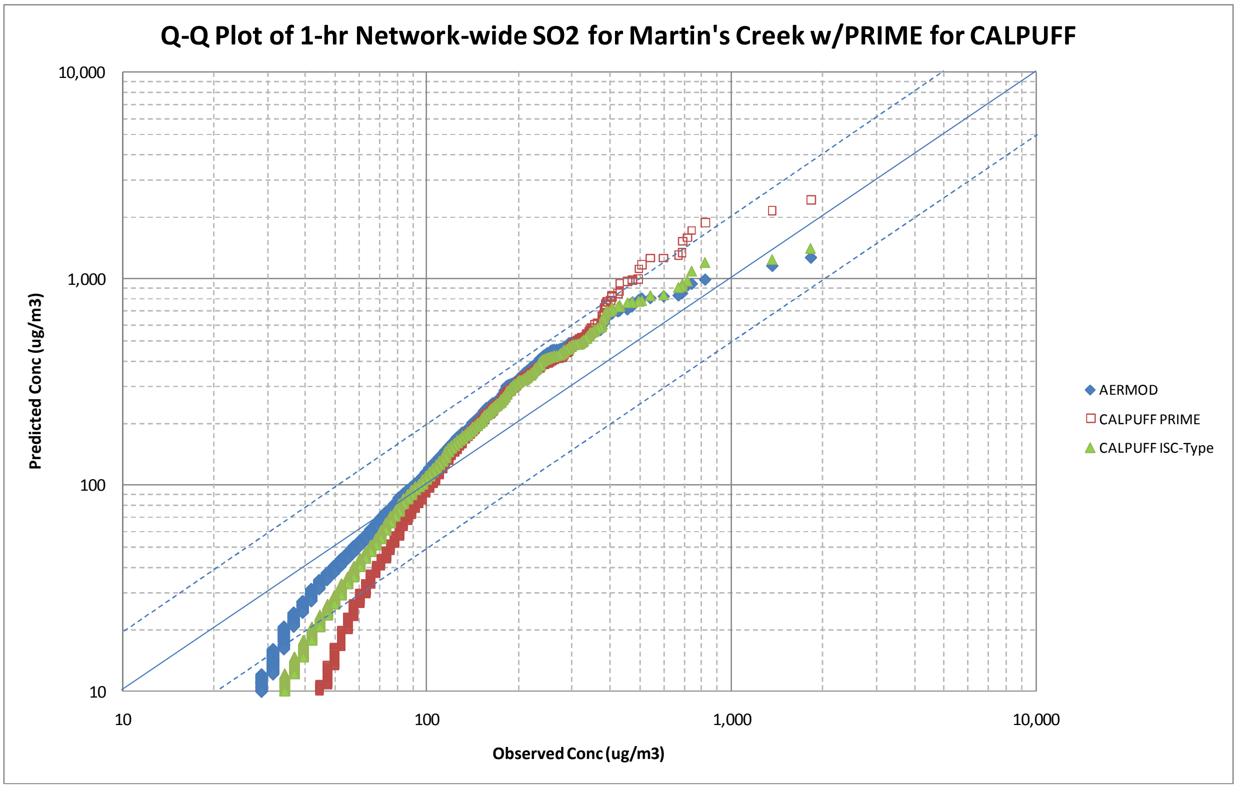

Figure 2. Q-Q plot of 1-hour Network-wide SO2 for Martin's Creek with PRIME option in CALPUFF

We have updated Table 11 of the NJDEP CALPUFF Validation Study, summarizing the model performance measures for the network peak 1-hour time series comparisons based on the BOOT program, to include results based on the use of CALPUFF with the PRIME downwash algorithm. Aside from the much higher 1^{st} and 2^{nd} highest modeled concentrations for CALPUFF with PRIME, the use the PRIME downwash option in CALPUFF did not dramatically affect the conclusions regarding relative performance CALPUFF vs. AERMOD for this study, although most performance measures degraded with the inclusion of PRIME downwash in CALPUFF as compared to CALPUFF with the ISC-Type downwash option. Note that the revised Table 11 also corrects a transcription error in the original table for the correlation coefficient for CALPUFF. We have also added the results for the normalized mean square error (NMSE), another statistical measure that is often used to assess model performance. A "perfect" model would have FB and NMSE values of 0.

Revised Table 11 from NJDEP Validation Study. Summary of Performance Measures for the Network 1-Hour Time Series

	Observed (µg/m^3)	CALPUFF Model	AERMOD Model	CALPUFF w/PRIME
Average	40.80	41.71	44.32	42.32
Highest	1823.5	1402.9	1271.8	2409.0
2nd Highest	1362.4	1240.2	1160.2	2141.3
FAC-2	n/a	0.68	0.68	0.68
Correlation Coef.	n/a	0.155	0.128	0.133
NMSE	n/a	4.85	4.75	6.16
FB (< 0 → over pred)	n/a	-0.022	-0.083	-0.036
FB_{FN}	n/a	0.428	0.399	0.430
FB_{FP}	n/a	0.450	0.481	0.467

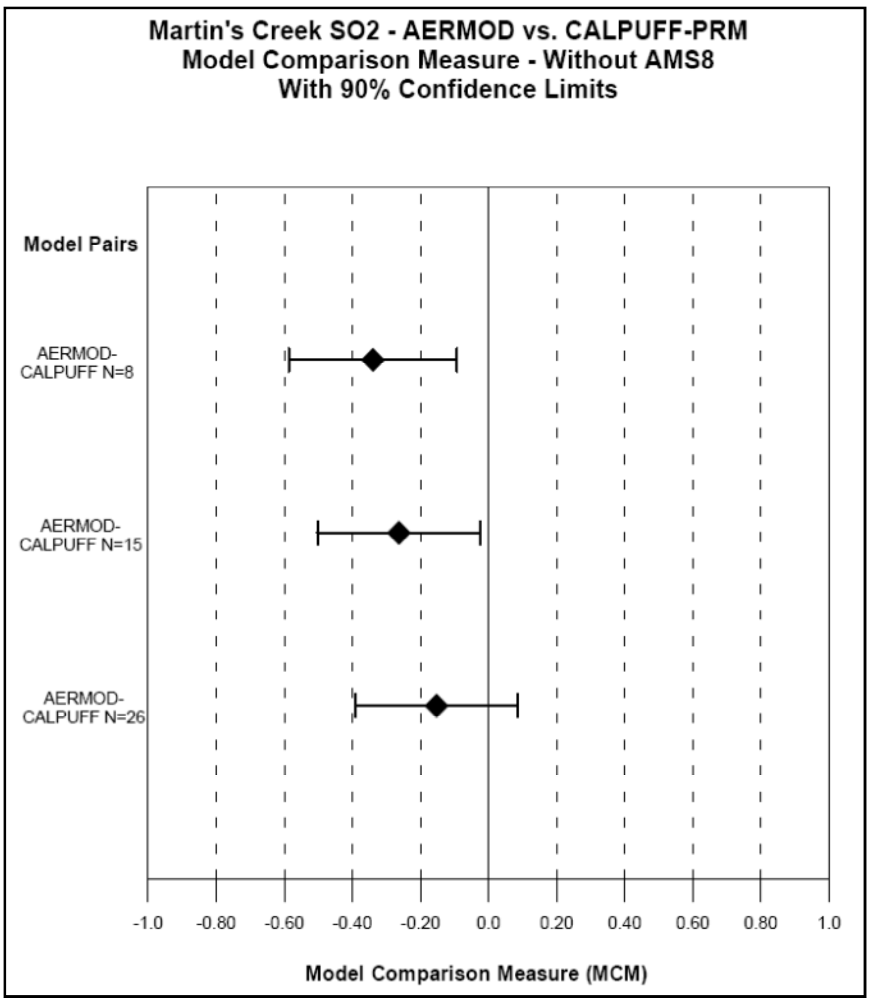

Figure 3. Model Comparison Measure for Martin's Creek Evaluation with PRIME Downwash in CALPUFF and without the AMS8 Stack-top Monitor

We have also updated Table 6 of the NJDEP CALPUFF Validation Study to include the highest-1st-high (H1H) and highest-2nd-high (H2H) modeled and observed concentrations for CALPUFF and AERMOD and to include CALPUFF model results with the PRIME downwash option. Table 6 of the NJDEP CALPUFF Validation Study summarized "network wide maximum and second-high monitored values with each model's actual maximum and second-high network wide predictions" based on the Martin's Creek field study. While the overall highest and 2nd highest values reported by NJDEP are consistent with the output from the BOOT program summarized in Table 11, it would be more appropriate to report the 1st highest and highest-2nd-highest values for consistency with the 3-hr and 24-hr regulatory design values for SO_2 (note that the NJDEP study was conducted before the 1-hour SO_2 NAAQS was promulgated). Consistent with the updated Q-Q plots shown above, CALPUFF results in the revised Table 6 exhibit a more pronounced bias to overestimate concentrations when the PRIME downwash option is used.

Revised Table 6 from NJDEP Validation Study. Network Wide Ratios of CALPUFF and AERMOD H1H and H2H Modeled to Observed Concentrations, Including CALPUFF Results with PRIME Downwash

Averaging Time	Observed (μg/m^3)	CALPUFF Model	Pred/Obs Ratio	AERMOD Model	Pred/Obs Ratio	CALPUFF w/PRIME	Pred/Obs Ratio
H1H 1-hr	1823.5	1402.8	**0.77**	1271.8	**0.70**	2409.0	**1.32**
H2H 1-hr	670.7	1240.2	**1.85**	1160.2	**1.73**	1877.3	**2.80**
H1H 3-hr	710.0	724.6	**1.02**	563.4	**0.79**	1620.5	**2.28**
H2H 3-hr	421.0	554.9	**1.32**	524.6	**1.25**	991.6	**2.36**
H1H 24-hr	185.3	200.9	**1.08**	165.9	**0.90**	309.1	**1.67**
H2H 24-hr	131.2	165.2	**1.26**	124.2	**0.95**	143.9	**1.10**
High Annual	13.1	11.31	**0.86**	11.15	**0.85**	10.82	**0.83**
Geometric Mean Ratios			**1.12**		**0.98**		**1.63**

Additional analysis of CALPUFF model performance indicates that CALPUFF exhibited a greater tendency to overestimate concentrations for Martin's Creek under stable conditions when the PRIME downwash option was used. Figure 2 presented above shows a revised Q-Q plot of network-wide 1-hour SO_2 values for AERMOD and CALPUFF, based on PRIME downwash for both models, with CALPUFF results based on ISC-Type downwash included for comparison. That Q-Q plot clearly shows a greater tendency toward overpredicting the peak values on the part of the CALPUFF model when the PRIME downwash option is selected. Figure 4 below shows 1-hour Q-Q plots by meteorological category, comparable to the plots presented in Figure 1 from NJDEP's comments, but including CALPUFF results based on the use of PRIME downwash. These Q-Q plots by stability category indicate that the additional tendency toward overprediction for CALPUFF with the PRIME downwash option for Martin's Creek is associated with stable conditions. There's also an indication that inclusion of PRIME downwash in CALPUFF reduced some of the higher concentrations predicted during unstable conditions, and CALPUFF results with PRIME drop off more rapidly at the lower end of the distribution under neutral conditions.

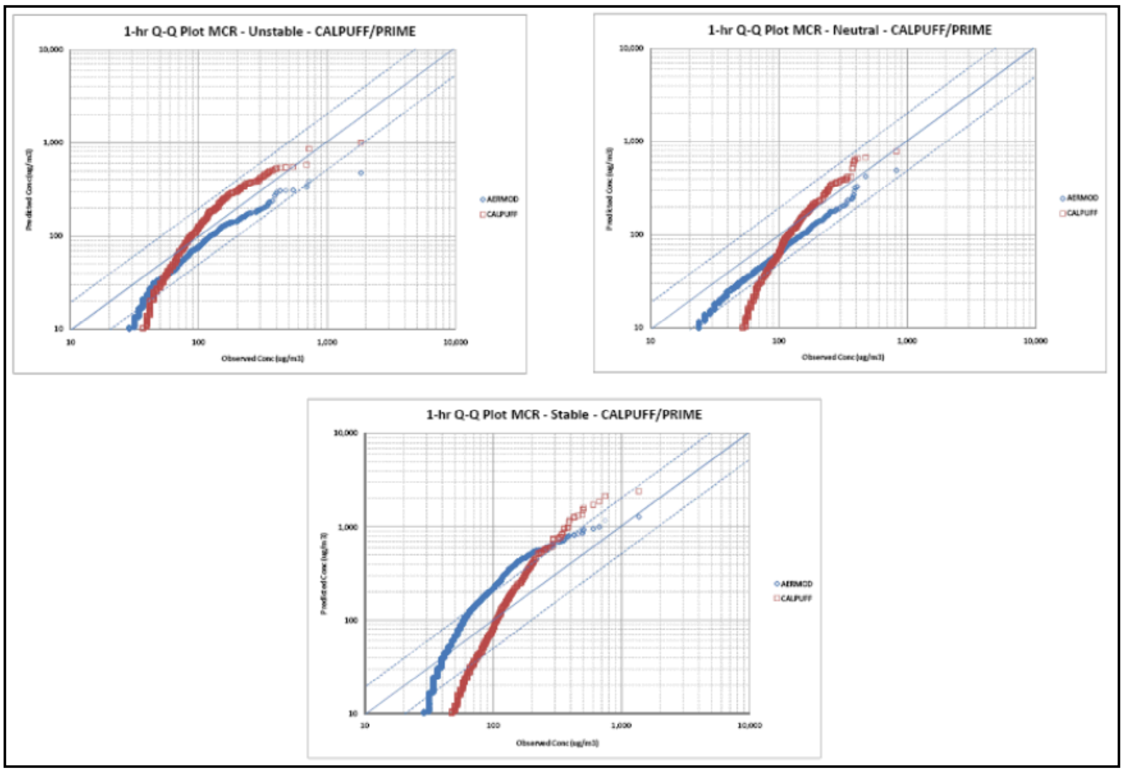

Figure 4. Q-Q plots of 1-hour Network-wide SO2 for Martin's Creek Based on Meteorological Category with PRIME Option in CALPUFF

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Appendix B.

Analysis of Model-to-Monitor Comparison for the Columbia, New Jersey Ambient SO2 Monitor

NJDEP's trajectory analysis of episodes of high ambient SO2 concentrations at the Columbia, New Jersey ambient SO_2 monitor, located about 2 kilometers northeast of the Portland plant (NJDEP, 2011), included a comparison of the top 10 AERMOD modeled 1-hour SO_2 concentrations based on the 1993-94 site specific meteorological data with the top 10 observed 1-hour SO_2 concentrations reported for the Columbia monitor from September 23, 2010, through February 17, 2011. NJDEP's comparisons of modeled to monitored concentrations at Columbia examined three emission scenarios for the Portland Plant, including maximum allowable emissions, 50 percent of allowable emissions, and "average" emissions based on the hourly emissions from CEMS reported for Portland for the period September through December 2010, covering the period when hourly emissions for Portland and Columbia ambient SO_2 data were both available. Despite the lack of temporal pairing between modeled concentrations based on 1993-94 site specific meteorological data and monitored concentrations for September 2010 through February 17, 2011, it is reasonable to expect some degree of comparability between modeled and monitored concentrations based on the upper end of the ranked distributions. NJDEP found generally good agreement between modeled concentrations based on allowable emissions, with modeled concentrations based on "average" emissions being about 50 percent less than the monitored concentrations. NJDEP concluded from these comparisons that AERMOD modeled concentrations based on allowable emissions "may most accurately reflect actual SO_2 concentrations in the vicinity of the plant."

An additional assessment of the potential contribution to modeled concentrations associated with inclusion of SODAR sigma-w data was conducted by the EPA based on NJDEP's analysis of Portland's impacts on the Columbia, New Jersey ambient SO_2 monitor. Given that the Columbia monitored data represent ambient SO_2 levels at a single location, and the lack of concurrent site specific meteorological data for Portland, it would not be meaningful to model the actual hourly emissions from the Portland plant in order to compare modeled vs. monitored concentrations paired in time and space. In addition, each of the three emission scenarios used in the NJDEP analysis are somewhat problematic in terms of their representativeness for capturing the peak of the observed concentration distribution. Since the peak observed concentrations are likely to be associated with episodes of high emissions, worst-case meteorological conditions, or both, we would expect modeling based on average actual emissions to be biased toward underestimating observed concentrations since the high emission episodes would not be reflected. On the other hand, we would expect modeling based on maximum allowable emissions to be biased toward overestimating observed concentrations, unless the plant operates at maximum capacity most of the time, which is not the case for Portland. The third emission scenario used by NJDEP based on 50 percent of allowable emissions might be a more appropriate scenario for this purpose, except for the fact that NJDEP used the same stack parameters as used for the "average" emission scenario which represents average loads. A review of the hourly emission data for Portland indicates that emissions are typically about 70 percent of "allowable" emissions for a given operating load due to the fact that the average sulfur content of the fuel being burned is about 70 percent of Portland's allowable sulfur content. This relationship was generally reflected in the "average" emissions scenario used by NJDEP, with 30 percent of allowable emissions and 40 percent load for Unit 1 and 38.5 percent of allowable emissions and 51 percent load for Unit 2. Based on this review of hourly emissions data for Portland, the EPA included an emission scenario based on 100 percent load and 70 percent of allowable emissions for both units 1 and 2 as being reasonably representative of peak operating levels during the period of monitoring data. However, since Portland frequently operates well below these levels, we would expect to see some bias toward overestimation in the modeled concentrations. AERMOD predictions based on the EPA adjustments to the Portland meteorological data are consistent with that expectation, with an average ratio of predicted/observed concentrations for the top 10 daily maximum 1-hour values of 1.14. By comparison, the average predicted/observed ratio for AERMOD for the same emission scenario using NJDEP's meteorological data for Portland without the EPA's adjustments was 0.77.

Table 1 summarizes the results of model-to-monitor comparisons for the Columbia monitor conducted by EPA to assess the potential effects on model performance associated with inclusion of SODAR sigma-w data and the adjustments to the measurement heights to account for the difference in base elevation of the meteorological tower and SODAR relative to the Portland stack base elevation, both separately and combined. The monitored and modeled concentrations in Table 1 are based on the top 10 daily maximum 1-hour values for consistency with the form of the 1-hour SO_2 NAAQS, and the monitored values have been updated to reflect observed concentrations for a complete year, from September 23, 2010, through September 22, 2011. It is unclear whether the modeled and monitored values presented in NJDEP's analysis of the Columbia data are based on the top 10 daily maximum 1-hour values or the overall highest hourly values. The results presented in Table 1 show that the average ratio of modeled/predicted concentrations for the top 10 daily maximum 1-hour values for AERMOD based on the EPA adjustments to the meteorological data is 1.14, indicating very good agreement between modeled and monitored concentrations, with a slight bias toward overestimation consistent with the fact that the modeled emission scenario represents peak operating conditions during the period. The average predicted/observed ratio drops to 0.68 when the SODAR sigma-w data are removed. A less significant drop in the average predicted/observed ratio to 0.85 occurred when the SODAR sigma-w data were included but without EPA's adjustments to the measurement heights. However, the average predicted/observed ratios were even lower at 0.61 when both the SODAR sigma-w and measurement height adjustments were excluded. For comparison, the average predicted/observed ratio for the 100%-load/70%-allowable emission scenario for AERMOD based on the meteorological data used by NJDEP was 0.77. Although these model-to-monitor comparisons are based on a single monitoring location and the use of 1993-1994 meteorological data for the modeled concentrations vs. 2010-2011 for the monitored concentrations, the results tend to corroborate the use of SODAR sigma-w data and other adjustments to the meteorological data incorporated in EPA's AERMOD modeling.

Table 1. Comparisons of daily maximum 1-hour SO_2 AERMOD modeled concentrations (ug/m3) based on 100% load and 70% allowable emissions vs. Columbia monitored concentrations, with and without the EPA adjustments to Portland meteorological data

Daily Max 1-hr Rank	Columbia Obs Conc (ug/m3)	AERMOD All Adj (ug/m3)	Pred/Obs All Adj	AERMOD No sig-w (ug/m3)	Pred/Obs No sig-w	AERMOD No H Adj (ug/m3)	Pred/Obs No H Adj	AERMOD No Adj (ug/m3)	Pred/Obs No Adj
1	479	782	1.633	384	0.802	401	0.839	310	0.648
2	426	531	1.245	337	0.791	379	0.890	263	0.617
3	413	433	1.047	224	0.542	357	0.863	216	0.523
4	356	416	1.169	218	0.614	313	0.881	212	0.595
5	348	356	1.023	212	0.609	296	0.851	210	0.602
6	327	351	1.073	210	0.643	265	0.811	204	0.625
7	306	309	1.010	206	0.673	248	0.810	186	0.609
8	290	301	1.038	205	0.704	248	0.852	182	0.625
9	283	299	1.059	201	0.713	232	0.823	179	0.634
10	277	296	1.068	190	0.684	230	0.830	176	0.635
Ave	**350.5**	**407.4**	**1.136**	**238.8**	**0.678**	**297.1**	**0.845**	**213.8**	**0.611**

Although NJDEP did not include CALPUFF modeled concentrations at the Columbia monitor location in the model-to-monitor comparisons presented in their trajectory analysis, the EPA has used the NJDEP CALPUFF modeling files for 1992-93 and 2002 that were included with their 126 petition to generate CALPUFF modeled concentrations at the Columbia monitor location using the same Portland source and emission inputs as used in the AERMOD modeling presented in Table 1. Results of these additional model-to-monitor comparisons using CALPUFF are presented in Table 2 based on the top 10 daily maximum 1-hour concentrations consistent with Table 1. The modeled concentrations for AERMOD with the EPA adjustments to the Portland site-specific meteorological data are also included for comparison.

Table 2. Comparisons of daily maximum 1-hour SO_2 AERMOD and CALPUFF modeled concentrations (ug/m3) based on 100% load and 70% allowable emissions vs. Columbia monitored concentrations.

Daily Max 1-hr Rank	Columbia Obs Conc (ug/m3)	AERMOD All Adj (ug/m3)	AERMOD Pred/Obs All Adj	CALPUFF 1992-93 Met Data (ug/m3)	CALPUFF Pred/Obs 1992-93	CALPUFF 2002 Met Data (ug/m3)	CALPUFF Pred/Obs 2002
1	479	782	1.633	1335	2.788	2406	5.027
2	426	531	1.245	1275	2.990	1841	4.317
3	413	433	1.047	1161	2.808	1759	4.256
4	356	416	1.169	1127	3.168	1331	3.741
5	348	356	1.023	1115	3.203	1305	3.751
6	327	351	1.073	1105	3.380	1100	3.363
7	306	309	1.010	1057	3.454	1070	3.497
8	290	301	1.038	1056	3.637	1048	3.609
9	283	299	1.059	1032	3.654	1015	3.593
10	277	296	1.068	973	3.508	973	3.509
Ave	**350.5**	**407.4**	**1.136**	**1123.5**	**3.259**	**1384.8**	**3.866**

The CALPUFF modeled concentrations at the location of the Columbia monitor using the NJDEP CALMET meteorological inputs for 1992-93 and 2002 exhibit a significant bias toward overprediction, with predicted/observed ratios of about 3.3 and 3.9, respectively. This bias toward overprediction in CALPUFF is consistent with the significantly more conservative modeling results based on CALPUFF as compared to AERMOD submitted with the NJDEP 126 petition for Portland. Although we acknowledge the limitations of these model-to-monitor comparisons given the different time periods associated with the modeled and monitored concentrations, and the limitations associated with comparisons at a single locations, we believe that these additional model-to-monitor comparisons using the Columbia, New Jersey monitoring data provide additional support for the EPA position that AERMOD is a more appropriate model for this application than CALPUFF.

References:

NJDEP, 2011. Analysis of the Sulfur Dioxide Measurements from the Columbia Lake NJ Monitor. Bureau of Technical Services, Division of Air Quality, New Jersey Dept. of Environmental Protection, March 4, 2011. Docket ID No. EPA-HQ-OAR-2011-0081-0019

Appendix C.

Analysis of Meteorological Variability

Based on AERMOD dispersion modeling of SO2 emissions from Portland, the EPA determined that the modeled concentrations from Portland, when combined with the relatively low background concentrations, cause violations of the 1-hour SO2 NAAQS in New Jersey. In the final rule, the EPA has defined Portland's significant contribution to nonattainment and interference with maintenance of the 1-hour SO2 NAAQS in New Jersey as those emissions that must be eliminated to bring the downwind receptors in New Jersey affected by Portland into modeled attainment in the analysis year. The EPA also analyzed the modeling results to determine the appropriate emissions reductions that were needed to eliminate "interfere with maintenance."

Meteorological variability is an important aspect of interference with maintenance due to the fact that the modeled concentrations which define a source's significant contribution to nonattainment are based on historical meteorological data and cannot explicitly account for that source's impacts under future meteorological conditions. The EPA acknowledged in the proposed rule, and public comments also noted, that this issue may have some additional importance in this case due to the fact that only one year of site-specific meteorological data was available to support the dispersion modeling analysis.

The question regarding meteorological variability is whether impacts from Portland emissions could be higher in the future due to differences in meteorological conditions of importance to transport and dispersion of emissions from Portland, and if so, how much higher would they likely be under the worst-case assumption that the meteorological data (in this case one year of available site-specific data) represent the least conservative (or most favorable) meteorological conditions.

Although we are not able to explicitly account for the impact of year-to-year variability of meteorology on downwind modeled concentrations based on the available site-specific data, the form of the 1-hour SO2 NAAQS based on the 99th percentile of the annual distribution of daily maximum 1-hour values, averaged across 3 years for monitoring data, is recognized as a more stable metric of ambient air quality that is less sensitive to meteorological variability than a deterministic standard that would be based on allowing one exceedance per year. For a deterministic standard, the inclusion of additional years of meteorological data can only increase the modeled design value or leave it unchanged, since the design value is the highest of the second-highest values across each of the individual years modeled. In contrast, the inclusion of additional years of meteorological data for a probabilistic standard such as the 1-hour SO2 NAAQS may increase or decrease the modeled design value since it is averaged across the number of years modeled at each modeled receptor.

To further illustrate this point, the EPA performed an analysis of modeled impacts from Portland based on 5 years of meteorological data from the Allentown National Weather Service (NWS) station for the period 2006 through 2010. The Allentown NWS station is located about 40 km southwest of Portland, essentially upwind of the maximum modeled impacts from Portland in New Jersey. Although we believe that the use of five years of Allentown meteorological data will provide meaningful information in relation to the potential contribution of meteorological variability for Portland, we believe that the use of one year of Portland site-specific data is preferred as the basis for estimating ambient impacts from Portland's SO2 emissions. The use of one year of site-specific meteorological data fulfills the requirements of Appendix W related modeling demonstrations of compliance with the NAAQS. Furthermore, Appendix W expresses a clear preference for the use of site-specific meteorological over NWS data, even in cases where only one year of data is available[14]. Therefore, the modeling analyses presented here are strictly to examine the issue of how meteorological variability should be treated with respect to interference with maintenance. This analysis does not necessarily imply that the Allentown meteorological data are adequately representative for purposes of regulatory modeling under Appendix W to estimate Portland's impacts in New Jersey.

The AERMOD modeling analysis utilized five years of Allentown NWS data in the TD-3505 (aka 'ISHD' or DS3505) format, containing the standard surface weather observations reported for each hour, including temperature, wind speed and direction, cloud cover, etc. We also supplemented the standard Allentown surface data with hourly average wind speed and direction derived from the 1-minute ASOS wind data (TD-6405 format), which were processed through the EPA AERMINUTE program for input to the AERMET meteorological processor. Upper air (radiosonde) data from the Albany, New York station in the FSL format were also used as input to AERMET.

Surface characteristics necessary for input to AERMET, including albedo, Bowen ratio, and surface roughness, were derived from a Beta version of AERSURFACE using 1992 National Land Cover Data (NLCD). The surface roughness estimates were based on the location of the Allentown NWS station meteorological tower while the estimates of albedo and Bowen ratio were based on the location of Portland, consistent with guidance in Section 3.1.2 of the EPA's AERMOD Implementation Guide (EPA, 2009). Surface roughness estimates for Allentown were also estimated based on application of a gust factor methodology (Weiringa, 1980; EPA, 2011), utilizing 10-minute average wind speeds and 10-minute peak gusts from the 1-minute ASOS wind data. The AERSURFACE and gust factor estimates of surface roughness were both based on eight 45-degree sectors centered on North, Northeast, East, etc. The AERSURFACE and gust factor estimates of surface roughness showed reasonably good agreement. However, based on comparisons of AERSURFACE and gust factor estimates of surface roughness and a review of available satellite imagery of the Allentown NWS station location, we adjusted the surface

[14] See 40 CFR Part 51, Appendix W Section 8.3.1.2.

roughness estimates based on AERSURFACE for sectors 3 (southeast) and 7 (northwest) to be more consistent with the gust factor estimates and actual land cover characteristics for those sectors.

The AERMOD model was applied using the AERMET-processed meteorological data for Allentown using the current allowable emissions from Portland for the 6km by 6km finely-spaced (100m) receptor grid focused on the area of peak impacts from Portland northeast of the plant. Since the purpose of this analysis was to assess the potential contribution due to meteorological variability to ambient impacts associated with Portland SO2 emissions, the AERMOD modeling did not include the monitored background concentrations incorporated in the modeling conducted in support of the section 126 finding and remedy for Portland. Modeled concentrations were generated for the five-year period of 2006 through 2010, and for each individual year within that range. The five-year modeling results are comparable to a modeling analysis conducted in support of a PSD permit. The most straightforward and simplest approach for estimating the potential contribution of meteorological variability, that is consistent with the form of the 1-hour SO2 NAAQS, is to compare the lowest individual year modeled design value[15] with the five-year averaged modeled design value. This approach should provide a reasonable indication of the "worst-case" potential contribution from meteorological variability for this specific application.

The results of this analysis are summarized in Table 1, which shows that the range of variability between the individual year with the lowest modeled design value and the 5-year average modeled design value based on the form of the 1-hour SO2 NAAQS is about 6 percent. For comparison, the range of variability across the 5 years for a deterministic 1-hour standard, using the same 5 years of meteorology data, was about 35 percent for the first highest 1-hour values and about 17 percent for the highest second-highest 1-hour values. Note that the modeled concentrations presented in Table 1 have been normalized based on a five-year unitless value of 100.

[15] The 99th percentile (4th highest) of the annual distribution of daily maximum 1-hour values, averaged across the number of years modeled.

Table 1. AERMOD Modeling Related to Meteorological Variability for Portland based on 2006-2010 Allentown, PA Meteorological Data

1-hour SO2 Probabilistic NAAQS		**1-hour Deterministic NAAQS (H2H design value)**		
Data Period	99th% daily max 1hr	Data Period	High-1st-High 1hr	High-2nd-High 1hr
2006-2010 5-yr	100.0	2006-2010 5-yr	100.0	100.0
2006 – Year 1	101.6	2006 – Year 1	76.9	86.7
2007 – Year 2	94.1	2007 – Year 2	73.6	86.0
2008 – Year 3	95.6	2008 – Year 3	100.0	88.9
2009 – Year 4	103.3	2009 – Year 4	72.6	85.8
2010 – Year 5	106.6	2010 – Year 5	87.7	100.0

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