

## Summary of Philadelphia 8-Hour Ozone NAA Attainment Demonstration

Site Name - County, State	Site Number	2002 Base Year Design Value	With Voluntary Measures		Without Voluntary Measures						Modeling Results		
			WOE Band Upper and Lower Bound of 2009 DV	WOE Based Probable 2009 DV	WOE Based Upper and Lower Bound of 2009 DV	WOE Based Probable 2009 DV	WOE Based Upper and Lower Bound of 2012 DV	WOE Based Probable 2012 DV	2009 BOTW - B4	2012 BOTW - B4			
<b>Philadelphia -Wilmington-Atlantic City, PA-NJ-MD-DE NAA</b>													
Fairhill - CECIL CO, MD	240150003	97.7	73.8	- 67.6	70.7	75.8	- 69.6	72.7	66.8	- 60.6	63.7	81	75
Brandywine Creek - NEW CASTLE CO, DE	100031010	92.7	76.9	- 70.7	73.8	78.3	- 72.1	75.2	70.8	- 64.6	67.7	81	76
Bellefonte - NEW CASTLE CO, DE	100031013	90.3	73.5	- 67.3	70.4	75.0	- 68.8	71.9	69.0	- 62.8	65.9	78	74
Killens Pond - KENT CO, DE	100010002	88.3	74.7	- 68.5	71.6	76.0	- 69.8	72.9	70.0	- 63.8	66.9	78	74
Lewes - SUSSEX CO, DE	100051003	87.0	74.3	- 68.1	71.2	75.1	- 68.9	72.0	70.6	- 64.4	67.5	77	74
Lums Pond - NEW CASTLE CO, DE	100031007	94.5	72.8	- 66.6	69.7	74.4	- 68.2	71.3	66.9	- 60.7	63.8	79	74
Seaford - SUSSEX CO, DE	100051002	90.0	69.5	- 63.3	66.4	70.6	- 64.4	67.5	63.1	- 56.9	60.0	75	70
Colliers Mills - OCEAN CO, NJ	340290006	105.7	85.7	- 79.5	82.6	86.8	- 80.6	83.7	79.3	- 73.1	76.2	91	86
Rider - MERCER CO, NJ	340210005	97.0	82.4	- 76.2	79.3	83.6	- 77.4	80.5	76.1	- 69.9	73.0	86	81
Ancora State Hospital - CAMDEN CO, NJ	340071001	100.7	82.5	- 76.3	79.4	83.3	- 77.1	80.2	75.8	- 69.6	72.7	87	82
Camden - CAMDEN CO, NJ	340070003	98.3	85.0	- 78.8	81.9	86.0	- 79.8	82.9	78.5	- 72.3	75.4	88	83
Clarksboro - GLOUCESTER CO, NJ	340155001	98.3	84.6	- 78.4	81.5	86.0	- 79.8	82.9	78.5	- 72.3	75.4	88	83
Millville - CUMBERLAND CO, NJ	340110007	95.7	75.4	- 69.2	72.3	76.8	- 70.6	73.7	67.8	- 61.6	64.7	81	75
Nacote Creek - ATLANTIC CO, NJ	340010005	89.0	73.3	- 67.1	70.2	74.1	- 67.9	71.0	68.1	- 61.9	65.0	77	73
Bristol - BUCKS CO, PA	420170012	99.0	84.6	- 78.4	81.5	85.6	- 79.4	82.5	79.6	- 73.4	76.5	88	84
West Chester - CHESTER CO, PA	420290050	95.0	76.7	- 70.5	73.6	78.6	- 72.4	75.5	71.1	- 64.9	68.0	82	77
New Garden - CHESTER CO, PA	420290100	94.7	72.3	- 66.1	69.2	74.3	- 68.1	71.2	65.3	- 59.1	62.2	79	73
Chester - DELAWARE CO, PA	420450002	91.7	77.6	- 71.4	74.5	78.8	- 72.6	75.7	72.8	- 66.6	69.7	81	77
Norristown - MONTGOMERY CO, PA	420910013	92.3	77.5	- 71.3	74.4	78.5	- 72.3	75.4	72.5	- 66.3	69.4	81	77
Elmwood - PHILADELPHIA CO, PA	421010136	83.0	72.7	- 66.5	69.6	74.1	- 67.9	71.0	68.1	- 61.9	65.0	75	71
Lab - PHILADELPHIA CO, PA	421010004	71.3	62.7	- 56.5	59.6	63.5	- 57.3	60.4	59.0	- 52.8	55.9	64	61
Roxborough - PHILADELPHIA CO, PA	421010014	90.7	79.5	- 73.3	76.4	80.8	- 74.6	77.7	74.8	- 68.6	71.7	82	78
Northeast Airport - PHILADELPHIA CO, PA	421010024	96.7	84.1	- 77.9	81.0	85.3	- 79.1	82.2	77.8	- 71.6	74.7	87	82

\* All values in ppb

Notes:

upper Bound: 3.1  
lower bound: -3.1

## Explanation of calculations in the Summary of Philadelphia 8-Hour Ozone NAA Attainment Demonstration

Maryland's Fairhill monitor was used for the sample calculations

### 1. With Voluntary Measures

Given the following:

Modeled 2009 DV = 81 ppb  
 Modeled 2009 Telecommute = 78.1

Located in hidden Cell P of the spreadsheet

WOE Based Probable 2009 DV:

Benefit of Telecommuting = Modeled 2009 DV - Modeled 2009 Telecommute = 81 ppb - 78.1 ppb = **2.9 ppb**

Now assume an additional benefit of 1 ppb for the High Energy Demand Day (HEDD) program<sup>(1)</sup>:

Total Voluntary Measures Benefit	=	Benefit of Telecommuting + Assumed Benefit of HEDD Program = 2.9 ppb + 1 ppb =	<b><u>3.9 ppb</u></b>
---	---	--	-----------------------

Next take the total voluntary measures benefit and divide by 2 to be conservative: 3.9 ppb / 2 = **1.95 ppb**

Next subtract the conservative total voluntary benefit from the without voluntary measures WOE based probable 2009 DV to calculate the voluntary WOE based probable 2009 DV.

Voluntary WOE Based Probable 2009 DV	=	Without Voluntary Measures WOE Based Probable 2009 DV	-	Conservative Total Voluntary Benefit	=	72.7 ppb - 1.95ppb = <b><u>70.7 ppb</u></b>
--	---	--	---	---	---	---

WOE 2009 Upper Bound: WOE Probable 2009 DV + 3.1 ppb = 70.7 ppb + 3.1 ppb = **73.8 ppb**

WOE 2009 Lower Bound: WOE Probable 2009 DV - 3.1 ppb = 70.7 ppb - 3.1 ppb = **67.6 ppb**

Note:

<sup>(1)</sup> Additional modeling is planned to calculate the modeled benefit of the HEDD program.

The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD). More detailed information can be found in the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

## Explanation of calculations in the Summary of Philadelphia 8-Hour Ozone NAA Attainment Demonstration

### Without Voluntary Measures (2009 DV)

Given the following:

Observed 2002 DV = 97.7 ppb

Modeled 2009 DV = 81 ppb

Modeled Benefit = Observed 2002 DV – Modeled 2009 DV = 97.7 ppb – 81 ppb = **16.7 ppb**

WOE Benefit = Modeled Benefit x 2

(Explanation: Due to 100% underestimation of the emissions reduction benefits by CMAQ due to the model's insensitivity to emissions changes)

Allowing for considerable margin, the underestimation of the WOE Benefit is conservatively cut in half (50%).

Now the conservative WOE Benefit is calculated as follows:

WOE Benefit\_Conservative = Modeled Benefit x 1.5 = 16.7 ppb x 1.5 = **25.05 ppb**

WOE Based Probable 2009 DV = Observed 2002 DV – WOE Benefit\_Conservative = 97.7 – 25.05 = **72.7 ppb**

Calculation of the WOE Based Upper and Lower Bound of 2009 DV:

WOE 2009 Upper Bound = WOE Based Probable 2009 DV + 3.1 ppb = 72.7 ppb + 3.1 ppb = **75.8 ppb**

WOE 2009 Lower Bound = WOE Based Probable 2009 DV – 3.1 ppb = 72.7 ppb – 3.1 ppb = **69.6 ppb**

Note:

The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD). More detailed information can be found in the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

## Explanation of calculations in the Summary of Philadelphia 8-Hour Ozone NAA Attainment Demonstration

### 2. Without Voluntary Measures (2012 DV)

Given the following:

Observed 2002 DV = 97.7 ppb

Modeled 2012 DV = 75 ppb

Modeled Benefit = Observed 2002 DV – Modeled 2012 DV = 97.7 ppb – 75 ppb = **22.7 ppb**

WOE Benefit = Modeled Benefit x 2

(Explanation: Due to 100% underestimation of the emissions reduction benefits by CMAQ due to the model's insensitivity to emissions changes)

Allowing for considerable margin, the underestimation of the WOE Benefit is conservatively cut in half (50%).

Now the conservative WOE Benefit is calculated as follows:

WOE Benefit\_Conservative = Modeled Benefit x 1.5 = 22.7 ppb x 1.5 = **34.05 ppb**

WOE Based Probable 2009 DV = Observed 2002 DV – WOE Benefit\_Conservative = 97.7 – 34.05 = **63.7 ppb**

Calculation of the WOE Based Upper and Lower Bound of 2009 DV:

WOE 2009 Upper Bound = WOE Based Probable 2009 DV + 3.1 ppb = 63.7 ppb + 3.1 ppb = **66.8 ppb**

WOE 2009 Lower Bound = WOE Based Probable 2009 DV – 3.1 ppb = 63.7 ppb – 3.1 ppb = **60.6 ppb**

Note:

The 3.1 ppb adjustment to calculate the lower bound and upper bound represents the uncertainty in future design values and was calculated by Jeff Stehr (UMD). More detailed information can be found in the WOE chapter 9, "Uncertainty in CMAQ and Over-predictions of Future Year Ozone Design Values".

## **Supplemental Voluntary Measure Weight of Evidence Demonstration**

In addition to the existing weight of evidence (WOE) analysis performed for the Philadelphia Nonattainment Area, the following supplementary evidence further exemplifies the probability that the region will attain the 8-hour ozone standard. The analysis described below was completed to examine how the modeled predicted future year 8-hour ozone design values might be lowered and given as a range based on voluntary controls which were not included in the full modeling demonstration completed by the Ozone Transport Commission (OTC) modeling centers for the Ozone Transport Region (OTR) states and is used in this modeling demonstration as part of this State Implementation Plan (SIP). The potential benefits from voluntary programs (i.e., an aggressive telecommuting program, the high electricity demand day (HEDD) program, and even an aggressive tree canopy program) help demonstrate that all of the region's monitors are progressing towards attaining the 8-hour ozone standard.

While not a formal part of MDE's WOE chapter, the analysis was completed to present supplemental evidence that leads to the conclusion that not only is MDE confident that Cecil County, Maryland will attain the 8-hour ozone standard but the entire Philadelphia nonattainment area will attain the 8-hour ozone standard as well.

### **Description of Analysis:**

1. Using the Fair Hill, Cecil County Maryland Monitor as the example monitor the predicted 2009 design value (DV) using the on the books/ on the way control measures is 81 ppb.
2. The UMD telecommute modeling included in the WOE documentation for this SIP predicted Fair Hill's DV to be 78.1 ppb.
3. Subtracting the telecommute run of 78.1 ppb from the predicted 2009 DV of 81 ppb there is a 2.9 ppb benefit from the telecommute program.
4. Assuming an additional 1 ppb of benefit from the HEDD program (based on cursory estimates from UMD modeling) there could be a total benefit 3.9 ppb based on the telecommute and HEDD programs.
5. In an effort to be conservative, divide the total benefit of 3.9 ppb by half and there potentially is 1.95 ppb benefit from telecommute and HEDD programs.
6. Now you can subtract the conservative 1.95 ppb of total benefit from the WOE based probable 2009 DV for Fair Hill ( $72.7\text{ppb} - 1.95\text{ppb} = 70.7\text{ppb}$ )
7. Jeff Stehr at UMD (as presented in the WOE chapter 11 of this SIP) has calculated that there should be a 3.1 ppb range used for the upper and lower boundaries of a CMAQ predicted DV. This 3.1 ppb upper and lower boundary represents the uncertainty in future design values (for more info see chapter 11 of this SIP).
8. Using the 3.1 ppb upper and lower boundaries and applying them to the results of step 6 (benefit of the telecommute and HEDD programs) the 2009 future year DV range for the Fair Hill monitor could be 67.6 ppb - 73.8 ppb.