Appendix D12

Calculation Methodology for Alternative DVBs and RRFs

1. Method for Determining the Alternative Baseline Design Values (DVB_{alt}):

The purpose of determining the Alternative Baseline Design Value is to provide an alternate approach to determining the 2002 modeling baseline design values that places less emphasis on the 2002 ozone season than on the other years used in the calculation of the modeling design value and to calculate the 2009 predicted modeling design value using the alternative baseline design value approach. Recalculating the modeled baseline design values ("alternate baseline design value") demonstrates an alternate approach to calculating the modeled design values that shows less bias (high or low). The alternate baseline design value, multiplied by the Relative Response Factor (RRF), provides an alternate design value ("alternate design value") which should more closely reflect predicted future air quality.

Method: The "Alternative Baseline Design Value" method was developed as an alternate means of calculating a baseline design value for the 8-hour ozone attainment demonstration modeling. This calculation differs from the methodology recommended in the United States Environmental Protection Agency (USEPA) guidance.[1] The calculation recommended in the USEPA guidance calculates the site-specific baseline design value (DVB) as the average of the design value periods which straddle the baseline inventory year which is 2002 (i.e., the average of the design values for the following three periods: 2000-2002, 2001-2003 and 2002-2004).

To calculate the Alternate Baseline Design Value, the fourth maximums[2] for a five-year period are averaged. An example of the Alternative Baseline Design Value is presented in Table D12.1.

Table D12.1: Data Used for the Calculation of the Alternative Baseline Design Value for Colliers Mills, Ocean County, New Jersey

	2000	2001	2002	2003	2004	2005	2006	DVB_{alt}
Fourth Maximum	**115**	**108**	**116**	**95**	**88**	**100**	**92**	**104.4**[3]

[1] USEPA. Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze. United States Environmental Protection Agency, Office of Air Quality Planning and Standards, Air Quality Analysis Division, Air Quality Modeling Group, Research Triangle Park, NC, EPA-454/B-07-002, April 2007.

[2] The fourth maximum is the fourth highest value of the year. Data are provided by NJDEP Bureau of Air Monitoring.

[3] This value was calculated by averaging the design values 2000-2004.

Calculations:

$(DVB)_{alt}$ = Average Fourth Maximum for 2000 through 2004

The Alternate Design Value $(DVF)_{alt}$ can be calculated by multiplying the Alternate Baseline Design Value with the Relative Response Factor (RRF) from the 2009 regional modeling (BOTW Base 4 modeling).

The equation below summarizes the Alternative Baseline Design Value method.

$(DVF)_{alt}$ = (RRF) $(DVB)_{alt}$

where

$(DVF)_{alt}$ is the calculated Alternative Design Value at each monitoring site.

RRF is the Relative Response Factor for each monitoring site obtained from the 2009 BOTW Base B4 modeling.

$(DVB)_{alt}$ is the average of the fourth maximums for 2000 – 2004 at each monitoring site.

Example:

The $(DVB)_{alt}$ was calculated at each monitoring site in the Northern New Jersey/New York/Connecticut nonattainment area and in the Southern New Jersey/ Philadelphia nonattainment area by finding the average of the fourth maximums for 2000 through 2004. See Table D12.2 for the results of the calculations for all the monitors in both nonattainment areas.

The calculations, using the data for Colliers Mills as an example, are shown below:

$(DVB)_{alt}$ = Average Fourth Maximum for 2000 through 2004
= (115+108+116+95+88)/5 = 104.4 ppb

The 2002 baseline design value for the 8-hour ozone attainment demonstration calculated using the USEPA guidance is 106 ppb.

$(DVF)_{alt} = (RRF)(DVB)_{alt}$

$(DVF)_{alt}$ = (0.868) (104 ppb)

= 90 ppb

From Table D12.2, the 2009 Modeled Design Value for Colliers Mills is 92 ppb.

Table D12.2: Modeled and Calculated Design Values for the Northern New Jersey/New York/Connecticut and Southern New Jersey/Philadelphia Nonattainment Areas

Site Name - County, State	Site Number	Air Monitoring Data	Modeling Results		Supporting Analyses		
		2002 Modeling Baseline (DV_B) (ppb)	RRF	2009 Modeled Results (DV_F) (ppb)	2002 Modeling Alternate Baseline (DV_{Balt}) (ppb)	2009 Modeled Results using Alternate Baseline (DV_{Falt}) (ppb)	2009 Modeled Results using Alternate Baseline and RRF** ($DV_{Falt\text{-}rf}$) (ppb)
NNJ/NY/CT Nonattainment Area							
Teaneck - BERGEN CO, NJ	340030005	91	0.928	85	88	81	76
Bayonne - HUDSON, NJ	340170006	84	0.911	77	84	76	73
Flemington - HUNTERDON, NJ	340190001	95	0.877	83	94	82	82
Rutgers Univ. - MIDDLESEX CO, NJ	340230011	96	0.874	83	94	82	82
Monmouth Univ. - MONMOUTH CO, NJ	340250005	95	0.880	84	94	82	82
Chester - MORRIS CO, NJ	340273001	95	0.882	84	92	81	80
Ramapo - PASSAIC CO, NJ	340315001	86	0.898	77	84	75	73
Botanical Garden - BRONX CO, NY	360050083	83	0.939	78	79	74	69
Queens College - QUEENS CO, NY*	360810124	83	0.894	74	83	74	73
Susan Wagner - RICHMOND CO, NY	360850067	93	0.904	84	91	82	79
Babylon - SUFFOLK CO, NY	361030002	93	0.917	85	90	82	78
Holtsville - SUFFOLK CO, NY	361030009	97	0.926	89	94	87	82
Riverhead - SUFFOLK CO, NY	361030004	83	0.901	74	81	72	70
White Plains - WESTCHESTER CO, NY	361192004	91	0.935	85	88	82	76
Danbury - FAIRFIELD CO, CT	90011123	95	0.897	85	93	83	81
Greenwich - FAIRFIELD CO, CT	90010017	95	0.913	87	91	83	79
Stratford - FAIRFIELD CO, CT	90013007	98	0.919	90	95	87	83
Westport - FAIRFIELD CO, CT	90019003	94	0.909	85	91	82	79
Middletown - MIDDLESEX CO, CT	90070007	95	0.888	84	93	82	81
Hamden - NEW HAVEN CO, CT*	90099005	93	0.912	85	93	84	81
Madison - NEW HAVEN CO, CT	90093002	98	0.905	88	94	85	82
SNJ/Phila. Nonattainment Area							
Fairhill - CECIL CO, MD	240150003	97	0.831	81	97	80	80
Brandywine Creek - NEW CASTLE CO, DE	100031010	92	0.875	81	90	78	74
Bellefonte - NEW CASTLE CO, DE*	100031013	90	0.873	78	85	74	71
Killens Pond - KENT CO, DE	100010002	88	0.891	78	87	77	72
Lewes - SUSSEX CO, DE	100051003	87	0.893	77	85	75	70
Lums Pond - NEW CASTLE CO, DE	100031007	94	0.843	79	88	74	73
Seaford - SUSSEX CO, DE	100051002	90	0.843	75	89	75	73
Bristol - BUCKS CO, PA	420170012	99	0.896	88	96	86	79
West Chester - CHESTER CO, PA*	420290050	95	0.868	82	95	82	79
New Garden - CHESTER CO, PA*	420290100	94	0.835	79	94	78	78
Chester - DELAWARE CO, PA	420450002	91	0.885	81	90	79	74
Norristown - MONTGOMERY CO, PA	420910013	92	0.883	81	92	81	76
Elmwood - PHILADELPHIA CO, PA	421010136	83	0.907	75	81	73	67
Lab - PHILADELPHIA CO, PA	421010004	71	0.906	64	69	62	57
Roxborough - PHILADELPHIA CO, PA	421010014	90	0.911	82	88	80	73
Northeast Airport - PHILADELPHIA CO, PA	421010024	96	0.901	87	94	84	78
Colliers Mills - OCEAN CO, NJ	340290006	106	0.868	92	104	90	86
Rider - MERCER CO, NJ	340210005	97	0.889	86	95	84	78
Ancora State Hospital - CAMDEN CO, NJ	340071001	100	0.872	87	99	86	82
Camden - CAMDEN CO, NJ	340070003	98	0.898	88	94	84	78
Clarksboro - GLOUCESTER CO, NJ	340155001	98	0.898	88	97	87	80
Millville - CUMBERLAND CO, NJ	340110007	95	0.847	81	94	79	78
Nacote Creek - ATLANTIC CO, NJ	340010005	89	0.874	77	87	76	72

*Note: 2002 Modeling Alternate Baseline Design Value calculated using the average of less than 5 years of monitoring data.

**For the Northern New Jersey/New York/Connecticut nonattainment area, the RRF_{min} = 0.874; for the Southern New Jersey/Philadelphia nonattainment area, the RRFmin = 0.831

Summary: Table D12.2 compares the calculated and modeled design values for the Northern New Jersey/New York/Connecticut nonattainment area monitors and the Southern New Jersey/Philadelphia nonattainment area monitors. The 2009 modeled design values calculated using the alternate 2002 modeling baseline design value are lower than the 2009 modeled values by an average 2 ppb.

For the Northern New Jersey/New York/Connecticut nonattainment area, 10 monitors showed 2009 modeled design values greater than 84 ppb using the USEPA baseline methodology but only 3 monitors showed 2009 modeled design values greater than 84 ppb (87, 87, and 85 ppb) using the alternate baseline methodology. For the Southern New Jersey/ Philadelphia nonattainment area, 7 monitors showed 2009 modeled design values greater than 84 ppb using the USEPA baseline methodology but only 3 monitors showed 2009 modeled design values greater than 84 ppb (90, 86, and 86 ppb) using the alternate baseline methodology. Use of this alternative baseline design value calculation method removes the excessive use of unusual meteorological influence of the 2002 ozone season and results in lower 2009 modeled design values.

Since the 2002 base year, upon which the ozone design value is heavily weighed, was an exceptionally hot summer, a better indication of what can be expected to occur in the future year is through the use of these alternative baseline design values. In the current case (2000-2004), the straight average removes a high bias. However, use of the straight average with data from other years could remove a low bias. For example, consider a modeling baseline design value for Colliers Mills centered on 2004, i.e. the years 2002-2006; the data are found in Table D12.1. 2004 is generally considered to be an unusually cool summer with ozone concentrations that were generally lower than years before or after it. Using the USEPA method for calculating a monitor's modeling baseline design value places more emphasis on the modeling baseline year ozone season (2004 in this example) than the other years used in the calculation, and results in a modeling baseline design value of 96 ppb. The straight average of the 4th highest ozone values over the same five years (2002-2006) is 98 ppb. In this case, the straight average method produces a higher baseline design value than the USEPA method, thus illustrating that the alternate method provides a more robust approach. Therefore, the use of the alternate base year design value gives a closer approximation to what can be expected to occur in future years.

Appendix D12-continued

Calculation Methodology for Alternative DVBs and RRFs

2. Method for Determining the Relative Response Factor (RRF) Method:

The purpose of using the Alternate Relative Response Factor and the Alternate Baseline Design Value to determine the Alternative Baseline Design Value (RRF) is to calculate the 2009 modeling design values for each nonattainment area monitor using an alternative relative response factor approach that uses the maximum response value for the nonattainment area. Recalculating the modeled design values ("alternate design value-response factor") using the minimum relative response factor (maximum response level) for the nonattainment area to show less bias (high or low) compared to the calculation in the USEPA methodology. The alternate baseline design value, multiplied by the maximum response factor, provides an alternate design value which should more closely reflect predicted future air quality.

Method: The 2009 modeled design values were calculated by multiplying the modeling baseline design values, based on monitored data, with a Relative Response Factor (RRF). The USEPA method uses the RRF associated with the maximum 8-hour ozone concentration in the grid cell associated with a monitoring site (i.e., maximum concentration of 9 grid cells - the monitoring grid cell plus the 8 grid cells surrounding the monitoring grid cell) averaged over a certain number of days when the ozone NAAQS is exceeded.

The Alternate RRF method is used to calculate the Alternative Design Value $(DVF)_{alt\text{-}r}$ by multiplying Alternative Design Value (see Table D12.2) with the minimum RRF from each multi-state nonattainment area that includes New Jersey (RRF_{min}).[4] The reason for using the minimum RRF is that this represents the maximum response. The minimum RRF for each nonattainment area was determined and applied in calculating the DVF_{alt} for each of the nonattainment areas. For example, if a 9 cell maximum ozone value of 90 ppb was multiplied by the average response RRF value, 0.878, the result would be 79 ppb. If a 9 cell maximum ozone value of 90 ppb was multiplied by the maximum response RRF value, 0.831, the result would be 75 ppb. Therefore, a maximum response RRF reflects a larger air quality response and thus lower ozone concentrations.

The $(RRF)_{min}$ was determined for both the Northern New Jersey/New York/Connecticut nonattainment and the Southern New Jersey/ Philadelphia nonattainment area by finding the lowest RRF value in each nonattainment area (See Table D12.2). The RRF for the monitors are listed in Table D12.2.

Table D12.3 lists the RRFs used in the RRF_{min} calculations.

[4] The lowest Relative Reduction Factor value in the nonattainment area

Table D12.3: Relative Response Factors for the Northern New Jersey/New York/Connecticut and Southern New Jersey/Philadelphia Nonattainment Areas*

Nonattainment Area	Maximum Response	Minimum Response	Average Response
Northern New Jersey/ New York/Connecticut	0.874[5]	0.939	0.905
Southern New Jersey/Philadelphia	0.831[6]	0.911	0.878

*The values in this table are the minimum, maximum and average RRFs from the 2009 BOTW modeling run for the ozone monitors in the entire nonattainment area.

Calculations:

The equation below summarizes the RRF method.

$(DVF)_{alt\text{-}r} = (RRF)_{min}\ (DVB)_{alt}$

where

$(DVF)_{alt\text{-}r}$ is the Alternate Design Value at each monitoring site calculated using the RRF method

RRF_{min} is the minimum RRF for the nonattainment area in which the monitor is located

$(DVB)_{alt}$ is the average of the fourth maximums for 2000 through 2004 at each monitoring site

Example:

The calculations, using the data for Colliers Mills as an example, are shown below:[7]

$(DVF)_{alt} = (RRF)(DVB)_{alt}$

$(DVF)_{alt} = (0.868)\ (104.4\ ppb)$

$= 90\ ppb$

$(DVF)_{alt\text{-}r} = (RRF)_{min}\ (DVB)_{alt}$

$(DVF)_{alt\text{-}r} = (0.831)\ (104\ ppb)$

$= 86\ ppb$

[5] This relative response factor is from the monitor at Rutgers University, Middlesex County, NJ
[6] This relative response factor is from the monitor at Fairhill, Cecil County, MD
[7] ibid.

From Table D12.2, the 2009 Modeled Design Value for Colliers Mills is 92 ppb.

Summary: The use of an average response RRF to calculate the 2009 modeled ozone design values shows air quality improvements that are already being measured in the air monitors in 2006. The maximum response[8] RRF for each of the New Jersey associated multi-state nonattainment areas (see Table D12.2) was applied to the alternative baseline design value for all the monitors in the nonattainment area and the 2009 modeled ozone design values were recalculated.

The 2009 modeled design values calculated using the alternate baseline and RRF values are lower by an average 5 ppb. Use of this alternative baseline design value calculation method removes the unusual meteorological influence of the 2002 ozone season and uses an RRF applying the maximum response to emission reductions within the nonattainment area. This calculation results in 2009 modeled design values within the range of the 2009 modeled design value ranges adjusted for transport. For example, the 2009 modeled design value range adjusted for transport for Colliers Mills is 81-88 ppb. The 2009 modeled design value is 92 ppb. And the 2009 modeled design value using the alternate 2002 modeling baseline value and maximum response RRF value is 86 ppb. This results in a modeled value, using the 2009 modeled design value (the USEPA's traditional approach), that falls within the range of design values adjusted for transport, therefore, further supporting New Jersey's demonstration of attainment.

[8] If a 9 cell maximum ozone value of 90 ppb was multiplied by the average response RRF value, 0.878, the result would be 79 ppb. If a 9 cell maximum ozone value of 90 ppb was multiplied by the maximum response RRF value, 0.831, the result would be 75 ppb. Therefore, a maximum response RRF reflects a larger air quality response and thus lower ozone concentrations.