Appendix S.1
Attainment Test

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ATTAINMENT TEST

I. Attainment Demonstration

This Appendix summarizes the procedures that were used to demonstrate attainment of the 8-hour ozone NAAQS in this SIP package. The modeling exercises for the 2011 attainment year were performed by the NCDAQ, with the results reviewed in close collaboration with the SCDHEC. As described in the USEPA's April 2007 *Final Guidance On The Use Of Models And Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze* ("*Attainment Guidance*"), an attainment demonstration consists of: (a) analyses which estimate whether selected emissions reductions will result in ambient concentrations that meet the NAAQS, and (b) an identified set of control measures which will result in the required emissions reductions. The necessary emission reductions for both of these attainment demonstration components may be determined by relying on results obtained with air quality models.

Section 3.0 of the *Attainment Guidance* recommends applying both a modeled attainment test and a subsequent screening test to the air quality modeling results to determine if the 8-hour ozone NAAQS will be met. Additional technical or corroboratory analyses may also be used as part of a "weight of evidence" determination to supplement the modeled attainment test and to further support a demonstration of attainment of the NAAQS.

The modeled attainment test, additional corroborative analyses and weight of evidence, and unmonitored area analysis are described in further detail in the remaining portions of this Appendix, detailing how the respective test or analysis was performed and applied to the attainment demonstration.

II. Modeled Attainment Test

The modeled attainment test is the practice of using an air quality model to simulate baseline (i.e., current) and future air quality. For the 8-hour ozone NAAQS, the baseline and future model estimates are used in a "relative" rather than "absolute" sense. Specifically, the ratio of the air quality model's future to baseline predictions is calculated at each ozone monitoring site. These monitoring site-specific ratios are called relative response factors (RRF). Future ozone design values (DVF) are then estimated at each monitor by multiplying the monitor-specific baseline ozone design value (DVB) by the modeled relative response factor for each monitor. If the resulting predicted site-specific DVFs are < 82 parts per billion (ppb), a clear demonstration of predicted attainment is shown. If the predicted DVFs are $\geq$ 82 ppb and $\leq$ 87 ppb, then a weight of evidence demonstration must be submitted that supports a demonstration of attainment. For DVFs > 87ppb, the *Attainment Guidance* states that more qualitative results are less likely to support a conclusion differing from the outcome of the modeled attainment test. Equation L-1 presents the modeled attainment test, applied at monitoring site "x" as described in Section 4.0 of the *Attainment Guidance*.

Future Design Value Equation:

(DVF) = (RRF) x (DVB)

Where (DVB) = the baseline design value monitored at site "x," ppb
= the average (of the three) design value periods which include the baseline inventory year (i.e. the average of the 2000-2002, 2001-2003, and 2002-2004 design values periods for the 2002 baseline inventory year).

(RRF) = the ratio of the future 8-hour daily maximum concentration predicted "nearby" a monitor (averaged over each day of the episode) to the current 8-hour daily maximum concentration predicted "nearby" the monitor (averaged over each day of the episode).

(DVF) = the estimated future design value, ppb.

It is important to consider an array of cells "nearby" a monitor rather than focusing on the individual cell containing the monitor. This allows for variations in the model performance where the peak ozone may not occur in the grid cell that contains the monitor but rather nearby the monitor. Table L-1 provides the USEPA's recommendations for defining "nearby" cells for grid systems having cells of various sizes. Since the attainment demonstration modeling was performed using a 12-kilometer grid resolution, the size of the array for "nearby" cells was 3 x 3.

Table L-1: USEPA's Recommendation for Defining "Nearby" Cells

Size of Cell (km)	Size of the Array of "Nearby" Cells
≤5	7 x 7
>5-8	5 x 5
>8-15	3 x 3
>15	1 x 1

The RRF is calculated by taking the ratio of the mean future year modeling 8-hour ozone daily maximum to the mean baseline year modeling 8-hour ozone daily maximum "near" the monitor.

Relative Response Factor Equation:

$$RRF = \frac{\text{mean future yr. 8-hr daily max "near" monitor "x"}}{\text{mean baseline yr. 8-hr daily max "near" monitor "x"}}$$

Section 14.1.1 of USEPA's *Attainment Guidance* outlines the process for determining which days are used in the RRF calculation. The day selection process starts by identifying all the days in the baseline modeling that has a modeled daily maximum 8-hour average ozone equal to or greater than 85 ppb. If there are 10 or more days greater than 85 ppb, then 85 ppb is used as the cutoff in the RRF calculation. If there are fewer than 10 days with a modeled daily maximum 8-hour average ozone equal to or greater than 85 ppb, then the threshold is reduced by 1 ppb until there are at least 10 days identified for use. If there are fewer than 10 days with a modeled daily maximum 8-hour average ozone equal to or greater than 70 ppb, then all days at 70 ppb and higher are used in the RRF calculation and consideration of modeling another episode should be explored.

The DVB, for purposes of the modeled attainment test, is defined in the *Attainment Guidance* by one of four methods:

1. The design value period (i.e. the average 4th highest value for the 3-year period used to designate an area "nonattainment," for this nonattainment designation, the period from 2001 to 2003);

2. The average 4th highest value for the 3-yr period straddling the baseline inventory year (e.g., the 2001-2003 design value period for the 2002 baseline inventory year);

3. The highest of the three design value periods which include the baseline inventory year (e.g., the 2000-2002, 2001-2003, 2002-2004 design value periods for a 2002 baseline inventory year); and

4. The average of the three design value periods which straddle the baseline inventory year (e.g., the average of the 2000-2002, 2001-2003, and 2002-2004 design value periods for a 2002 baseline inventory year).

The USEPA recommends the fourth method (average of the three design value periods straddling the baseline year), which is the DVB shown in Table 2-2 and Table 2-3 at each ozone monitoring site in the Metrolina region.

As mentioned earlier in this document, the mandated attainment date for the Metrolina nonattainment area is June 15, 2010, which requires the 1997 8-hour ozone standard to be attained by the end of 2009. Since the NCDAQ and the SCDHEC believe that it may be necessary to request two one-year extensions of the attainment date, the expected attainment year is 2011. The results for both years have been calculated. Table L-2 lists the attainment test results for 2009 by monitor in the Metrolina area. Similarly, Table L-3 lists the attainment test results for 2011. In both tables, the first column is the monitoring site, then the county of the monitoring site's location, followed by the DVB used for the attainment test. The next series of columns are the number of days used in the calculation, the ozone level threshold needed to reach at least 10 days for RRF, the calculated RRF, and finally the resulting DVF for the 2009 and 2011 attainment years, respectively. The bold italicized DVFs are values that fall within the range where additional weight of evidence is needed to demonstrate attainment. Based on the 2009 modeling, half of the monitors in the Metrolina nonattainment area have predicted DVFs that fall below 82 ppb and the other half fall between 82 ppb and 87 ppb. By 2011, only two of the monitors are predicted to have DVFs that fall between 82 ppb and 87 ppb with the other six sites falling below 82 ppb. With either the 2009 or the 2011 modeling predictions, additional weight of evidence is required to demonstrate attainment. The NCDAQ and the SCDHEC believe that the weight of evidence presented in Section 3 fully supports a demonstration of attainment.

Table L-2: Metrolina Attainment Test Results for 2009

Monitoring Site	County	DVB (ppb)	Number of Days used in RRF	Ozone Threshold (ppb)	RRF	DVF (ppb)
Arrowood	Mecklenburg	84.7	18	85	0.883	74
County Line	Mecklenburg	97.3	12	85	0.875	***85***
Crouse	Lincoln	90.7	10	84	0.867	78
Enochville	Rowan	97.0	12	85	0.870	***84***
Garinger (Plaza)	Mecklenburg	95.3	20	85	0.888	***84***
Monroe	Union	87.0	11	79	0.884	76
Rockwell	Rowan	97.3	12	83	0.861	***83***
York	York, SC	83.0	10	82	0.861	71

Table L-3: Metrolina Attainment Test Results for 2011

Monitoring Site	County	DVB (ppb)	Number of Days used in RRF	Ozone Threshold (ppb)	RRF	DVF (ppb)
Arrowood	Mecklenburg	84.7	15	85	0.854	72
County Line	Mecklenburg	97.3	12	85	0.846	***82***
Crouse	Lincoln	90.7	10	83	0.829	75
Enochville	Rowan	97.0	13	85	0.837	81
Garinger (Plaza)	Mecklenburg	95.3	20	85	0.862	***82***
Monroe	Union	87.0	12	78	0.858	74
Rockwell	Rowan	97.3	10	83	0.837	81
York	York, SC	83.0	13	81	0.841	69

III. Additional Corroborative Analyses And Weight Of Evidence Determination

As part of the weight of evidence determination, the following analyses will be evaluated:

- Alternative DVFs calculations,
- Metrics of air quality modeling results,
- Air quality modeling results from other studies,
- Observed air quality trends and additional reductions in emissions, and
- Local measures not modeled.

The weight of evidence determination is a supplement to the modeled attainment test and further supports that the area will attain the NAAQS for 8-hour ozone by the attainment date. Based on the air quality measurements for 2007 through 2009, a monitor in the Metrolina nonattainment area has a design value above the 1997 8-hour ozone standard. However, the Metrolina area does have clean data for 2009 and meets the requirements to request a one-year extension of the attainment date. Since the ambient air quality measurements for 2008 were high, the NCDAQ believes that it may be necessary to request a second one-year extension of the attainment date.

A. Alternative DVF Calculation

The NCDAQ used the USEPA recommended method of calculating the DVB in its modeled attainment test. However, the NCDAQ has commented several times on various draft versions of the attainment guidance that they do not believe that a weighted DVB is appropriate and that a DVB calculated using a straight average minimizes the impacts of any abnormally hot/dry or cool/wet meteorological conditions. As part of the weight of evidence demonstration, the NCDAQ proposes an alternative method to calculate the DVB and presents the modeled attainment test results with this alternative DVB.

The USEPA recommends calculating the DVB by averaging the three design value periods that straddle the baseline inventory year. This methodology results in a center weighting of annual 4th highest ozone concentrations around the baseline inventory year because the three design value periods averaged contain overlapping data. The simplified recommended DVB calculation for this SIP modeling exercise is shown below.

Recommended Baseline Design Value Equation:

$$DVB = \frac{1*(2000\ 4^{th}\ Highest) + 2*(2001\ 4^{th}\ Highest) + 3*(2002\ 4^{th}\ Highest) + 2*(2003\ 4^{th}\ Highest) + 1*(2004\ 4^{th}\ Highest)}{9}$$

The weighting scheme of annual 4th highest ozone concentrations in the recommended DVB calculation weights the center, or third, year three times more than that of the first or last year and one and half times more than that of the second or forth year. If this third year is an abnormally hot/dry or cool/wet period, the unusual meteorological conditions and resulting air quality conditions will be amplified upward or downward in the modeled attainment exercise.

To minimize potential impacts of any abnormal meteorological conditions while still considering ozone conditions across a five-year span, an alternative DVB calculation that does not weight any of the years more than another, but is a straight average of annual 4th highest ozone concentrations for the five-year span centered on the baseline inventory year was considered.

Recommended Baseline Design Value Equation:

$$DVB = \frac{2000\ 4^{th}\ Highest + 2001\ 4^{th}\ Highest + 2002\ 4^{th}\ Highest\ \ 2003\ 4^{th}\ Highest + 2004\ 4^{th}\ Highest}{5}$$

The results of applying the five-year straight average DVB to the remainder of the Modeled Attainment Test equations, at each monitoring site in the Metrolina region are shown in Table L-4 and Table L-5.

Table L-4: Five-Year Average Alternative Attainment Test Results for 2009

Monitoring Site	County	DVB 5-Year Straight Average 2000-2004 (ppb)	RRF	DVF (ppb)
Arrowood	Mecklenburg	83.4	0.883	73
County Line	Mecklenburg	95.6	0.875	***83***
Crouse	Lincoln	89.2	0.867	77
Enochville	Rowan	94.4	0.870	***82***
Garinger (Plaza)	Mecklenburg	93.8	0.888	***83***
Monroe	Union	84.6	0.884	74
Rockwell	Rowan	94.6	0.861	81
York	York, SC	79.8	0.861	68

Table L-5: Five-Year Average Alternative Attainment Test Results for 2011

Monitoring Site	County	DVB 5-Year Straight Average 2000-2004 (ppb)	RRF	DVF (ppb)
Arrowood	Mecklenburg	83.4	0.854	71
County Line	Mecklenburg	95.6	0.846	80
Crouse	Lincoln	89.2	0.829	73
Enochville	Rowan	94.4	0.837	79
Garinger (Plaza)	Mecklenburg	93.8	0.862	80
Monroe	Union	84.6	0.858	72
Rockwell	Rowan	94.6	0.837	79
York	York, SC	79.8	0.841	67

In comparison to the respective DVF values found in Table L-2 and Table L-3, the DVF values in Table L-4 and Table L-5 are slightly lower at each monitoring site. These differences were expected, as 2002 was an abnormally hot and dry year throughout the Southeast with ozone concentrations that were higher than in the surrounding years of 2000, 2001, 2003, and 2004. Figure L-1 below illustrates this by charting the number of days with temperatures greater than 90 degrees F versus the maximum fourth highest 8-hour ozone value for the Metrolina area. Comparing 2002 to the surrounding years used in the DVB (2000, 2001, 2003 and 2004), 2002 had significantly more days with greater than 90 degrees ºF temperatures. Similarly, the maximum fourth highest 8-hour ozone value was approximately five ppb higher than the surrounding years used in the DVB.

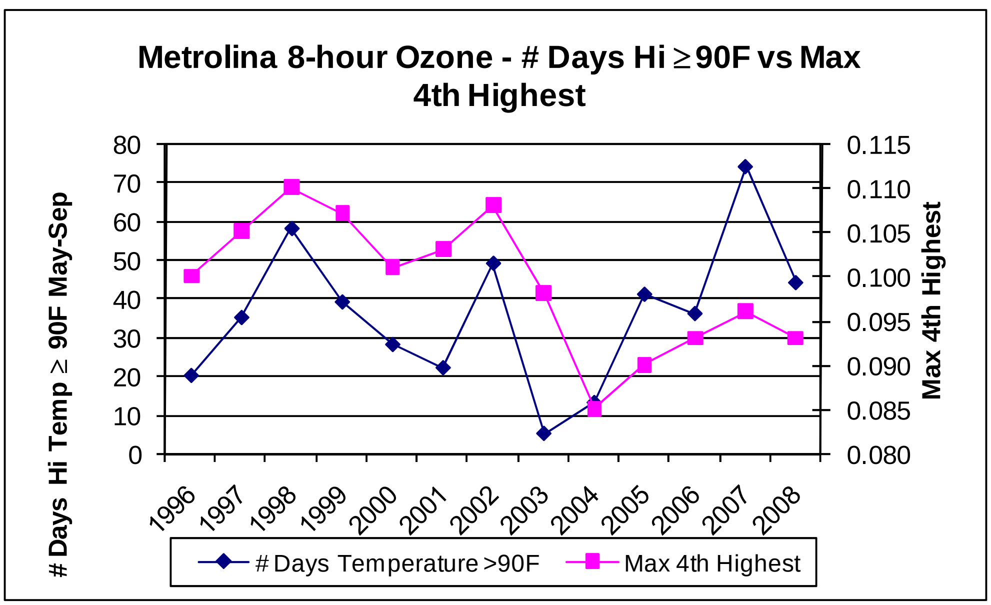


Figure L-1: Charts the number of days greater than 90 degree F versus the 4th highest 8-hour ozone value for the Metrolina area.

Thus, the recommended DVB calculation weighted the higher air quality conditions several times more than in the NCDAQ alternative DVB calculations. The NCDAQ firmly believes that the non-weighted or straight five-year average approach to the DVB calculation is more appropriate and minimizes dramatic fluctuations in meteorological and air quality conditions from year to year. This would be the case whether the center weighted year was an abnormally hot/dry year or a cool/wet year.

While none of the monitoring sites in the Metrolina region had DVF values at or above 85 ppb in Table 3.1-1 or Table 3.1-2 using the NCDAQ alternative DVB calculation, there are still three monitors in Table 3.1-1 that have DVFs that fall between 82 ppb and 87 ppb. This continues to indicate that some additional weight of evidence should still be included to demonstrate attainment. These results are not inconsistent with what was concluded using all recommended modeled attainment test calculations.

B Air Quality Modeling Metrics

In Section 7.0 of the *Attainment Guidance*, various aspects of air quality models, modeled performance, and uncertainties associated with the length of modeled episodes and limited observational datasets are described. A series of three additional air quality modeling outputs or metrics is recommended to provide assurance the modeled demonstration indicates attainment. These metrics look at the relative change between the baseline and future years modeling and help to demonstrate how widespread the improvement in air quality is expected to be in the future. Although the final guidance did not recommend percentage cut points that corresponds to supportive weight of evidence, an earlier draft version of the *Attainment Guidance* recommends that the metrics should be at least 80 percent or higher.

As described in Section 7.1 of the *Attainment Guidance*, the modeling data for the area displayed in Figure 5.2-1 from the 2002, 2009, and 2011 modeling were applied to the following metrics:

1. <u>Relative change in surface grid-hours greater than 84 ppb</u>. This metric is termed Persistence-Hour and is defined as the number of grid-cells in a given region with predicted hourly 8-hour ozone concentrations greater than 84 ppb. The relative change in Persistence-Hour is presented as a percent reduction computed for the modeling period May through September from the baseline year case to the future year case.

2. <u>Relative change in the number of grid cells with predicted 8-hour daily maxima greater than 84 ppb.</u> This metric is termed Persistence-Daily metric and is similar to Persistence-Hour, but uses the modeled daily maximum 8-hour ozone concentrations greater than 84 ppb instead of the hourly 8-hour ozone concentrations. The relative change in Persistence-Daily is also presented as a percent reduction computed for the modeling period May through September from the baseline year case to the future year case.

3. <u>Relative change in the sum of hourly predictions greater than 84 ppb.</u> This metric is termed Severity-Hour and is defined as the sum of all grid-cells with predicted hourly 8-hour ozone concentrations greater than 84 ppb. Given the definition of Persistence, this Severity could be considered as a weighted form of the Persistence metric. The relative change in Severity is also presented as a percent reduction computed for the modeling period May through September from the baseline year case to the future year case.

In addition to the three recommended metrics, two additional metrics were computed to create a comprehensive corroborative analysis. The two additional metrics are:

4. Relative change in the sum of the predicted 8-hour daily maxima greater than 84 ppb. Severity-Daily metric is similar to Severity-Hour, but uses the modeled daily maximum 8-hour ozone concentrations greater than 84 ppb instead of the hourly 8-hour ozone concentrations. The relative change in Severity-Daily is also presented as a percent reduction computed for the modeling period May through September from the baseline year case to the future year case.

5. Air Quality Index (AQI) Counts. The AQI Counts metric is a count of the number of grid-cells with predicted maximum 8-hour ozone concentrations sorted within each of the Code Green, Yellow, Orange and Red categories, as defined by the USEPA's AQI Index. As with the persistence and severity metrics, the AQI counts metric can be applied to both hourly and daily maximum 8-hour ozone concentrations. AQI Counts are presented as percentages of the total number of grid-cells within the study region.

The metrics described above were applied to the modeling results for just of the nonattainment area. Below, Figure L-2 depicts the region for which this modeling data was extracted for the 2002 baseline and the 2009 and 2011 attainment year modeling runs.

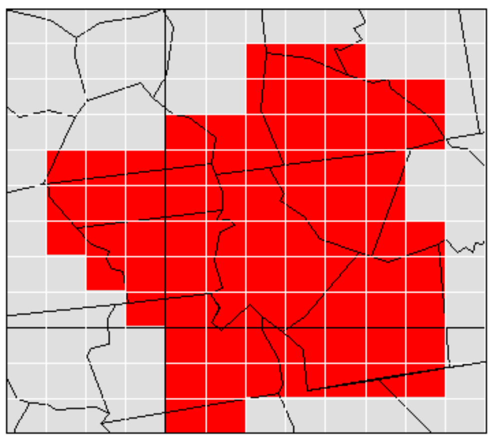


Figure L-2: Area for which the air quality metrics were applied.

The results from each of the five air quality modeling metric calculations demonstrated significant reductions of greater than 85 percent in the 2009 future year air quality modeling and greater than 90 percent in the 2011 future year air quality modeling for days that modeled above the NAAQS in the Metrolina nonattainment area. Each metric demonstrated very large relative reductions for 2009 and demonstrated more substantial reductions for 2011. It is important to note that the relative reductions in all metrics well surpassed the draft version of the *Attainment Guidance* recommendation of 80 percent for these particular calculations.

It should be noted that a minor alteration in the spatial distribution of the emissions inventory in the 2011 air quality modeling required a rerun of the air quality model for the 2002 baseline year to appropriately calculate the 2011 based RRFs without introducing any modeling bias due to the minor emissions inventory spatial distribution alteration. So, there are subtle differences in the hourly and daily grid cell counts for 2002.

Figure L-3 presents the relative reductions calculated in the first four metrics described above. The left two bars are the Persistence-Hour and Persistence-Daily reductions, and the right two bars are the

Severity-Hour and Severity-Daily reductions. The 2009 modeling results demonstrate a 90.0 percent reduction in persistence of hourly maximum ozone and 86.4 percent reduction in persistence of daily maximum ozone. The severity reductions for 2009 are on a similar scale of 90.3 percent and 86.9 percent reduction for hourly and daily maximum ozone, respectively. The 2011 modeling results demonstrate a 97.4 percent reduction in persistence of hourly maximum ozone and 95.9 percent reduction in persistence of daily maximum ozone. The severity reductions for 2011 are equally on a similar scale of 97.5 percent and 96.1 percent reduction for hourly and daily maximum ozone, respectively.

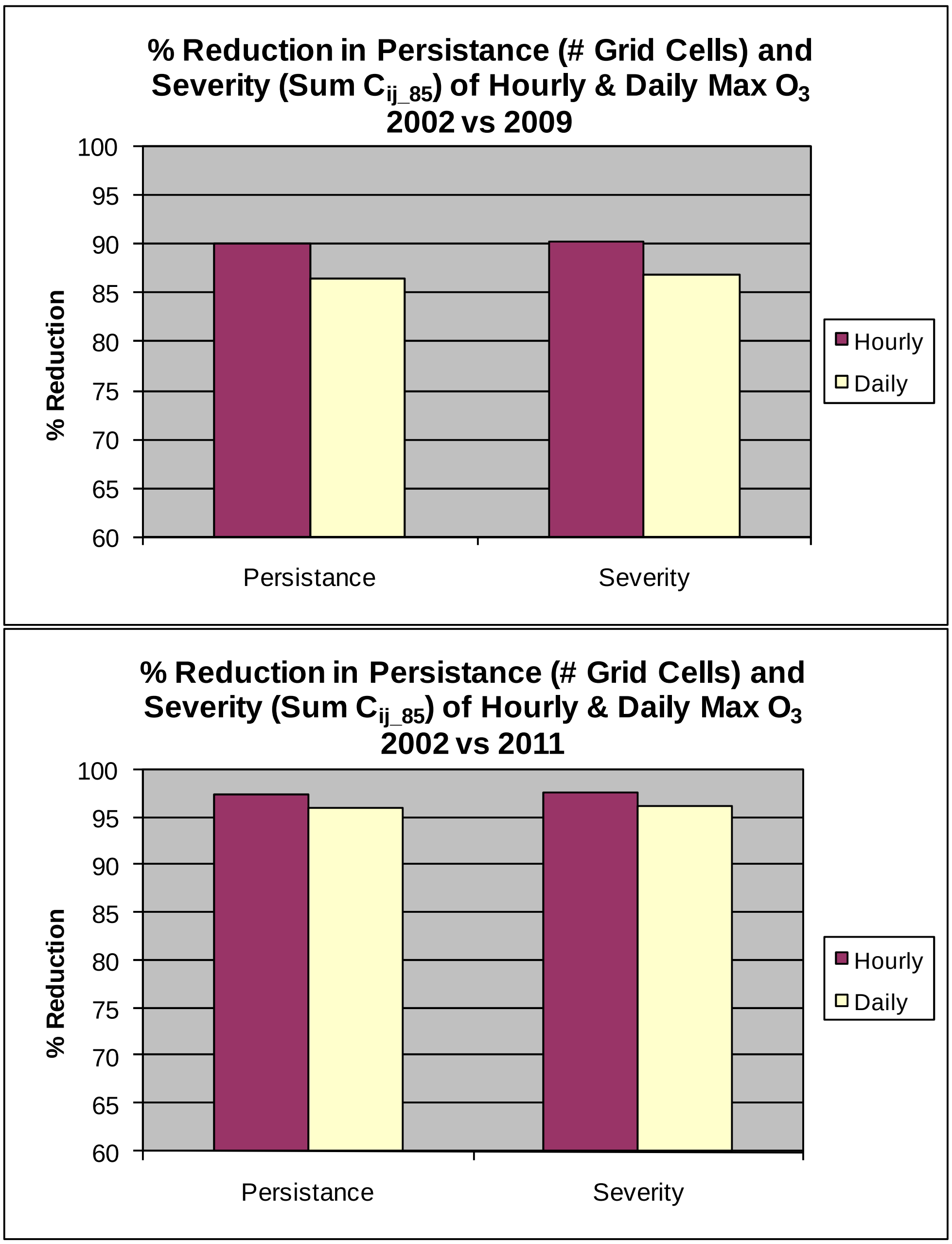


Figure L-3: Persistence and Severity for the Metrolina Area.

Equating the 86.4 percent relative reduction in the daily maximum ozone persistence to AQI Counts, the top portion of Figure L-4 demonstrates a drop from 339 grid cells in the Code Orange and Red levels in the 2002 baseline modeling to 46 grid cells in the 2009 future modeling. Furthermore, the number of grid cells in the Code Yellow and above (>65 ppb) range is reduced by 51.9 percent from 3,600 grid cells in 2002 to 1,733 grid cells in 2009. When the 2011 future year modeling is considered in the bottom portion of Figure 3.2-3, the 95.9 percent relative reduction in the daily maximum ozone persistence translates into a drop from 317 grids cells in the Code Orange and Red levels in 2002 to only 13 grid cells in 2011. Additionally, the number of grid cells Code Yellow and greater is reduced by 65.0 percent from 3,503 grid cells in 2002 to 1,227 grid cells in 2011.

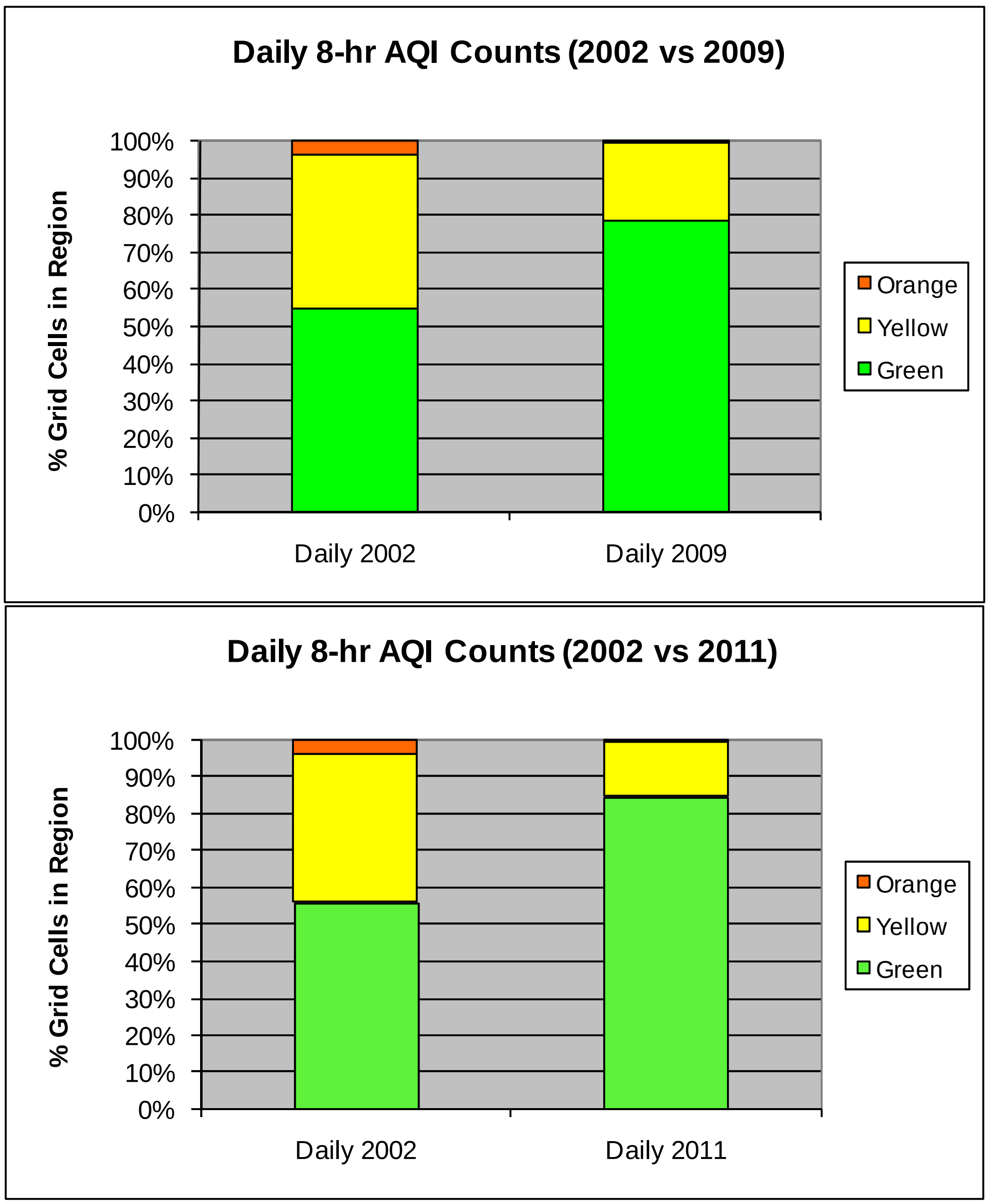
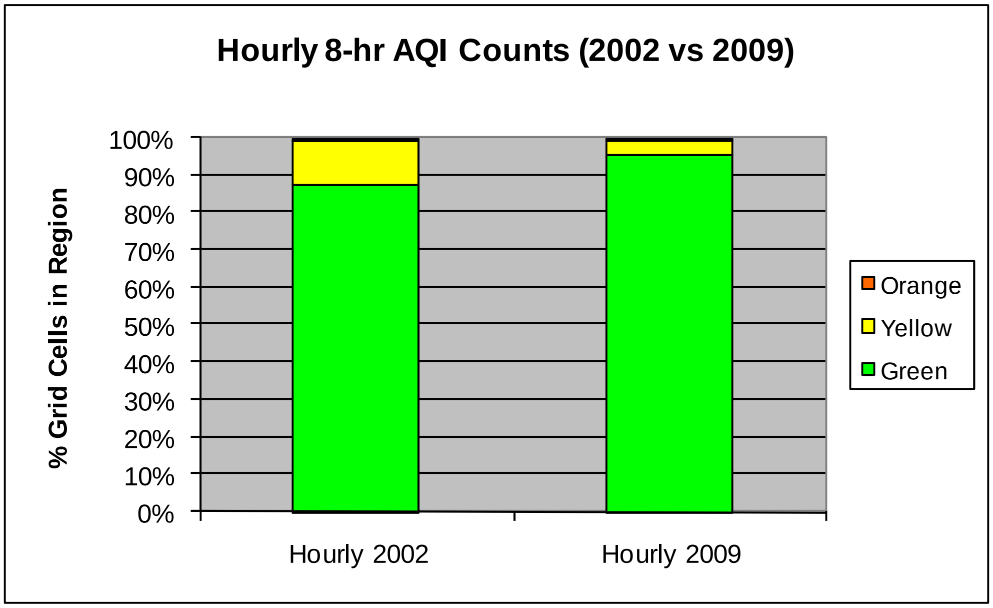


Figure L-4: Daily AQI counts for the Metrolina Area.

The hourly AQI Counts are equally encouraging. For 2009, Figure L-5 (top) displays the 90.0 percent relative reduction in hourly persistence in terms of the AQI counts. It corresponds to a reduction from 1,315 hourly grid cells in the Code Orange and Red levels in the baseline modeling to only 131 hourly grid cells in the 2009 future year modeling. Looking at all hourly grid cells Code Yellow and greater, the count is reduced from 24,230 to 8,959, which translates to a 63.0 percent reduction. Figure L-5 (bottom) presents the 97.4 percent relative reduction in hourly persistence in terms of the AQI counts for 2011. This reduction translates to a reduction from 1,195 hourly grid cells in the Code Orange and Red levels in 2002 to only 31 hourly grid cells in 2011. The reduction in hourly grid cell Code Yellow and greater is equally impressive with a reduction from 23,336 to 5,874. This is a 74.8 percent reduction from 2002 to 2011.



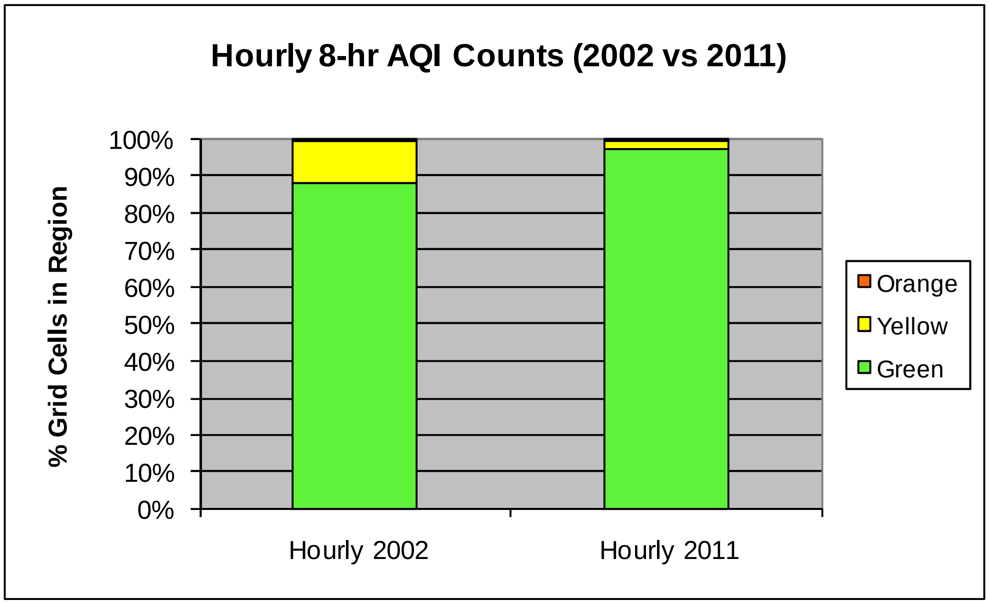


Figure L-5: Hourly AQI Count for the Metrolina Area.

The tremendous improvements in air quality from the 2002 baseline year to the 2009 and 2011 future years can further be illustrated by looking at just the percentage of occurrence of the Code Yellow and Orange grid cells throughout the Metrolina area. Figures L-6 and L-7 present metric for 2009 (top) and 2011 (bottom) in terms of the daily and hourly percentage of occurrence, respectively.

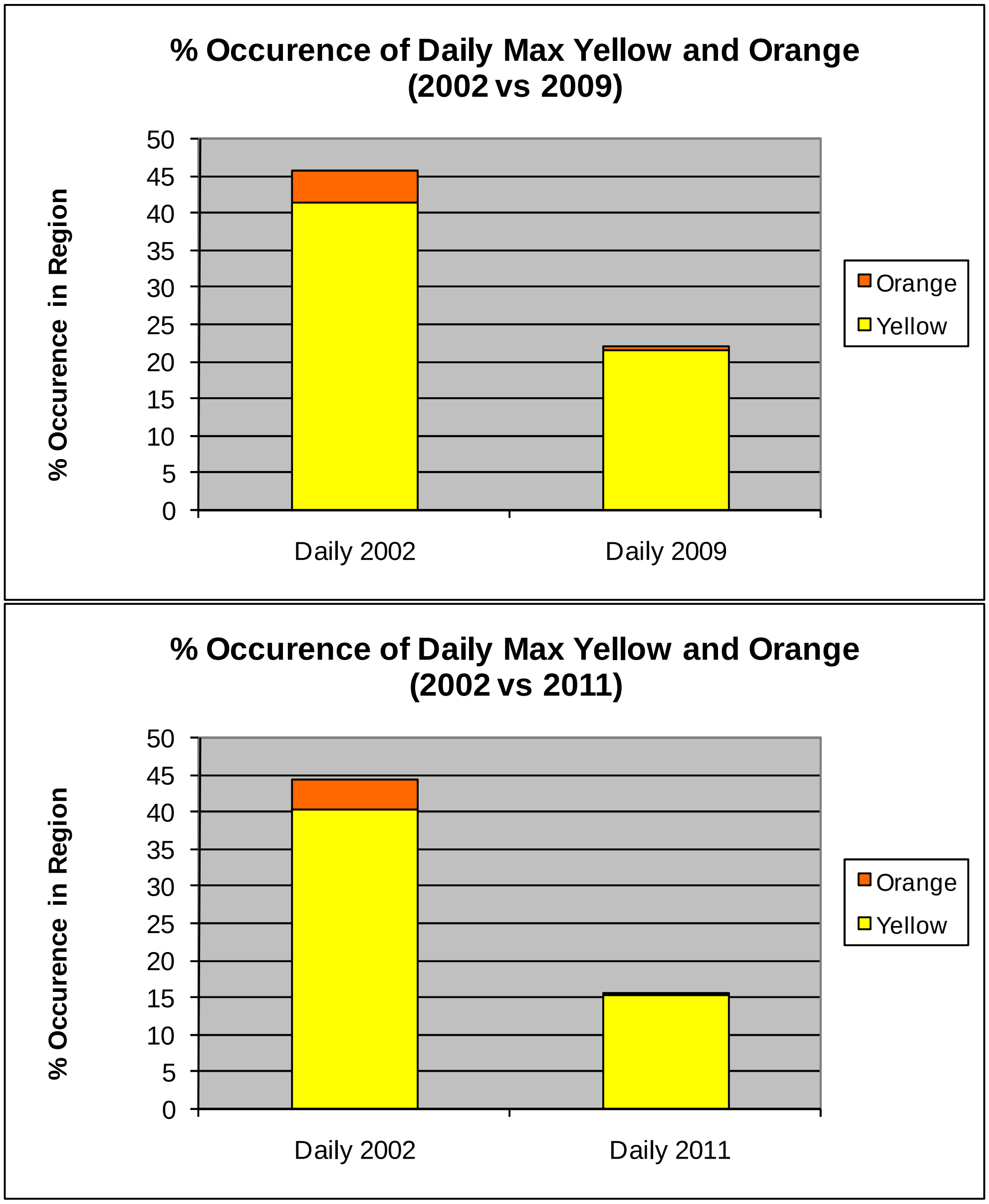
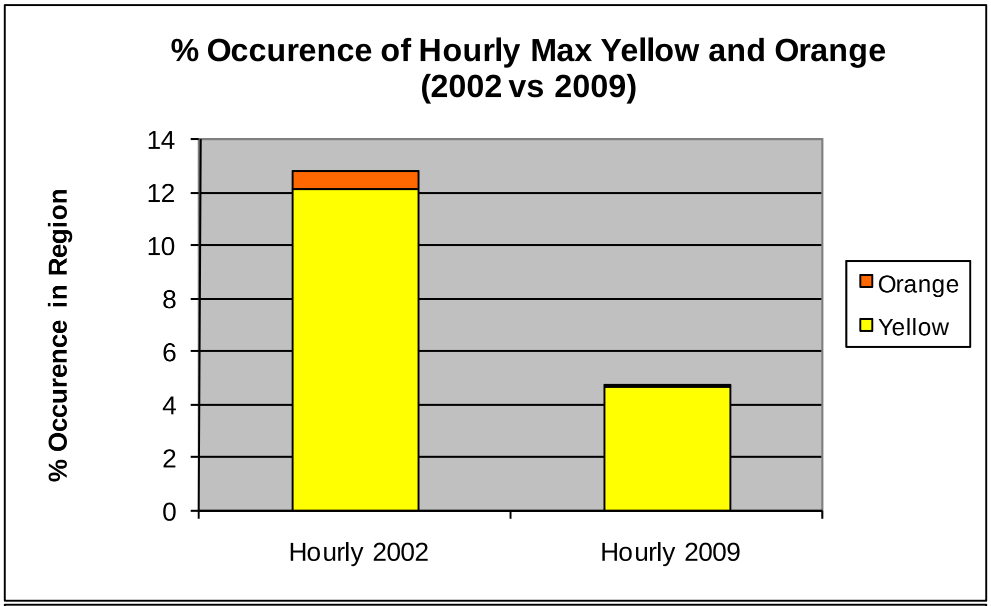


Figure L-6: Percent Occurrence of Daily Maximum Code Yellow and Code Orange Grid Cells for the Metrolina Area.



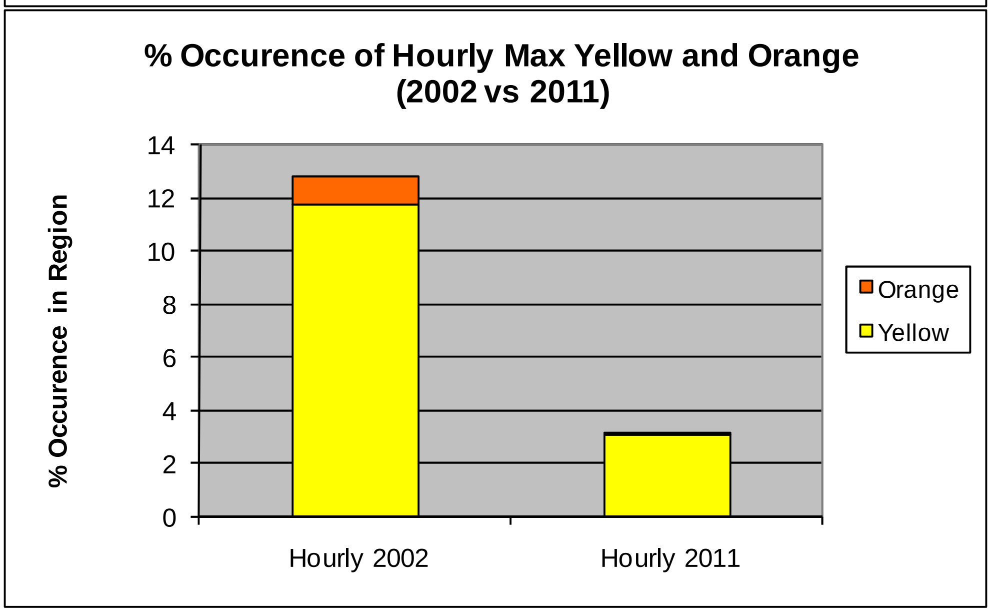


Figure L-7: Percent Occurrence of Hourly Maximum Code Yellow and Code Orange Grid Cells for the Metrolina Area.

Finally, all of the AQI grid cell counts displayed in Tables L-4 through L-7 are summarized below. Table L-6 contains all of the grid cell counts for both the Hourly and Daily AQI Count analyses for the 2002 baseline and 2009 future year modeling. Similarly, Table L-7 contains all of the grid cell counts for both the Hourly and Daily AQI Count analyses for the 2002 baseline and 2011 future year modeling.

Table L-6: Total number of grid cells for the AQI Categories 2002 vs 2009.

	Grid Cells		Grid Cells	
	Daily 2002	Daily 2009	Hourly 2002	Hourly 2009
Green	4304	6171	165466	180737
Yellow	3261	1687	22915	8828
Orange	339	46	1315	131
total	7904	7904	189696	189696

Table L-7: Total number of grid cells for the AQI Categories 2002 vs 2011.

	Daily 2002	Daily 2011	Hourly 2002	Hourly 2011
Green	4401	6677	166330	183822
Yellow	3186	1214	22171	5843
Orange	317	13	1195	31
total	7904	7904	189696	189696

C. Air Quality Modeling Results From Other Studies

Another recommended weight of evidence analysis is to review other air quality modeling results that included the Metrolina nonattainment area to determine how other modeling results compare to the attainment demonstration. There are two air quality modeling studies to which results are available for the Metrolina area.

The first is the EAC modeling that the NCDAQ performed for the EAC areas within North Carolina. Since the modeling domain for this analysis covered the majority of North Carolina, including the Metrolina nonattainment area, the modeling results can be easily compared to the attainment demonstration. There are some differences between the two modeling exercises. One difference is that the EAC modeling was carried out on 4 episodes (one in 1995, two in 1996 and one in 1997) for a total of sixteen days. Another is the DVB is based on the higher of the 1999-2001 or 2001-2003 design values. Finally, the EAC modeling did not model 2009, but there are results for 2007 and 2012. Table L-8 displays the EAC modeling results for the Metrolina monitors for both of these future years.

Table L-8: Metrolina DVFs based on EAC Modeling

Monitoring Site	County	DVB (ppb)	2007		2012	
			RRF	DVF (ppb)	RRF	DVF (ppb)
Arrowood	Mecklenburg	092	0.891	82	0.848	78
County Line	Mecklenburg	101	0.861	**87**	0.802	81
Crouse	Lincoln	92	0.870	80	0.826	76
Enochville	Rowan	99	0.879	**87**	0.818	81
Garinger (Plaza)	Mecklenburg	98	0.888	**87**	0.816	80
Monroe	Union	88	0.852	75	0.795	70
Rockwell	Rowan	100	0.870	**87**	0.800	80

As can be seen from the EAC modeling, although there are still four monitors slightly above the 8-hour ozone standard in 2007, all of the monitors are well below the standard by 2012. It should be noted that for the Greensboro/Winston-Salem/High Point EAC area, the EAC attainment test results predicted the highest monitor in the area to be at 83 ppb in 2007 and the actual 2005-2007 design value for the area was 83 ppb.

Another air quality modeling exercise that contained results for the Metrolina nonattainment area is the USEPA's modeling for CAIR. The Technical Support Document for the final CAIR, March 2005, provided modeling results with and without the implementation of the CAIR. Differences between the USEPA's modeling and the attainment demonstration are: 1) the meteorology was for 2001, 2) the DVB was the weighted design values the 1999-2003 period, and 3) the modeling results were for 2010. These modeling results are listed in Table L-9.

Table L-9: Metrolina DVFs based on the USEPA's CAIR Modeling

County	DVB (ppb)	DVF (ppb)	
		2010 Base	2010 CAIR
Lincoln	92.3	76.1	74.5
Mecklenburg	100.3	82.5	81.4
Rowan	99.7	81.3	80.1
Union	87.7	71.9	71.1
York, SC	83.3	70.0	68.5

The USEPA's results were for the highest monitor in a county where more than one monitor is located. The USEPA's modeling results predict that the Metrolina nonattainment area should be below the 8-hour ozone standard by 2010. Therefore, this modeling supports weight of evidence that the Metrolina area will attain the 8-hour ozone standard by 2011.

D. Air Quality Trends and Additional Reductions in Emissions

Since the 8-hour ozone designation for the Metrolina area, the 8-hour ozone design values have improved significantly. The 2001-2003 design value period had values as high as 100 ppb and six out of the seven North Carolina monitors in the area were violating the NAAQS. Preliminary data indicates that for the latest design value period, 2007-2009, the highest violating monitor, the County-Line monitor in Mecklenburg County, will have a value of 86 ppb and only that monitor will exceed the NAAQS (See Table L-10).

Table L-10: Design Values (ppb) for the North Carolina Monitors in the Metrolina Area

Monitoring Site	County	2001-2003	2002-2004	2003-2005	2004-2006	2005-2007	2006-2008	2007-2009
Arrowood	Mecklenburg	84	81	78	80	83	79	75
County Line	Mecklenburg	**98**	**92**	**87**	**88**	**93**	**94**	**86**
Crouse	Lincoln	**92**	**86**	81	79	83	82	76
Enochville	Rowan	**99**	**91**	**85**	**85**	**90**	**88**	82
Garinger (Plaza)	Mecklenburg	**96**	**91**	**86**	**88**	**90**	**89**	82
Monroe	Union	**88**	**85**	79	78	81	80	76
Rockwell	Rowan	**100**	**94**	**88**	83	**89**	**88**	83
York	York, SC	84	81	75	76	79	77	71

The current ozone design values are very close to the predicted attainment year design values. The reduction in design values since the area was designated nonattainment is attributed to significant reductions in NO_x emissions that have occurred. The emission reductions from the NO_x SIP call occurred between 2004 and 2007, the initial Phase I year for CAIR is 2009, and every year the mobile source fleet becomes cleaner and reduces the NO_x emissions from the highway and off-road mobile source sectors.

All of these reductions have contributed to the improvement of the design values. In fact, the air quality measurements for 2009 exhibit clean data, i.e. the fourth highest value at each monitor is below the 1997 8-hour ozone standard.

Continued reductions of emissions from the mobile source sector and the utility sector will influence the ozone formation in this region. The NCDAQ has estimated that there will be approximately 7.6 tons per day of NO_x emissions reduced each year from the highway and off-road mobile sectors. These reductions are the result of federal motor vehicle and equipment engine standards for both highway vehicles and off-road equipment, respectively.

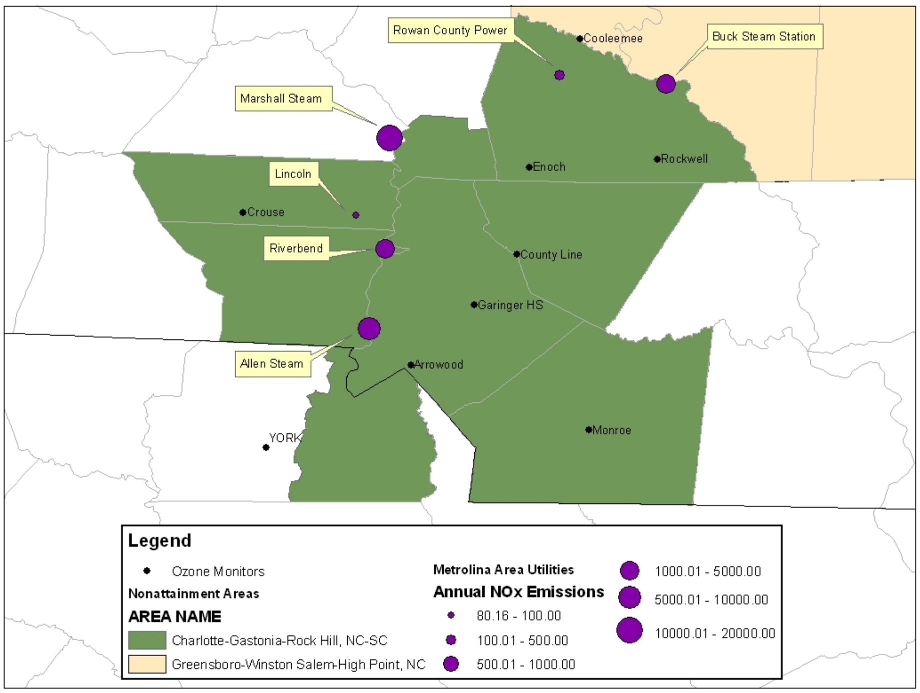


Figure L-8: Location and size of the Duke Energy facilities located in the vicinity of the Metrolina nonattainment area.

Additionally, the overall background levels of ozone are expected to decrease as the utilities in the eastern United States put on additional controls to meet CAIR as well as the reduction in emissions of highway and off-road mobile sources throughout the country. For North Carolina, 2009 is the final compliance year for the NO_x emission caps for the Clean Smokestacks Act. Figure L-8 displays the location and size of the Duke Energy facilities located in the vicinity of the Metrolina nonattainment area. Table L-11 lists the units that are in and around the Metrolina area and shows the year the controls recently came on line and the estimated amount of NO_X emissions reductions for the ozone season.

Table L-11: Utility NOx Emission Reductions since 2006 Ozone Season

Facility	County	Technology	Operational Date	Ozone Season Reductions (tons/season)
Allen Steam Station Unit 2	Gaston	SNCR	Spring 2007	~300

Facility	County	Technology	Operational Date	Ozone Season Reductions (tons/season)
Unit 3		SNCR	Fall 2007	
Buck Steam Station Units 3 & 4 Units 5 & 6	Rowan	Low NOx Burners SNCR	Spring 2007 Fall 2006	~350
Riverbend Unit 4 Unit 5 Unit 6 Unit 7	Gaston	SNCR SNCR & Burners SNCR & Burners SNCR	Spring 2007 Spring 2007 Fall 2006 Fall 2006	~325
Marshall Steam Station Unit 2 Unit 3 Unit 4	Catawba	SNCR SCR SNCR	Spring 2007 Fall 2008 Fall 2006	~2,300
Total expected reduction = 3,275 tons/ozone season				

SNCR = Selective Non-Catalytic Reduction
SCR = Selective Catalytic Reduction

The combination of the highway and off-road mobile sources and utility NO_x emission reductions that occurred in the Metrolina area between the end of the 2006 ozone season and before the beginning of the attainment year 2009 was significant. The additional NO_x emission reductions in the area that resulted in the Metrolina area having clean data for 2009, which will allow the State to request a one-year extension of the attainment date.

E. Local Measures not Modeled

As discussed in Section I of the attainment demonstration narrative, the Metrolina nonattainment area is a NO_x limited area and the largest sources of NO_x emissions in this region come from mobile sources (highway and off-road) and electric generating facilities. A significant source of NO_x emission reductions that has not been included in the 2009 modeling is the addition of a SCR unit at Marshall Unit 3. When the modeling was started, Duke Energy had installed a SNCR unit at Marshall Unit 3. However, since the expected 2009 Duke Energy system-wide NO_x emissions is very close to the Clean Smokestack Act annual budget for this company, Duke Energy has announced that they plan to install a SCR unit in order to provide a safety margin in meeting the Clean Smokestack Act NO_x budget. As can be seen in Figure L-8 in the previous section, the Marshall Steam Station is located north of and adjacent to the Metrolina nonattainment area. The additional NO_x emission reductions expected at this facility caused an impact on the ozone formation in the Metrolina area on days when the winds are coming from the North/Northwest and on days when there is recirculation occurring. This SCR unit was installed in the Fall of 2008 and was operational at the beginning of 2009. The unit was modeled with the expected emissions reductions for the 2011 attainment year. A copy of the 2009 compliance plan for Duke Energy documenting the installation of the SCR at Marshall Unit 3 can be found in Appendix M. In addition to the Marshall NO_x emission reductions, the Metrolina area has a number of groups that work towards decreasing emissions. These measures are voluntary measures that, although they may not account for large emission reductions, are directionally correct. A few of the known measures that are under way in the Metrolina area are listed below.

- I-77 HOV lane in Mecklenburg County. A recent evaluation of the HOV lanes on I-77 through Charlotte, North Carolina reported that there has been an observed increase of use of the HOV lanes since it has opened. It was reported that in November 2005, "…the HOV lane carried nearly 50 percent of the average number of persons who are traveling in a general-purpose lane in the morning peak hour, but in less than 20 percent of the number of vehicles." Additionally, the "Average daily patronage on the CATS [Charlotte Area Transit System] express routes using the I-77 HOV facility increased by 63 percent between October 2004 and 2005 …". This reduction of vehicle miles traveled in this area was not modeled in the attainment demonstration. Having more people carpooling or using the transit system in Mecklenburg will reduce both VOC and NOx emissions. A copy of the North Carolina Department of Transportation (NCDOT) evaluation of the I-77 HOV lane can be found at the end of this Appendix.

- Truck Stop Electrification in Rowan County. In 2006, 50 spaces at a truck stop in Rowan County were converted with Idle Aire technology. This technology provides truckers with electricity and air conditioning, allowing the truckers to turn off their engines while they rest. This results in a reduction of both NO_x and VOC emissions.

- Express Bus Route (Cabarrus/Rowan Counties). A new connecting service was created between Rider and Salisbury Transit. This provided an express route between Kannapolis and Salisbury. Having an express route between these two cities reduces the number of personal cars on the roadways, which in turn will reduce VOC and NO_x emissions. This new express route became operational in April 2009.

- Express Bus Route (York/Mecklenburg Counties). CATS has offered an Express Bus Route between Rock Hill and Charlotte since 2001. Additional service was added in 2008.

- Pedestrian walkways and Bikeways Projects: A number of the communities are creating walkways and bikeways in order to provide safe pathways for pedestrians and bicyclists to move about busy traffic areas. These types of projects provide safe alternatives to driving in the city.

- Idle Reduction Policies. North Carolina Department of Public Instruction has issued a policy that all school bus drivers are to refrain from idling their buses while waiting to pick up children at the school as well as when the buses are at the transportation yard. Additionally, several cities and businesses have issued idle reduction policies for their fleet vehicles. This reduces VOC and NO_x emissions as well as fine particulate matter. Some of the partners passing idle reduction policies include: Town of Concord, City of Salisbury, and Duke Power.

- South Carolina's Breathe Better (B^2) Anti-Idling Program for Schools. Several elementary schools in the Rock Hill area started the B^2 program during the 2008-2009 school year.

- Biodiesel use. A number of cities, counties and businesses have started using biodiesel for their diesel fleet. Most often B-20 is being used. B-20 will reduce VOC emissions as well as fine particulate matter. Some of the partners using biodiesel include: Gaston County Landfill, Town of Matthews, City of Monroe, Union County, NCDOT, and Duke Power.

- Diesel Retrofits. A number of cities, counties and school districts have installed Diesel Oxidation Catalysts (DOCs) or Diesel Particulate Filters (DPFs) on their diesel equipment. The vehicles that have been retrofitted include schools buses, as well as county fleet trucks for solid waste pickup. Although these types of filters are designed to remove fine particulate matter, when used with ultra low sulfur diesel fuel, NO_x and VOC emissions are also reduced. Some of the partners installing DOCs and/or DPFs include: Cabarrus County Schools, Gaston County Schools, Iredell County Schools, Lincoln County Schools, Mecklenburg County Schools, Rowan County Schools, Salisbury Public Schools, City of Charlotte and Mecklenburg County.

- Grants to Replace Aging Diesel Engines (GRADE). Mecklenburg County Air Quality has developed this incentive program to reduce air pollution from off-road construction equipment. GRADE provides incentive funding to owners of offroad construction equipment such as loaders, graders, bull dozers etc., who are willing to replace their aging equipment with newer less polluting technology.
- Grants to Replace Aging Diesel Engines Plus (GRADE+). Mecklenburg County Air Quality received a grant under the American Recovery and Reinvestment Act to expand the GRADE program to include 13 North and South Carolina Counties and also cover on-road and stationary diesel engines.
- Diesel Emissions Reduction Act (DERA). DERA provides new diesel emissions reduction grant authority for EPA. This funding is used to achieve significant reductions in diesel emissions that improve air quality and protect public health. In response to DERA, EPA created grant and funding programs under the National Clean Diesel Campaign (NCDC) to build on the success of its regulatory and voluntary efforts to reduce emissions from diesel engines. Through this effort, EPA is working to reduce the pollution emitted from the existing fleet by promoting a variety of cost-effective and innovative emission reduction strategies.
- North Carolina Heavy-Duty Vehicle Idling Restrictions. The North Carolina Environmental Management Commission adopted a rule to reduce unnecessary idling of heavy-duty trucks on July 9, 2009. If no appeal is made for legislative review, the rule is schedule to become effective on September 1, 2009. This rule generally prevents any person who operates a heavy-duty vehicle to cause, let, permit, suffer or allow idling for a period of time in excess of five consecutive minutes in any 60 minute period.
- Idling Restrictions for Commercial Diesel Vehicles. Section 56-35-10 of the Code of Laws of South Carolina, which became law in May 2008, stipulates that, barring certain exceptions, an operator of a commercial diesel vehicle may not allow the vehicle to idle for more than ten minutes in any sixty-minute period.

F. Weight of Evidence Conclusions

The SCDHEC agrees with the NCDAQ that it is better to use a five-year straight average DVB in the attainment test since it will normalize the effects of meteorology on design values more so than a weighted DVB. Based on the alternative DVF calculated in this section, all of the Metrolina nonattainment area monitors are predicted to be below the 8-hour ozone NAAQS in 2009 and 2011. Although the monitors still fall within the range for weight of evidence requirements in 2009, the monitor DVFs are lower than when a weighted DVB is used.

The air quality modeling metric analyses for the Metrolina nonattainment area demonstrates relative reductions well beyond the recommended 80 percent mark that is considered appropriate for concluding that a proposed strategy would meet the 8-hour ozone NAAQS. Additionally, other air quality modeling studies have found that the Metrolina area should attain the 8-hour ozone NAAQS on a similar schedule as the air quality modeling presented throughout this attainment demonstration.

The observed air quality trends in conjunction with further NO_x emission reductions expected in the Metrolina area strengthens the argument that the attainment demonstration is an acceptable demonstration. Finally, given the variety of additional emissions reductions that were not included in the development of this modeling exercise, but will occur throughout the surrounding areas, it is reasonable to conclude that the short lived events portrayed in the future modeled year by an extremely small number of remaining exceeding grid cells will be below the NAAQS in 2011.

The SCDHEC and the NCDAQ agree that the weight of evidence provided in this section is strong evidence that the Metrolina nonattainment area will attain the 8-hour ozone NAAQS by 2011.

IV Unmonitored Area Analysis

The modeled attainment test does not address future air quality at locations where there is not an ozone monitor nearby. To guard against the possibility that air quality levels could exceed the standard in areas with limited monitoring, Section 3.4 of the *Attainment Guidance* suggests that additional review is necessary, particularly in nonattainment areas where the ozone monitoring network just meets or minimally exceeds the size of the network required. This review is intended to ensure that a control strategy leads to reductions in ozone at other locations that could have baseline (and future) design values exceeding the NAAQS were a monitor deployed there. The test is called an “unmonitored area analysis.”. The purpose of the analysis is to use a combination of model output and ambient data to identify areas that might exceed the NAAQS if monitors were located there.

SCDHEC currently operates a network of 18 ozone monitors. Ten of these monitors were established as State and Local Air Monitoring Stations (SLAMS). These SLAMS monitors were selected based on specific monitoring objectives (background concentration, area of highest concentration, high population, source impact, transport, and rural impact) as required by the USEPA and siting scales (micro, middle, neighborhood, urban, and regional) established by the USEPA. Eight monitors are Special Purpose Monitors that were established by SCDHEC to obtain a better understanding of ozone in South Carolina.

The adequacy of the Metrolina area ozone monitoring network is further demonstrated when plotted against a projected spatial field of 2009 and 2012 ozone design values. Figures L-9 and L-10 present the 2009 and 2012 future year ozone design value modeling output from the VISTAS/ASIP State Collaborative effort and the location of each ozone monitor in and around North Carolina. The 2009 and 2012 ozone design value spatial fields were created using the USEPA’s Modeled Attainment Test Software (MATS). It is clear from the MATS analysis that all of the regions of higher, yet attaining, ozone design values have numerous representative ozone monitors. There are no identified ozone hotspots that would require any additional monitoring considerations in the Metrolina area.

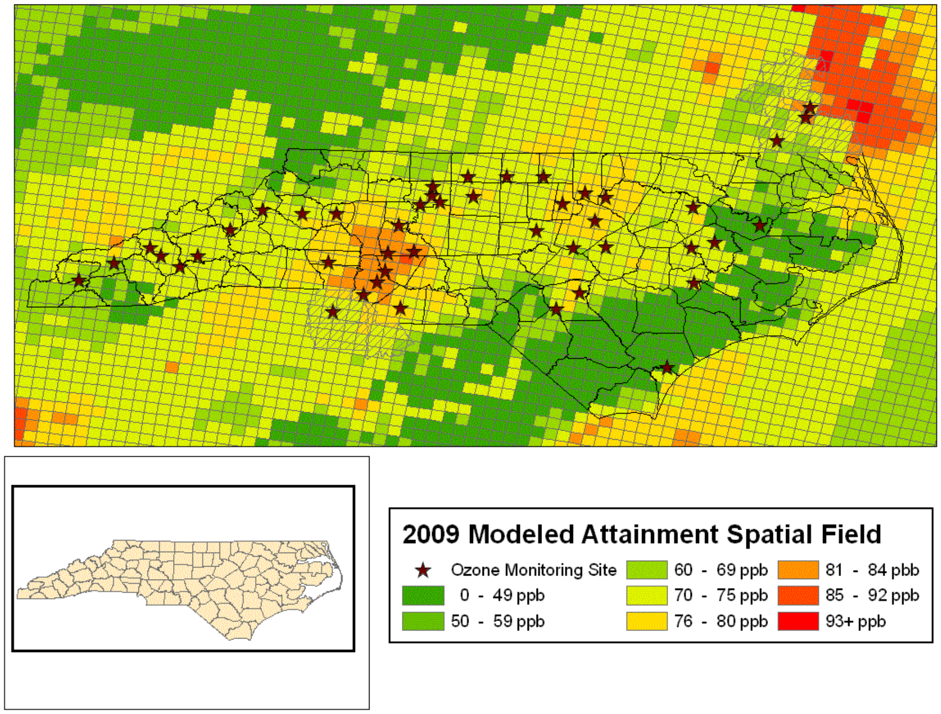


Figure L-9: Ozone Monitors and 2009 Modeled Spatial Field

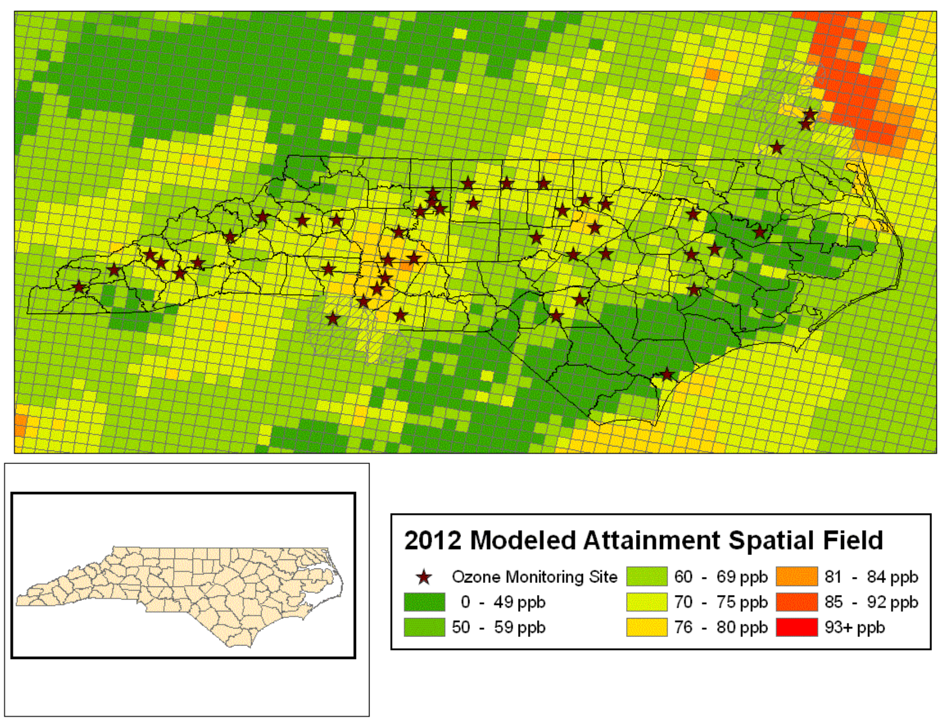


Figure L-10: Ozone Monitors and 2012 Modeled Spatial Field