

US EPA ARCHIVE DOCUMENT

ENCLOSURE

**RICHMOND OZONE NONATTAINMENT AREA
PETITION FOR RECLASSIFICATION**

FINAL TECHNICAL SUPPORT DOCUMENT

SEPTEMBER 9, 2004

Richmond Nonattainment Reclassification Petition Ozone Air Monitoring Data Analysis

INTRODUCTION

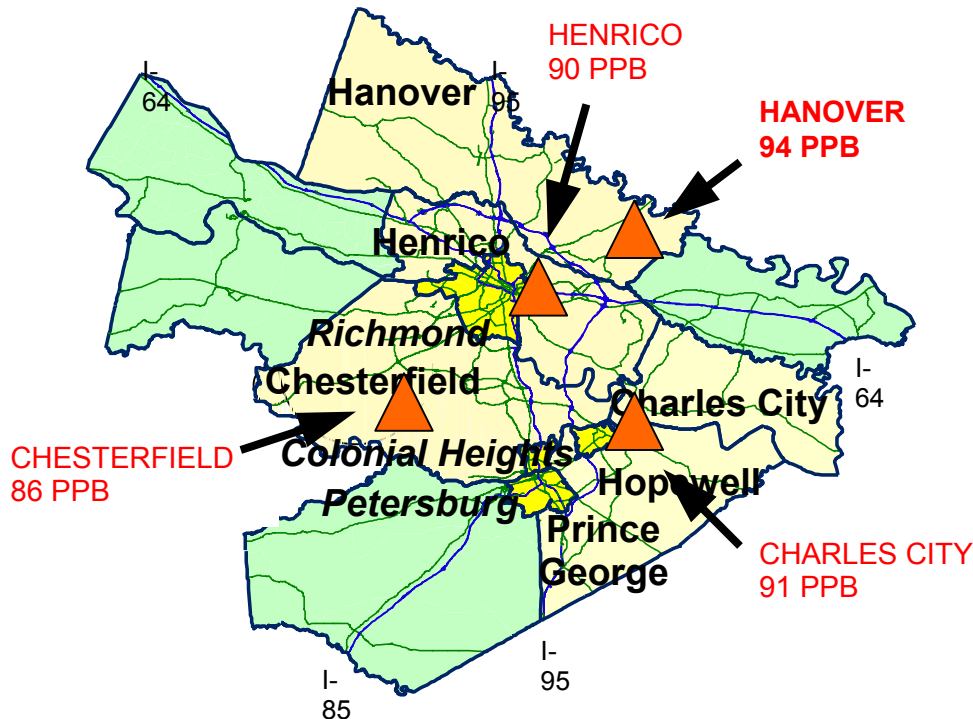
The Department of Environmental Quality operates four continuous ozone air quality monitors in the Richmond metropolitan area. These monitors are configured to provide a comprehensive profile of ozone concentrations in the Richmond area and includes both upwind/downwind and urban/rural sites. Specifically, these monitors are listed below:

- **Chesterfield County Monitor (Bensley Armory)** - Serves as the upwind monitor to the Richmond metro area that is located the center of the County.
- **Henrico County Monitor (Math & Science Center)** – Serves as the urban core monitor located just North of central Richmond City.
- **Hanover County Monitor (McCellan Road)** – Serves as the primary downwind monitor for the metro area.
- **Charles City Monitor (Shirley Plantation)** – Serves as a secondary downwind monitor for the metro area.

This monitoring network has been in place for since the early 1990's with the exception of the local movement of the Hanover monitor in 2000.

Provided below is a map of the location of the Richmond ozone monitors and their current official design values based on 2001 to 2003 data, which represents the average of the 4th highest values during each of these years.

Richmond Monitoring Network & Ozone Design Values (2001-2003)



The “worst case” monitor that was used to set the 8-hour ozone standard nonattainment classification is the primary downwind monitor located in Hanover County. This monitor’s current official design value is 94 ppb, which is within the 5% range allowed for reclassification to the lower marginal level (92 ppb). All the other monitors in the metro area had design values within the marginal classification range when the area was designated nonattainment.

In addition, 2004 ozone data in the Richmond areas shows that the downward trend in ozone concentrations is continuing. This data (to date) shows that one monitor is in attainment and the remaining three area monitors are within the marginal nonattainment range as shown by the updated design values (2002-2004) provided below:

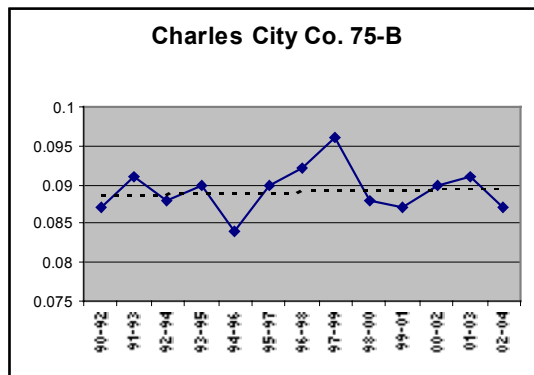
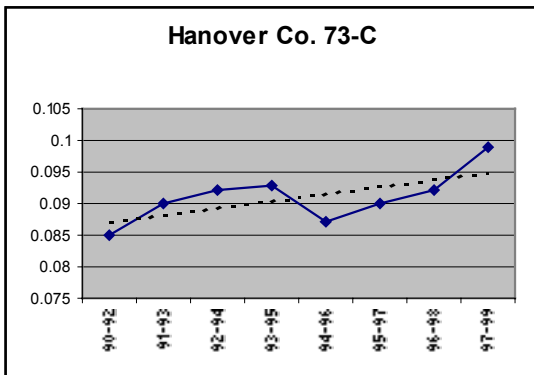
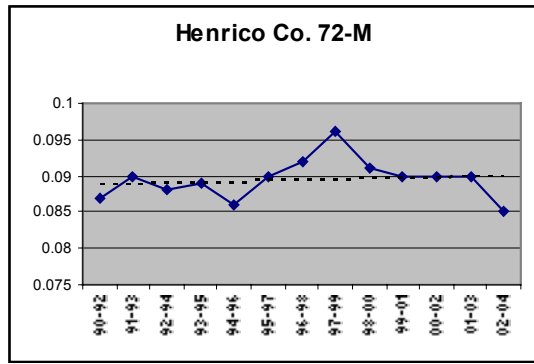
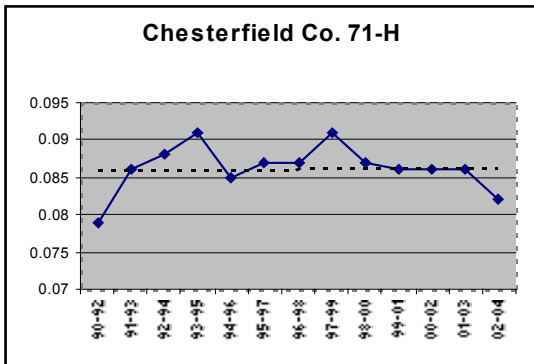
Richmond Ozone Monitor Design Values (2002 to 2004)

- **Chesterfield** **82 ppb (attainment)**
- **Henrico** **85 ppb (marginal nonattainment)**
- **Hanover** **90 ppb (marginal nonattainment)**
- **Charles City** **87 ppb (marginal nonattainment)**

MONITORING DATA TRENDS

To further analyze ozone trends in the Richmond area, individual and cumulative data evaluations have been performed on ozone monitoring data in the area beginning in 1990. Provided below are trend graphs for each of the four Richmond monitors that show the design value trends from 1990 to 2004.

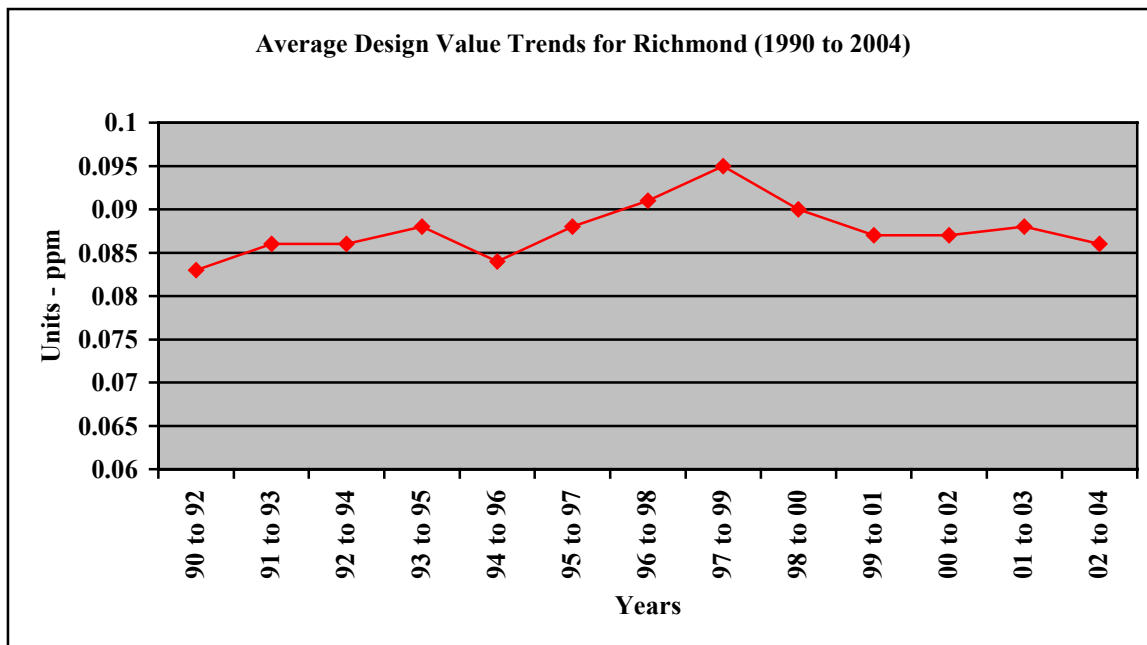
Richmond Monitor Design Value Trends from 1990 to 2004



As can be clearly seen from these graphs, the general trend lines for the Richmond monitors have increased only slightly over period analyzed. In addition, three monitors have remained solidly in the marginal range in terms of design values during the same period. Furthermore, a definite downward trend can be seen at these three monitors since the official promulgation of the 8-hour ozone standard in 1997. The anomaly observed in the Hanover monitor is due to its closure and removal after the 1999 ozone season. Therefore, the trend after the 1997-1999 design value period is not available for this particular monitor. The relocated Hanover monitor has just completed its first three-year monitoring period recording a design value of 94 ppb. As indicated earlier, the data (to date) for 2004 at this monitor reduces the design value to 90 ppb.

To further evaluate this data, the average of the design values for all four monitors has been plotted and is presented below. This graph serves as an indication of the overall ozone concentration trends in Richmond during the 1990 to 2004 period.

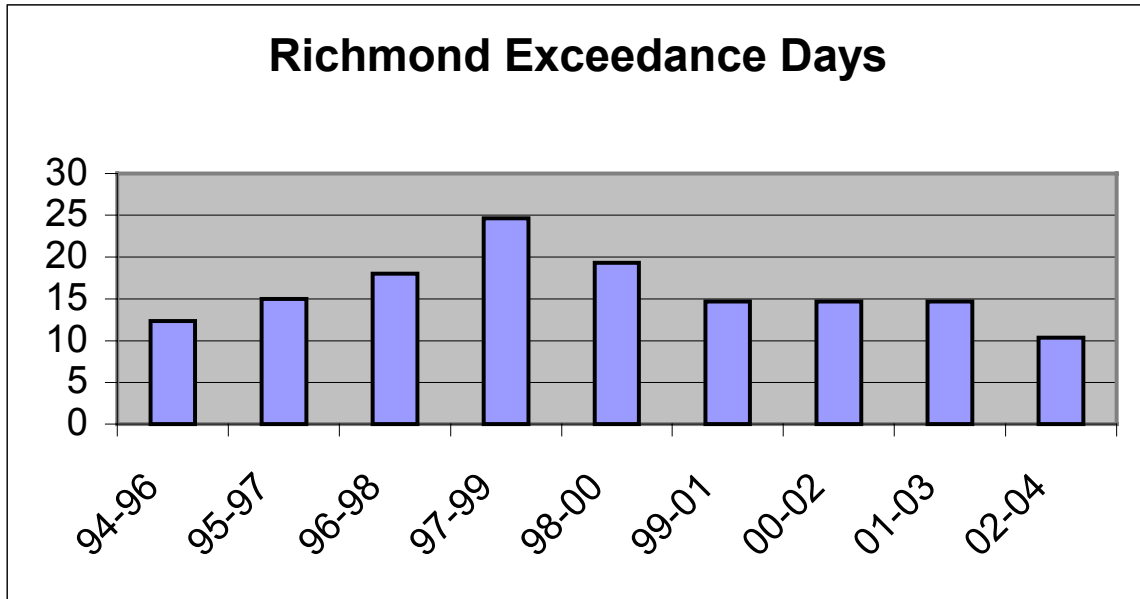
Overall Richmond Monitor Design Value Trend (1990 to 2004)



It can be seen that the general trend for the Richmond area is that ozone concentrations and corresponding average design values are consistent with a marginal nonattainment classification and have remained mostly in the core marginal range of 85 to 90 PPB. The general decrease in average concentrations from the “worst case” period of 1997-1999 is again shown by this data.

Finally, the average number of days when exceedances of the 8-hour standard were recorded in the Richmond area from 1994 to 2004 have been plotted below to serve as an indicator of the amount of time that area residents have been exposed to levels of ozone above the standard.

Number of Richmond High Ozone Days (Three-Year Average Trend)



Again, this data shows a mostly stable and consistent trend of average exceedance days in the Richmond area, other than the exceptional period during the late 1990's. The same clear downward trend can again be seen from this peak period (1997 to 1999) to the present time.

CONCLUSIONS

The analysis of the most recent official monitoring data provided above supports the petition for the reclassification of the Richmond 8-hour ozone nonattainment area to a marginal nonattainment area in that:

- Three of the four monitors in the Richmond metro area have and continue to record levels consistent with a marginal nonattainment classification.
- The majority of the monitoring indicators for the Richmond metro area are indicative of a marginal nonattainment area with design values and overall area averages well within the range for this lesser classification (85 to 92 PPB).
- The one monitor of exception to this general trend in Hanover County is located in the rural and sparsely populated Northeast corner of the nonattainment area. The vast majority of the metro area's population is located in areas where the corresponding monitors have consistently recorded marginal levels of ozone nonattainment (Chesterfield & Henrico).
- Only one exceedance of the 8-hour standard has been recorded in the Richmond area during the 2004 ozone season. When including this season's monitoring data (to date) in the analysis, all four monitors are now below moderate nonattainment concentration levels based on the latest three-year period (2002 to 2004).

Richmond Nonattainment Reclassification Petition *Regional Ozone Modeling Analyses*

INTRODUCTION

Given the tight timeframe for submitting this petition for the reclassification of the Richmond nonattainment area, only limited modeling could be performed specifically to support this petition. However, several previous modeling exercises performed by DEQ and EPA provide consistent indications that the Richmond area is likely to attain the ozone standard during the 2007 to 2010 timeframe. A listing of these modeling analyses is provided below:

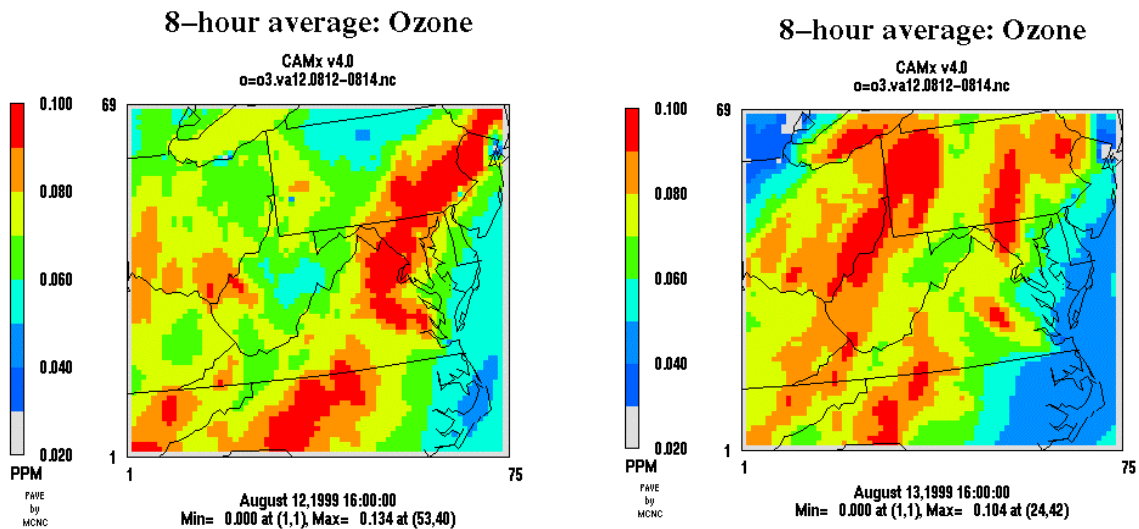
- DEQ Early Action Compact Regional Ozone Modeling
- EPA NO_x SIP Call Rule Modeling
- EPA Heavy Duty Diesel Engine Standard Modeling
- EPA Clear Skies Act (CSA) Modeling
- EPA Clean Air Interstate Rule (CAIR) Modeling

The remainder of this section will summarize these modeling exercises and the results and predictions relating to the Richmond nonattainment area.

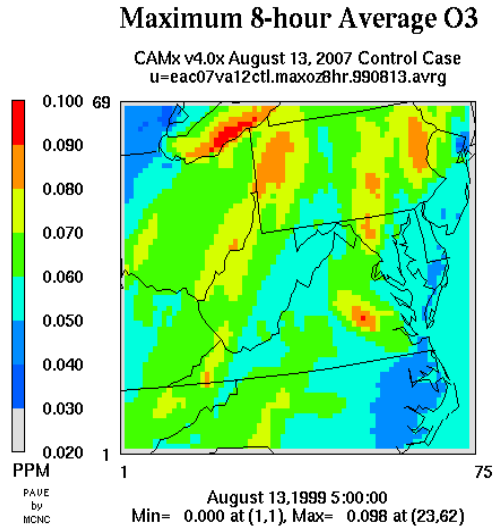
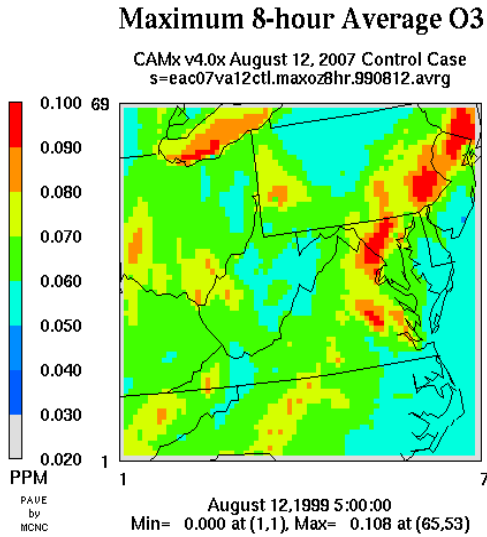
VDEQ EARLY ACTION COMPACT MODELING

As part of the early action compact and planning process for the Roanoke and Winchester areas in Virginia, the DEQ performed a regional modeling exercise to demonstrate that these areas would attain the 8-hour ozone standard by 2007. Although Richmond was not the focus of this modeling, data is also available for this area that provides data on predicted ozone reductions and resulting levels in the Richmond area by 2007. Provided below are graphic and table summaries of the data for Richmond from this modeling:

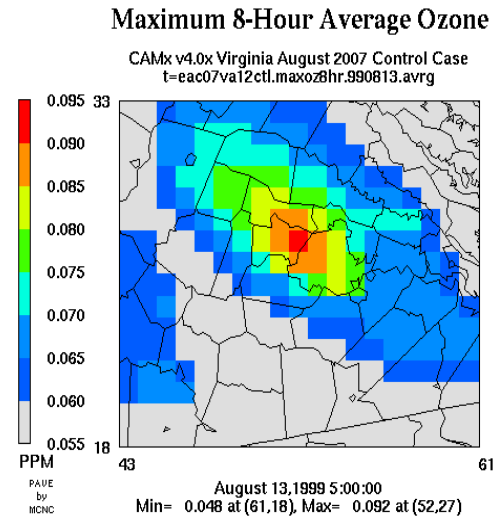
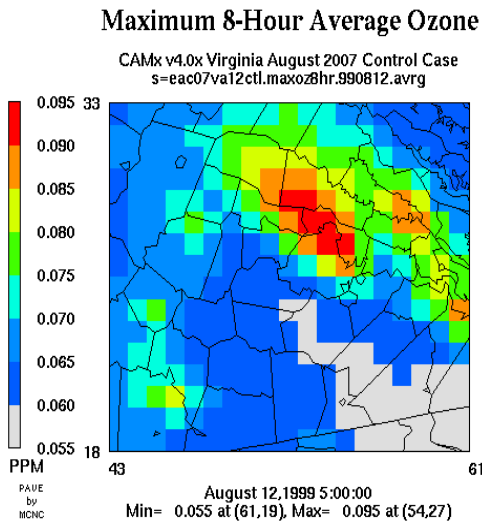
Regional Modeling Results – Base Case Episode (August 1999)



Regional Modeling Results – 2007 Future Control Case Predictions (Full Domain)



Regional Modeling Results – 2007 Future Control Case Predictions (Central VA)

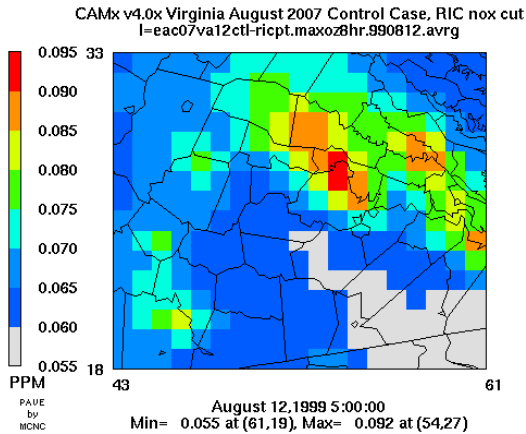


Although initial visual review of these results appears to indicate a continuing issue with high 8-hour ozone levels in the Richmond areas, it should be noted that in the base case modeling, ozone concentrations are over-predicted in the Richmond area for the selected 1999 episode. Logically, this over-prediction is continued into the 2007 control episode. While all the factors leading to this over-prediction by the model are not yet known, some of this was attributable to a major error in future Richmond utility emissions and the overly conservative estimates of Richmond VOC point source emissions due to the application of rule effectiveness and other factors.

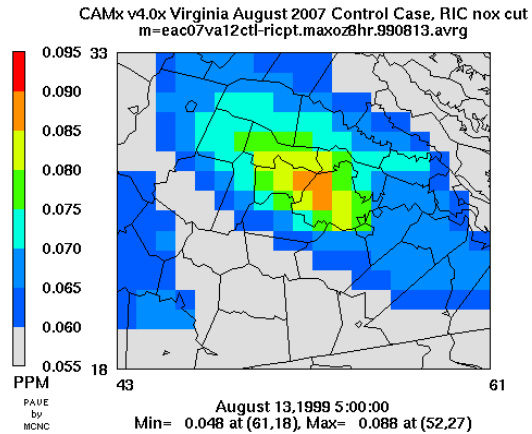
After correcting the error in area utility emissions which resulted in a decrease of area NO_x emissions by about 30 ton/day, the control case was run again and produced the following results.

Revised Modeling Results – 2007 Future Control Case (Corrected Utility NO_x Emissions)

Maximum 8-Hour Average Ozone



Maximum 8-Hour Average Ozone



Selection of Current Design Values (per Draft EPA Ozone Modeling Guidance)

County/City	AIRS ID	1998-2000 Design Value, ppb	2001-2003 Design Value, ppb	Current Design Value
Chesterfield	510410004	88	86	88
Henrico	510870014	92	90	92
Hanover	510850001	95	94	95
Charles City	510360002	88	91	91

Attainment Test Results for Monitors in the Richmond Area (Exact Grid Cell)

County/City	Modeled Average Base-Year (1999) Daily 8-hr Maximum O3 (ppb)	Modeled Average Future-Year (2007) Daily 8-hr Maximum O3 (ppb)	Relative Reduction Factor (RRF)	Current Design Value	2007 Future Design Value	Design Value (2001-2003)	2007 Future Design Value
Chesterfield	83.31	69.13	0.83	88	73.0	86	71.4
Henrico	86.43	76.77	0.888	92	81.7	90	79.9
Hanover	83.67	72.31	0.864	95	82.1	94	81.2
Charles City	80.87	71.37	0.882	91	80.3	91	80.3

Attainment Test Results for Monitors in the Richmond Area (Max 9 Grid Cells)

County/City	Modeled Average Base-Year (1999) Daily 8-hr Maximum O3 (ppb)	Modeled Average Future-Year (2007) Daily 8-hr Maximum O3 (ppb)	Relative Reduction Factor (RRF)	Current Design Value	2007 Future Design Value	Design Value (2001-2003)	2007 Future Design Value
Chesterfield	86.94	76.35	0.878	88	77.3	86	75.5
Henrico	91.74	80.22	0.874	92	80.4	90	78.7
Hanover	88.72	79.45	0.895	95	85.0	94	84.1
Charles City	86.8	78.69	0.907	91	82.6	91	82.5

■ Nonattainment ■ Attainment

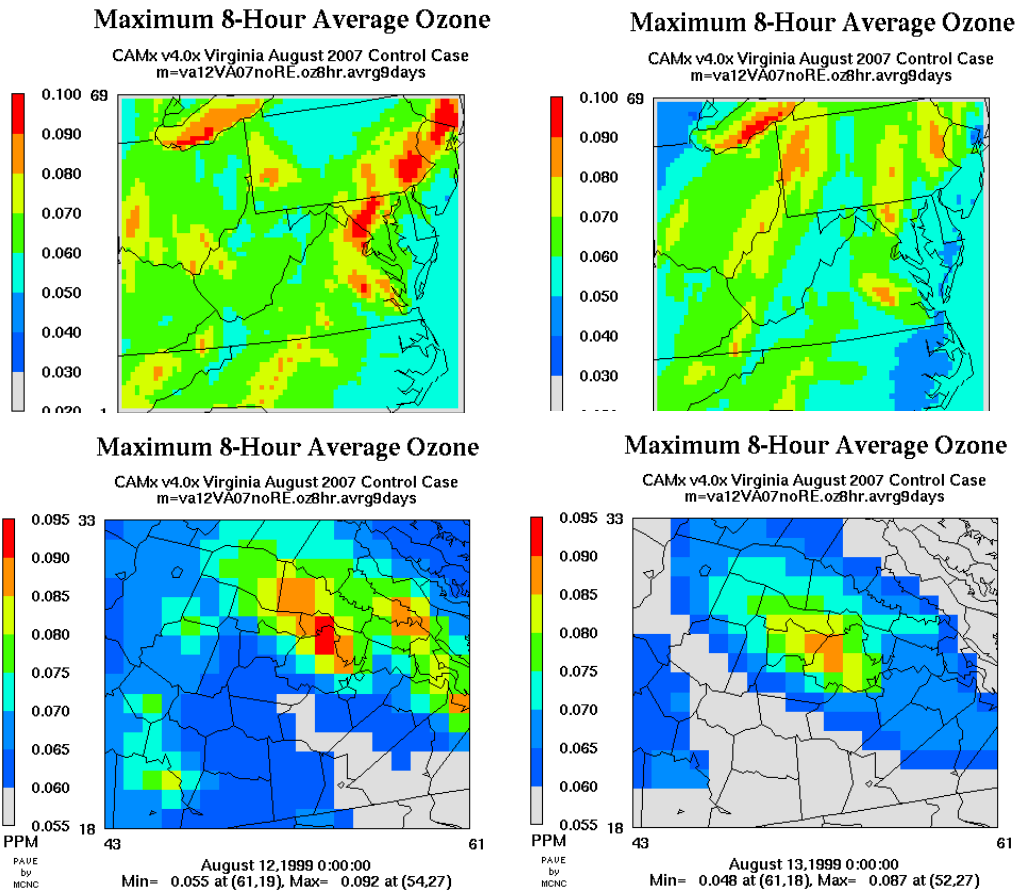
Two attainment tests were applied to the modeling results, an exact monitor grid cell analysis (first table), and a 9 grid cell maximum analysis (second table). As can be seen by these results, application of the attainment test by developing relative reduction factors (RRF) and applying them to the three-year design value during the time of the modeled episode produces positive results in terms of predicted future design values. The exact cell test predicts attainment at all area monitors. The 9 cell maximum test predicts attainment at 3 monitors and concentrations at the standard at 1 monitor.

However, since the design values used to officially designate these areas were from a different time period (2001 to 2003), an additional analysis was performed by applying the RRFs developed to the current area monitor design values. This additional analysis predicts attainment in 2007 at all area monitors for both attainment tests.

VDEQ REFINED EAC MODELING (UPDATED POINT SOURCES)

In an effort to further refine the EAC modeling specific to the Richmond area and to utilize more representative estimates for point source emissions, consistent 1999 and 2007 point source emissions were developed using updated estimates of rule effectiveness and other assumptions. These revisions were reflected in both the base and projection inventories and reduced point source VOC emissions of up to 20%. The impact of this revision was greater in the future year due to the fact that the original point source projection inventory was developed using a different process than the base inventory. The results of this refined modeling are presented below:

Revised Modeling Results – 2007 Future Control Case (Revised Point Source Emissions)



Attainment Test Results for Monitors in the Richmond Area (Exact Grid Cell)

County/City	Days Used	Modeled Average Base-Year (1999) Daily 8-hr Maximum O3 (ppb)	Modeled Average Future-Year (2007) Daily 8-hr Maximum O3 (ppb)	Relative Reduction Factor (RRF)	Current Design Value (ppb)	2007 Future Design Value (ppb)	Pass/Fail Status
Chesterfield	6	81.71	69.52	0.851	88	74.9	Pass
Henrico	5	88.94	76.72	0.863	92	79.4	Pass
Hanover	5	86.84	74.66	0.860	95	81.7	Pass
Charles City	5	82.76	72.97	0.882	91	80.3	Pass

Attainment Test Results for Monitors in the Richmond Area (Max 9 Grid Cells)

County/City	Days Used	Modeled Average Base-Year (1999) Daily 8-hr Maximum O3 (ppb)	Modeled Average Future-Year (2007) Daily 8-hr Maximum O3 (ppb)	Relative Reduction Factor (RRF)	Current Design Value (ppb)	2007 Future Design Value (ppb)	Pass/Fail Status
Chesterfield	6	89.57	77.18	0.862	88	75.9	Pass
Henrico	5	97.39	83.09	0.853	92	78.5	Pass
Hanover	5	94.11	82.2	0.873	95	82.9	Pass
Charles City	5	90.22	79.96	0.886	91	80.6	Pass

Again, the same two attainment tests were applied to the refined Richmond modeling results. Under this scenario, in all cases attainment is predicted for the area monitors and surrounding grid cells.

EPA MODELING EXERCISES

A number of modeling exercise have be performed by EPA to support various rulemaking actions, beginning with the NO_x SIP Call (SC) and most recently in support of the Clear Skies Act (CSA) and Clean Air Interstate Rule (CAIR). Although these various modeling exercises were performed for different reasons, all of them have produced predicted future ozone levels that provide additional information on predicted ozone trends in the future. A summary of these modeling exercises and the resulting ozone predictions for the Richmond area is provided in the table below:

MONITOR	2007	2010	2015	2020
Chesterfield	74 PPB (SC)	74 PPB (CAIR)	71PPB (CAIR)	69 PPB (CSA)
Henrico	77 PPB (SC)	77 PPB (CAIR)	74 PPB (CAIR)	65 PPB (CSA)
Hanover	77 PPB (SC)	NA	NA	NA
Charles City	77 PPB (SC)	77 PPB (CAIR)	74 PPB (CAIR)	65 PPB (CSA)

As can be seen above, all of these EPA modeling exercises predict attainment in the Richmond area as early as 2007 and continuing out to 2020 with decreasing ozone concentrations.

As an additional supporting analysis the relative reduction factors produced by the two modeling exercises that used 2007 as a projection year were applied to the appropriate Richmond area monitor design values to project the future attainment status of these monitors. The results of this analysis are presented below:

EPA NO_x SIP CALL & HEAVY DUTY DIESEL STANDARDS MODELING RESULTS FOR RICHMOND

Monitor	Current Design Value (2003)*	Relative Reduction Factor	2007 Future Design Value
NO_x SIP CALL (Control Case)			
Chesterfield	88 ppb	0.8531	75.1 ppb
Henrico	92 ppb	0.8662	79.7 ppb
Hanover	95 ppb	0.8579	81.5 ppb
Charles City	91 ppb	0.8609	78.3 ppb
HEAVY DUTY DIESEL (Base Case)			
Chesterfield	88 ppb	0.8772	77.2 ppb
Henrico	92 ppb	0.8763	80.6 ppb
Hanover	95 ppb	0.8683	82.5 ppb
Charles City	91 ppb	0.8744	79.6 ppb

* Higher design value for all monitors when compared to 1997

CONCLUSIONS

The referenced modeling exercises support the petition for the reclassification of the Richmond 8-hour ozone nonattainment area to a marginal nonattainment area in that:

- The modeling evidence presented shows that the Richmond area will continue to experience lower ozone levels and will attain the 8-hour standard by 2007.
- Specifically, all of these analyses predict that the Richmond area will come into compliance with the 8-hour standard by 2007 or 2010, depending on the analysis involved.
- Continued attainment and decreasing ozone levels are predicted for the Richmond area out into the future (2015 & 2020).

Richmond Nonattainment Reclassification Petition Ozone Precursor Emissions Analysis

INTRODUCTION

The Department of Environmental Quality periodically develops comprehensive air pollutant emissions inventories to support air quality planning and tracking purposes. A statewide base year 2002 ozone precursor inventory, currently in draft form, has been developed to serve as a baseline for 8-hour ozone planning purposes. A summary of this inventory and projected emissions to 2007 for the Richmond area are provided in this analysis to document the anticipated emissions reductions expected from existing and future state and federal control programs. These controls can be categorized as follows:

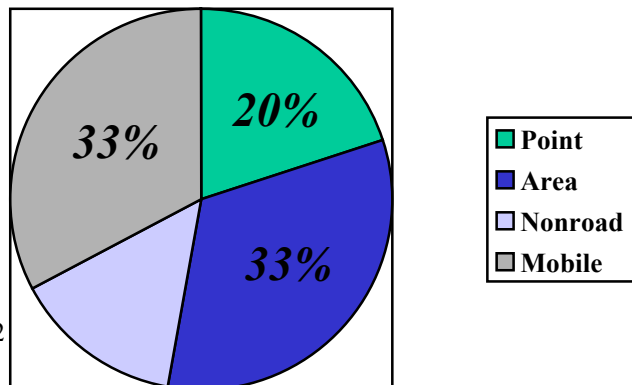
- **Stationary & Area Source Controls** - In addition NO_x SIP Call program which will produce significant utility NO_x emission reductions, the EPA has developed a number of control programs to address smaller “area” sources of emissions that are significant contributors to ozone formation. These programs reduce emissions from such sources as industrial/architectural paints, vehicle paints, metal cleaning products, and selected consumer products.
- **Motor Vehicle Controls** - Significant progress continues in reducing motor vehicle emissions. Several federal programs have established more stringent engine, vehicle and fuel standards for cars, sport utility vehicles, and large trucks. These programs combined are expected to produce progressively larger emission reductions over the next twenty years as new vehicles replace older ones.
- **Non-Road Vehicle & Equipment Standards** - The category of “non-road” sources that covers everything from lawn & garden equipment to aircraft, has become a significant source of air pollutant emissions. In response, EPA has adopted a series of strategies to address these sources. These programs include engine emission standards for lawn & garden equipment, construction equipment, boat engines, and locomotives.

2002 BASELINE EMISSIONS INVENTORY FOR RICHMOND

Provided below is a summary of the 2002 baseline ozone season daily emissions inventory of VOC and NO_x for the Richmond nonattainment area:

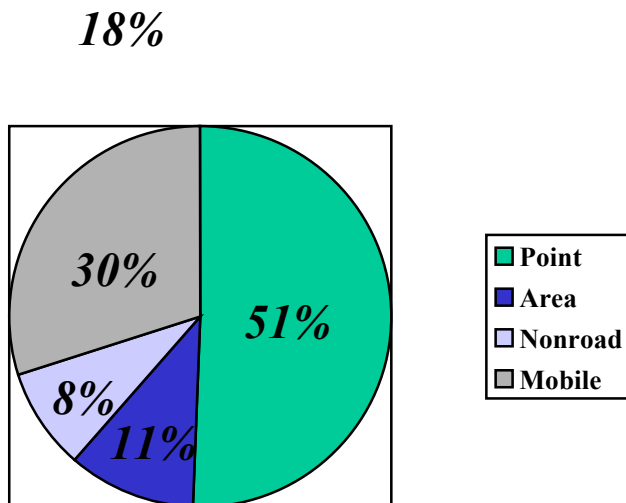
VOC Emissions:

CATEGORY	DAILY EMISSIONS
Point	27.94 tons
Area	45.71 tons
Nonroad	19.64 tons
Mobile	46.31 tons
TOTAL:	139.60 tons



NO_x Emissions:

CATEGORY	DAILY EMISSIONS
Point	120.80 tons
Area	25.62 tons
Nonroad	19.81 tons
Mobile	72.29 tons
TOTAL:	238.51 tons

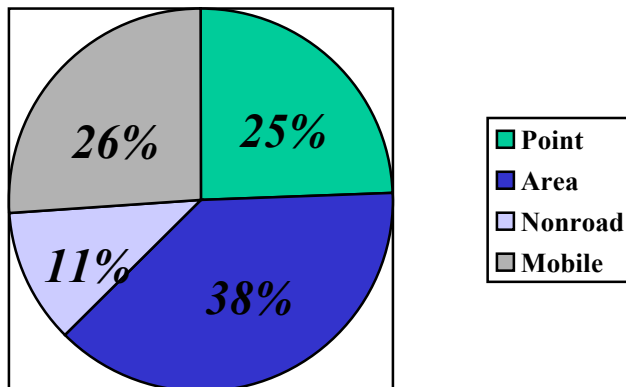


2007 PROJECTED EMISSIONS INVENTORY FOR RICHMOND

Provided below is a summary of the 2007 projected ozone season daily emissions inventory of VOC and NO_x for the Richmond nonattainment area:

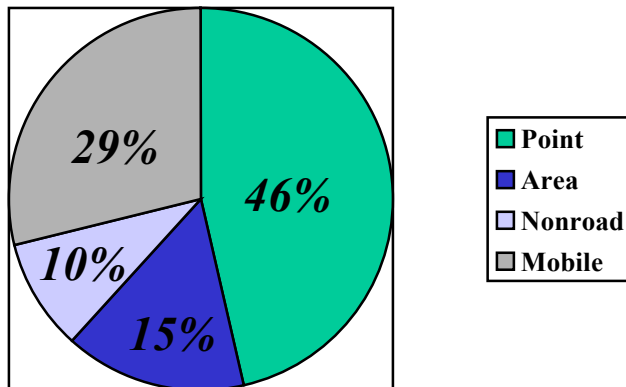
VOC Emissions:

CATEGORY	DAILY EMISSIONS
Point	30.18 tons
Area	46.70 tons
Nonroad	14.14 tons
Mobile	32.16 tons
TOTAL:	123.17 tons



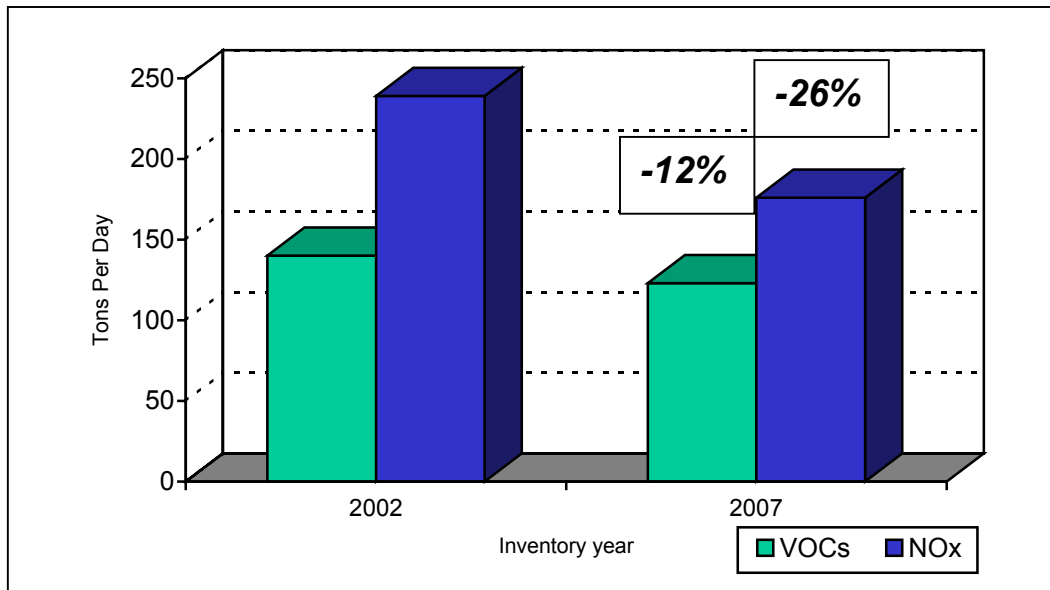
NO_x Emissions:

CATEGORY	DAILY EMISSIONS
Point	81.63 tons
Area	26.60 tons
Nonroad	17.26 tons
Mobile	50.82 tons
TOTAL:	176.31 tons



OZONE PRECURSOR EMISSION REDUCTIONS IN RICHMOND BY 2007

Provided below is a summary of the anticipated emission reductions in ozone season daily emissions of VOC and NO_x for the Richmond nonattainment area by 2007:



As can be seen from the graph above, it is predicted that a 12% reduction in VOC emissions and 26% reduction in NO_x emissions will occur in the Richmond nonattainment area by 2007 due to the implementation of state and federal control measures.

CONCLUSIONS

The emissions analysis presented supports the petition for the reclassification of the Richmond 8-hour ozone nonattainment area to a marginal nonattainment area in that:

- Significant reductions in both VOC and NO_x emissions are expected in the Richmond area between 2002 and 2007.
- These local reductions, combined with ozone transport reduction from other areas, are likely to be sufficient to bring the area into compliance with the 8-hour ozone standard.
- The predicted reductions from many of these control measures will continue to increase beyond the 2007 timeframe.
- Additional control measures have been committed to as part of this process that will further reduce ozone precursor emissions by 2007 below the levels included in this analysis.

