ROANOKE CLEAN AIR PLAN

The Roanoke Ozone Early Action Compact Area

State Implementation Plan

December 31, 2004

Roanoke Clean Air Plan

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For the
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1. BACKGROUND

A. Introduction & Project Background

In 1997 the United States Environmental Protection Agency (EPA) established a new 8-hour ozone National Ambient Air Quality Standard (NAAQS). This standard was the result of a review of ground level ozone and related health impacts, and was set to replace the older 1-hour standard. The purpose of this new standard was to address the longer-term impact of ozone exposure at lower levels. As such, the new standard is set at a lower level (0.08 parts per million) than the previous standard (0.120 parts per million) and is more protective of human health.

As part of the implementation of the new standard, states submitted area designation recommendations to the EPA in June of 2000 that identified potential ozone nonattainment areas based on air quality data from 1997 to 1999. The Roanoke Metropolitan Statistical Area (MSA) was identified at that time as one of the potential nonattainment areas in Virginia, mainly based on the fact that ozone concentrations exceeding the standard had been recorded at the monitor located in the Town of Vinton. The State and EPA have reaffirmed this designation in subsequent nonattainment recommendations and proposals.

During the development of these state recommendations, a number of concerns were raised by the potential nonattainment areas about the adverse impacts of a possible nonattainment designation on these areas. In response, the Virginia Department of Environmental Quality (DEQ) began to investigate voluntary actions that could be implemented proactively to improve air quality and lessen the possible impact of a formal nonattainment designation in areas that marginally exceed the new standard.

The most promising of all the options explored is the EPA's ozone Early Action Compact (EAC) program. The EAC concept was originally developed by several areas in Texas in early 2002 and subsequently endorsed and expanded by the EPA as national voluntary program.

EACs are voluntary agreements by the localities, states, and the EPA to develop Early Action Plans (EAPs) to reduce ozone precursor pollutants and improve local air quality in a proactive manner, and in a shorter time than what would occur through the traditional nonattainment area designation and planning process. These plans must include the same components that make up traditional State Implementation Plans (SIPs). This includes emissions inventories, control strategies, schedules and commitments, and a demonstration of attainment based on photochemical modeling.

The goal of an EAP is to develop a comprehensive strategy that will bring an area into attainment of the 8-hour ozone standard by 2007. This goal is will be achieved by selecting and implementing local ozone precursor pollutant control measures that when combined with other measures on the state and national level, are sufficient to bring the area into compliance with the standard. If the area is successful in developing a plan that demonstrates attainment of the 8-hour ozone standard by 2007, the EPA will defer the effective date of the nonattainment designation for the area. This deferral will remain in place as long as certain milestones are met, such as implementation of local controls by 2005. If all interim milestones are met and the area demonstrates attainment of the standard during the period from 2005 to 2007 through air quality data, then the nonattainment designations will be withdrawn by EPA, without further regulatory requirements. If an area fails at any point in the process, it will revert back to traditional nonattainment status, with all the associated requirements of such a designation.

The Roanoke MSA area entered into an Early Action Compact with both the Commonwealth and EPA for the area including Botetourt and Roanoke Counties, the Cities of Roanoke and Salem, and the Town of Vinton. This Compact was signed by all the parties involved and then submitted to the EPA by the required date (December 31, 2002). The area has subsequently established and commissioned the Roanoke Early Action Plan Task Force to serve as the major stakeholder group to coordinate the development of an early action plan for the area. This Task Force has a diverse and knowledgeable membership, which greatly aided the development of a comprehensive plan.

Both this area, and the other Early Action Compact area in Virginia (Northern Shenandoah Valley), are well suited for this project due to their geographic location and extent, marginal nonattainment air quality levels, and common influences of ozone transport and other external factors. Both areas are located in the western part of Virginia and would be separate and relatively small nonattainment areas, if formally designated.

Since the EAC process in Roanoke area began with the establishment of the Roanoke Early Action Task Force and the formal development and signing of the Early Action Compact, a series of required documents have been produced, culminating in the submission of the official EAP in March 2004. Provided below is a listing and timeline of the products and documents provided by the Roanoke EAC effort:

- **December 31, 2002 –** Early Action Compact for the Roanoke Area.
- **June 16, 2003 –** Potential local control list submission.
- **June 30, 2003 –** 1st annual status report for January to June 2003.
- **December 31, 2003 –** 2nd annual status report for July to December 2003.
- **March 31, 2004 –** Completed local Early Action Plan submitted to DEQ & EPA.
- **June 30, 2004 –** 3rd annual status report for January to June 2004.

All these documents and enclosures, along with other information concerning the EAC program and other EAC areas, can be viewed and retrieved at from the following EPA web site:

http://www.epa.gov/ttn/naaqs/ozone/eac/index.htm

As a result of the completion of these task and documents, EPA published its formal air quality designations and classifications for the 8-hour ozone standard on April 30, 2004, for all areas of the County. This action included the deferral of the effective date for all nonattainment areas with approved early action plans including the Roanoke area. Specifically, the Roanoke area was designated as a "basic" nonattainment area with the effective date of the designation deferred to September 30, 2005. Additional deferrals of the effective date of the nonattainment designation will be granted by EPA as long as the Roanoke continues to meet the schedule and commitments contained in the EAP, including the submission of this State Implementation Plan.

The remainder of this SIP narrative document describes the process and results of the ozone early action plan for the Roanoke area including significant events/actions, public participation, and technical support activities performed to support the overall planning effort.

B. The 8-Hour Standard in the Roanoke Metropolitan Statistical Area (MSA)

During the past several years air quality planning in the Roanoke MSA has intensified as ozone concentrations in the Roanoke MSA have exceeded the value permitted by the 8-hour ozone NAAQS. Due to legal challenges to the NAAQS and ensuing litigation, EPA has just recently designated areas of the United States in violation of the 8-hour ozone NAAQS. Based on the most current official ozone monitoring data, the Roanoke MSA has been designated a nonattainment area with a deferred effective date as described earlier.

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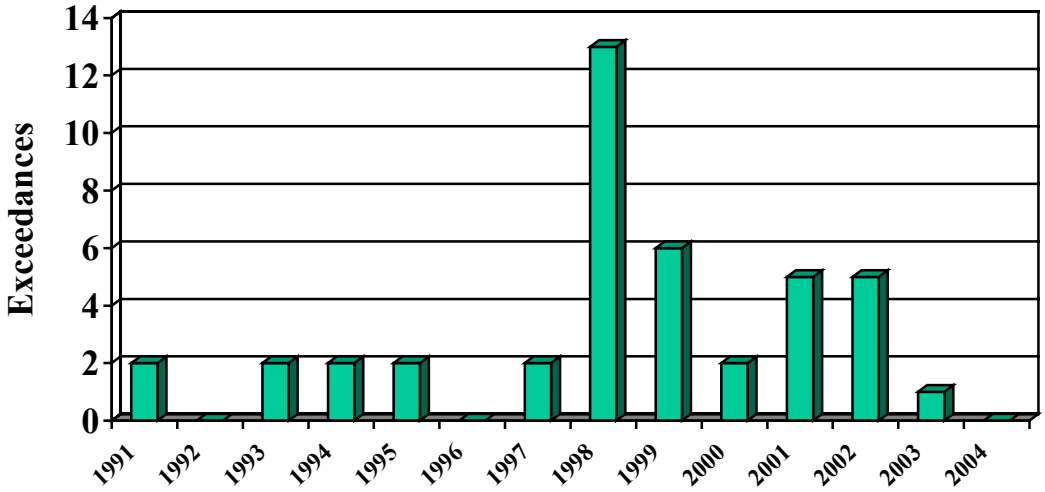
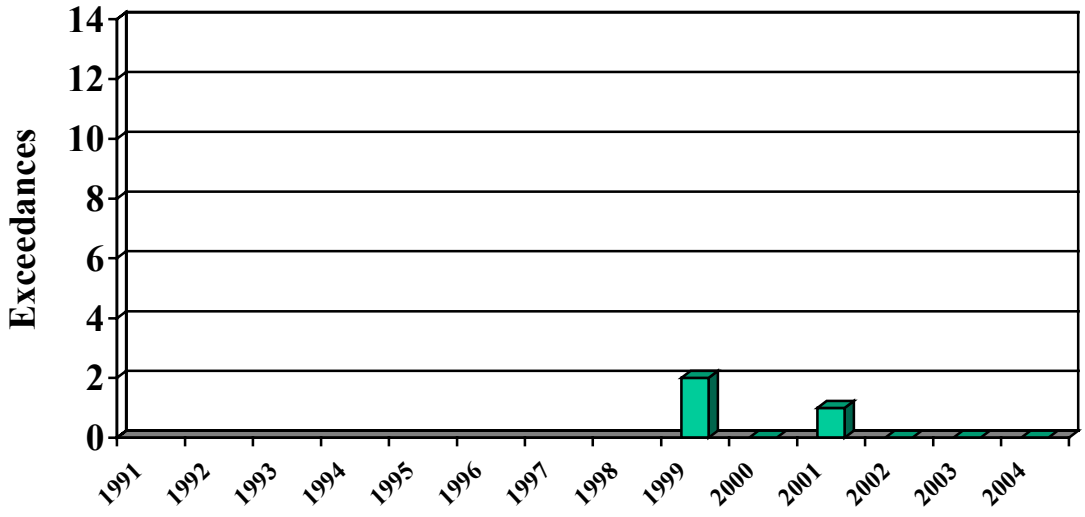
The 8-hour ozone standard is determined by averaging three years of the fourth highest 8-hour ozone levels in an area. This number, called the design value, must be lower than 85 parts per billion (ppb) to comply with the standard. Currently, the Roanoke MSA official design value (averaging 2001, 2002 and 2003) is 85 ppb. Each year this design value may vary. Data is available for the Roanoke MSA for the 8-hour ozone standard beginning in 1990. Ozone concentrations have exceeded the standard a total of 42 times during the period from 1990 to 2004. The number of exceedences recorded in Roanoke from 1991 to 2004 are shown below. Data from the nearby monitors in Wythe and Rockbridge Counties are also shown for comparison purposes:

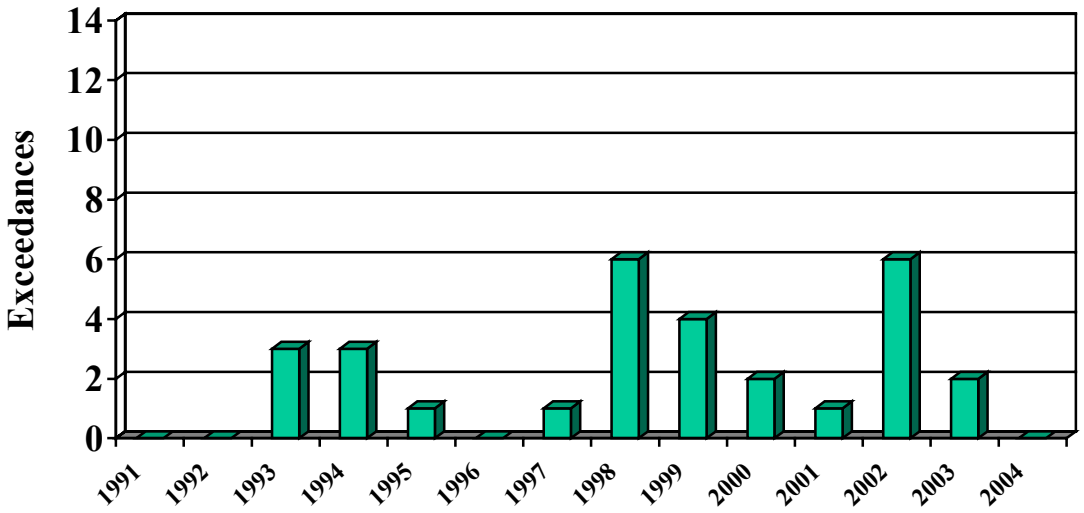
Roanoke 8-hour Ozone Exceedances (1991 to 2004)



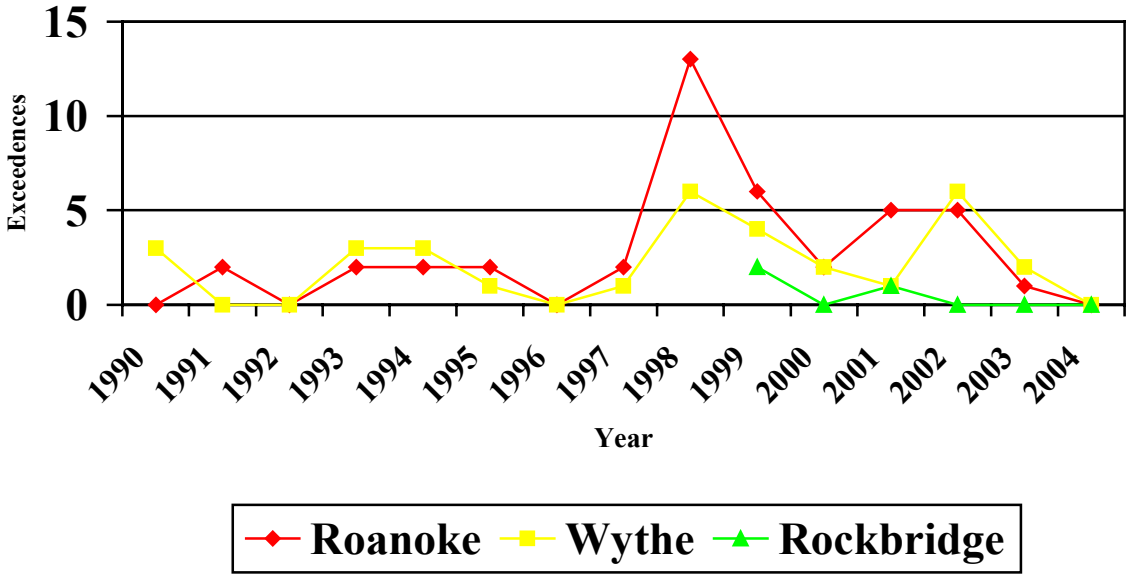
Rockbridge Co. 8-hour Ozone Exceedances (1999 to 2004)



Wythe Co. 8-hour Ozone Exceedances (1991 to 2004)



8-Hour Ozone Exceedences (1990 to 2003)



During 2002 to 2004, the Roanoke monitor recorded 8-hour exceedences on the following days:

2002		2003		2004
June 11	91 ppb	June 24	91 ppb	NONE
July 17	94 ppb			
August 10	85 ppb			
August 11	92 ppb			
August 13	99 ppb			

Based on unofficial ozone data from the summer of 2004, the Roanoke area is currently in compliance with the 8-hour standard. The three-year average design value at the Roanoke monitor for 2002 to 2004 is 79 ppb.

C. Early Action Program (EAP)

The region agreed and committed itself to the EAP process to expedite air cleanup for future public health and welfare. The EAP was developed according to the protocol endorsed by EPA Region 6 on June 19, 2002. This protocol offers a more expeditious time line for achieving clean air than expected under EPA's 8-hour implementation rulemaking.

The principles of the EAP to be executed by Local, State and EPA officials are:

- Early planning, implementation, and emission reductions leading to expeditious attainment and maintenance of the 8-hour ozone standard;
- Local control of the measures to be employed, with broad-based public input;
- State support to ensure technical integrity of the EAP;
- Formal incorporation of the EAP into the SIP;
- Deferral of the effective date of nonattainment designation and related requirements so long as all EAP terms and milestones are met; and
- Safeguards to return areas to traditional SIP requirements should EAP terms and/or milestones be unfulfilled, with appropriate credit given for emission reduction measures implemented.

The Roanoke MSA EAP has two principal components:

1. The Early Action Compact (EAC) — EAC was the Memorandum of Agreement to prepare and implement an Early Action Plan (EAP). More specifically, the EAC established measurable milestones for developing and implementing the EAP.

2. The Early Action Plan (EAP) — This EAP serves as the Roanoke MSA's official air quality improvement plan, with quantified emission-reduction measures. The EAP will include all necessary elements of a comprehensive air quality plan, (such as formal State Implementation Plans), but will be tailored to local needs and driven by local decisions. Moreover, the EAP will be incorporated into the formal SIP and the region will be legally required to carry out this plan just as in nonattainment areas. For example, development of the EAP requires the same scientific diligence and undergo the same scrutiny as the nonattainment areas SIPs, so that the emission reduction strategies selected will be adequate to ensure the region stays in attainment of the 8-hour standard.

EAP versus Traditional Nonattainment

A major advantage of the region's participation in an EAP is the flexibility afforded to the signatories in selecting emission reduction measures and programs that are best suited to local needs and circumstances. Recognizing the varied social and economic characteristics of the region, not all measures can or should be implemented by every entity.

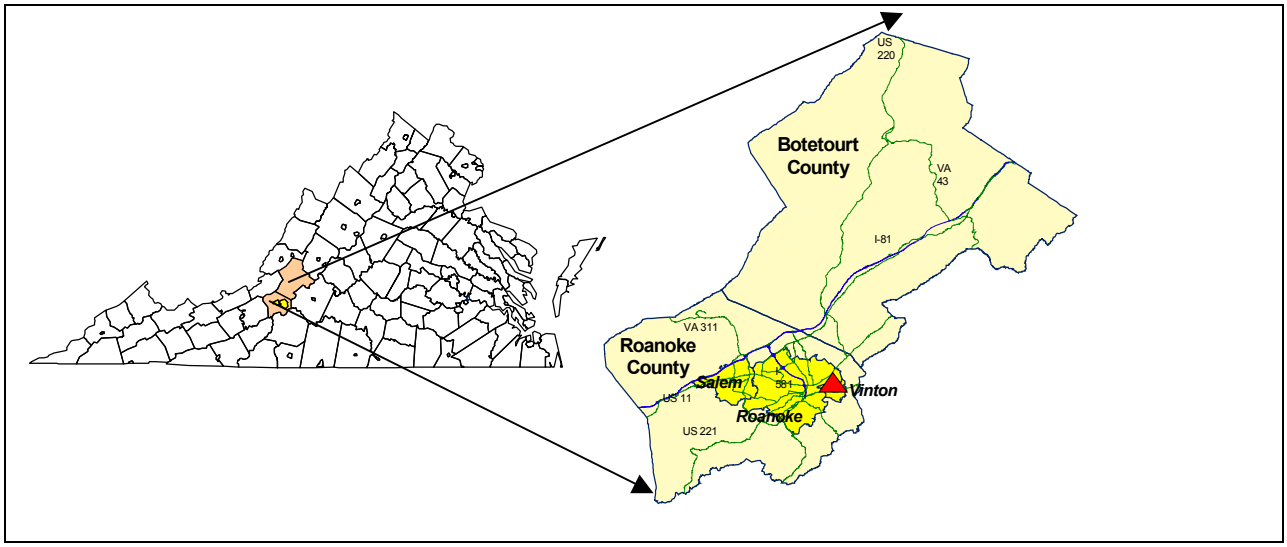
- The EAP allows for more local control in selecting emission-reduction measures.
- The EAP provides deferral of nonattainment designation and related requirements, as long as Plan requirements and milestones are met. This would prevent any related stigma associated with a formal nonattainment designation.
- The EAP is designed to achieve clean air faster than under the traditional SIP process.
- Should any milestones be missed in designing or implementing the Plan, the area would automatically revert to the traditional SIP requirements, with appropriate credit given for emission reduction measures already implemented.

The Roanoke MSA's EAP is designed to enable a local, proactive approach to ensuring attainment of the 8-hour ozone NAAQS, and so protect human health. Using the EAP approach, the region could begin implementing by 2005 emission-reduction measures directed at attaining the 8-hour standard. This allows for a significantly earlier start than waiting for formal EPA nonattainment designation, and it gives more flexibility in choosing which emission reduction strategies to implement. The area is then required to demonstrate compliance with the ozone standard by 2007 through ozone monitoring data.

D. Description of the Early Action Compact Area

The Roanoke Metropolitan Statistical Area (MSA) is located within the Blue Ridge Mountains area of Virginia and has typical topographic characteristics of such a mountain and valley area. The major urbanized center area is located in a valley and made up of the Cities of Roanoke and Salem, along with the Town of Vinton where the ozone monitor for the area is located. The more suburban and rural Roanoke County with Botetourt surrounds this core urban area to the North. The major commercial transportation corridor of Interstate 81 runs through the entire MSA from north to south, which is just to the west of the urban core. A significant portion of Northwestern Botetourt County is rural and part of the Jefferson National Forest.

Figure 2 – Roanoke Early Action Area



The vital statistics of the area in terms of ozone related criteria are as follows:

- Land Area – 851 square miles
- Population (2000) – 235,932
- Population density (2000) – 277 per square mile
- Projected Population (2010) – 244,499
- Volatile Organic Compound Emissions (2002) – 45 tons per day
- Oxides of Nitrogen Emissions (2002) – 50 tons per day
- Prevailing Ozone Season Wind Direction – From the Southwest
- 8-hour Ozone Design Value (2001 – 2003) – 0.085 parts per million

2. PROJECT ORGANIZATION & PROGRESS SUMMARY

The Ozone Early Action Plan development process is a joint effort of the Roanoke Valley Area Metropolitan Planning Organization and the Virginia Department of Environmental Quality. The Roanoke Valley-Alleghany Regional Commission (RVARC) is the administrative agency for the Roanoke Valley Area Metropolitan Planning Organization. Staff with the Commission have been detailed to work on the Ozone Early Action Plan and to manage the involvement of a consultant, E.H. Pechan & Associates, which assisted with development of the plan.

A. Project Organization

The Ozone Early Action Plan Task Force was established to guide the consultant and Roanoke Valley-Alleghany Regional Commission staff in the development of the Ozone Early Action Plan when it is not practical to engage the public at large on every minor detail. The Task Force is staffed by the RVARC.

B. Progress Summary

As stated before the Roanoke EAC process began back in the fall of 2002 with discussions and final agreement to participate in the EAC program. This resulted in the formal submission of a compact, signed by representatives of the all parties involved, to the EPA on December 23, 2002.

Beginning in early 2003 work began in earnest to develop a local air quality plan through the establishment of the Roanoke Early Action Plan (EAP) Task Force which is described in detail later in this document. The first deliverable of the taskforce and major milestone in the EAP process was a list of ozone precursor pollutant control measures under consideration for inclusion in the formal local air quality (EAP) plan. This list was developed and submitted to EPA on June 11, 2003.

On June 30, 2003, the 1st Semi-Annual Status Report was submitted to EPA. That report fulfilled the first reporting milestone required by the EAC. This report described the process achieved thus far by the taskforce in developing control strategies and gaining public input.

The 2nd Semi-Annual Status Report in December 2003 provided a list of the control measures under consideration for adoption by the Roanoke areas. This report listed and described each measure and provided the likely implementation dates, a current assessment of the amount of emission reductions expected to be achieved through implementation of the measure, and the geographical area in which each control measure is anticipated to apply.

On March 31, 2004, all the efforts of the parties involved culminated in the development and submission of the final local Early Action Plan and supporting documentation. This submission contained local, state, and federal control measures and estimates, emissions inventories and predictions, and a demonstration that the area would come into compliance with the ozone standard by 2007.

On June 30, 2004, the 3rd Semi-Annual Status Report was submitted to which provided additional detail on the implementation of the Roanoke EAP.

The specific process used to select and evaluate local control measures contained in the final local plan is presented below:

- All participating members cast initial votes for potential control measures to be carried forward in the process from the original potential local control measure list that was submitted to EPA. The top measures from this voting were those the group generally believed were most likely to be effective and acceptable if included in the final local control plan.

- Three subcommittees made up of taskforce members were established to individually evaluate each potential local control measure that was previously voted forward in the process. These subcommittees covered the following categories of potential local controls:

    1. Heavy Duty Diesel and Diesel equipment strategies
    2. Air-quality action day, public education, and stationary sources strategies
    3. Lawn and garden equipment strategies

The individual committees then met continuously to define, evaluate, and quantify the measures in each category. Once this process was completed, a draft local control plan was developed and presented to the whole task force and accepted for inclusion in the status report during the December taskforce.

The subsequent final Early Action Plan (EAP) was then developed and presented for formal adoption to each governing body of each jurisdiction involved. In turn, each jurisdiction has formally adopted the plan and committed to its subsequent implementation.

C. Stakeholder Involvement and Meetings

Throughout the EAP process, extensive efforts were extended to inform and involve the public in the process in order to obtain their input and participation. The main vehicle used to coordinate the overall EAP process was the EAP Task Force. This group was staffed by the RVARC. The complete make-up of the Task Force was not static; however, its core makeup includes representation from the following organizations ***(Blue Ridge Bicycle Club, Roanoke Regional Chamber of Commerce, Blue Ridge Environmental Network, US Forest Service, Piedmont Environmental Council, RIDE Solutions, Salem – Roanoke County Chamber of Commerce, Virginia Tech, Norfolk Southern Corp., Southern Environmental Law Center, Clean Valley Council, Roanoke Valley Greenways Commission, Roanoke Valley Asthma and Air Quality Coalition, Sierra Club – Virginia Chapter, Roanoke Valley Economic Development Partnership, Roanoke Valley Resource Authority, Virginia Health Department, City of Roanoke, City of Salem, County of Roanoke, County of Botetourt, Town of Vinton, Virginia DEQ, Virginia DOT (VDOT), Federal Highway Administration)*** Many other organizations have participated on an ad hoc basis. Provided below is a comprehensive list of meetings, actions, and public events involved in the EAP effort in the Roanoke area:

Monday December 16, 2002 - Early Action Compact (EAC) Signing Ceremony, Public and Press Invited, Press Releases preceded the event, a media pack was developed in conjunction with RVARC's on call PR Consultant.
January 14, 2003 - Ozone EAP Task Force Kickoff meeting (*see Task Force Makeup Above)
Wednesday February 19, 2003 – EAP was featured in Leadership Roanoke Valley Air Quality Program at Roanoke County Fire and Rescue Training Center (LRV Quality of Life Program – All Day)
February 28, 2003 – **EAP Task Force Meeting** – Consultant Presentations and Selection of finalist for contract.
March 28,2003 – **EAP Task Force Meeting** – Air Quality Modeling Presentation and Discussion – Virginia DEQ

March 10, 2003 – Oral Presentation to Cosmopolitan Club (Mark McCaskill, Lunch Meeting, Q&A included)
April 10, 2003 – Oral Presentation to Roanoke Regional Chamber of Commerce Transportation Committee concerning the EAP. (Mark McCaskill, 12:00 pm, Q&A included)
April 23, 2003 – Oral Presentation to Roanoke Valley Greenways Commission concerning the EAP. (Mark McCaskill, 5:00 pm, Q&A included)
May 1, 2003 – Media Interview Channel 10 6:00 O'clock News
May 2, 2003 – **EAP Task Force Meeting** – E.H. Pechan Associates – Draft Strategies Menu Discussion
May 15, 2003 Advertisement sent to ***Roanoke Times*** and ***Roanoke Tribune*** for May 29, 2003 public input meeting. Advertisement will run in the Sunday May 18, 2003 Edition (Roanoke Times) and Thursday May 22, 2003 edition (Roanoke Tribune).
May 16, 2003 – Distribution of Draft Strategies List to "Regional Mayor's and Chairs" meeting (Local Elected and Chief Administrative Officers for the Region)
May 16, 2003 – Notice of May 29th public meeting in Roanoke Regional Chamber's Monthly Electronic Newsletter "Member Connections"
May 19, 2003 – **EAP Task Force** teleconference meeting with E.H. Pechan concerning draft strategies.
May 19, 2003 – May 29th meeting **press release** to following recipients (Joe McKean, WDBJ-TV; Melissa Preas, WSLS-TV; Ray Reed, The Roanoke Times; Chris Kahn, Associated Press; William Little, Fincastle Herald; Claudia Whitworth, The Roanoke Tribune; Jeff Walker, The Vinton Messenger; Meg Hibbert, Salem Times Register; Rick Mattioni, WVTF-FM (Public Radio); Kevin LaRue, WFIR-FM (Roanoke's News Radio)
May 27, 2003 – Retransmission of above press release
May 29, 2003 – Interview with Dan Heyman WVTF News concerning public meeting
May 29, 2003 – Article published in Roanoke Times concerning public meeting (see file)
May 29, 2003 – Public Meeting Roanoke County Headquarters Library (28 Attendees) – Public comments cataloged and transmitted to consultant (E.H. Pechan) for revision of draft strategies list.
June 25, 2003 – Isak Howell (The Roanoke Times) requests the list of potential strategies to do an Ozone related story.
June 26, 2003 – Isak Howell story appears in The Roanoke Times and mentions the Ozone EAP and public participation.
July 30, 2003 – Ozone EAP featured in July 29, 2003 edition of "Legislative Connection" email distributed by Roanoke Regional Chamber of Commerce.
August 8, 2003 – Ozone EAP Task Force meeting. Initial "Voting" on strategies.
September – Article featuring Ozone EAP process and the Roanoke Valley's participation featured in the National Association of Development Organizations' (NADO) "Economic Development Digest" September Edition – Kelly Novak Author
September 4, 2003 – Ozone EAP Task Force meeting and establishment of "subcommittees" to evaluate strategies.
September – November, 2003 subcommittee meetings.
November 14, 2003 – Ozone EAP Task Force Meeting.
November 26, 2003 – Press Release to announce December 5, 2003 EAP Open House
November 30, 2003 – Advertisement of December 5, 2003 in Roanoke Times.
December 1, 2003 – Notices placed at City of Roanoke Main, Gainsboro, Jackson, Melrose and Williamson Road Library Branches.
December 2, 2003 – City of Roanoke Environmental Information Officer placed November 26 Press Release in the City's "My Roanoke" email newsletter.
December 2, 2003 – Notices announcing Open House placed at Harrison Museum of African American Culture as well as Refugee & Immigration Services.
December 5, 2003 – Ozone Open House 11:00 am to 1:00 pm.
December 5, 2003 – Ozone Task force meeting.
January 11, 2004 – Legal advertisement in "Roanoke Times" announcing January 20, 2004 Public Hearing"
January 18, 2004 – Follow-up legal advertisement in "Roanoke Times" announcing January 20, 2004 Public Hearing"

January 19, 2004 – Presentation to Regional Chamber of Commerce concerning Ozone EAP.
January 20, 2004 – Ozone EAP Draft Public Hearing.
January 21, 2004 – Interview with WVTF Public Radio for broadcast.
January 22, 2004 – Interview with News 7 (CBS) for 5:00 p.m. and 6:00 p.m. news.
January 20, 2004 – Formal resolution of EAP adoption (Town of Vinton).
January 27, 2004 – Formal resolution of EAP adoption (Roanoke County).
January 29, 2004 – Formal resolution of EAP adoption (City of Salem).
February 17, 2004 – Formal resolution of EAP adoption (City of Roanoke).
February 24, 2004 – Formal resolution of EAP adoption (Botetourt County).
February 27, 2004 – Meeting of the Roanoke Early Action Task force.
March 11, 2004 – Conference call with EPA Region III concerning the technical assessment (air quality modeling) effort in support of the early action effort.
March 24, 2004 – Effective date for State regulations that establish the EAC areas in Virginia as ozone precursor emissions control areas that are now subject to various existing source control (RACT) requirements.
March 31, 2004 – Submission of the official Roanoke Early Action Plan to DEQ and EPA.
April 22, 2004 – Roanoke EAP submission press event.
April 30, 2004 – Published final EPA rule for air quality designations and classifications for the 8-hour ozone standard and deferral of the effective date of nonattainment designations for approved early action compact areas, including the Roanoke area. The first deferral of the effective date for Roanoke designation extends to September 30, 2005.
June30, 2004 – Submission of the 3rd semi-annual status report for the Roanoke EAC area.

3. EMISSION REDUCTION STRATEGIES

This section describes the local control measures that have been adopted and included in the final local Early Action Plan. These measures, when combined with control strategies at the state and federal levels, are meant to significantly reduce ozone precursor emissions and bring the Roanoke Valley area into compliance with the 8-hour ozone standard.

A. Local Control Measures

Described below is a summary of the local control strategies in the final Early Action Plan. These control measures are grouped according to the categories and subcommittees established by the Task Force to evaluate these measures. **A further description all these control measures, local contacts, and actual or predicted implementation dates are presented in Appendix A.**

Heavy Duty Diesel and Diesel Equipment Strategies

Local Phase I Controls

Heavy Duty Diesel and Diesel Equipment Strategies

#1 – Reduction of locomotive idling and resulting emissions. Through a local voluntary agreement, the Norfolk Southern Railroad Company will implement an internal policy to limit locomotive idling at its facilities/yards in the City of Roanoke. This measure is expected to reduce NO_X emissions in the area by 0.153 tons/day. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#2 – Limitation of idling times for local school bus fleets. This measure involves restrictions on idling and idling times for school bus and other local government vehicles throughout the EAC area. The City of Roanoke has initiated an engine and equipment idling policy whereby City vehicles shall not be parked with their engines idling for more than five (5) minutes unless it is essential for the performance of work. Exceptions exist for public safety vehicles. As a reminder of the policy, special message keychains have

been produced and attached to all fleet vehicle keys. The City of Salem and Roanoke County have developed similar policies and restrictions. Botetourt County is in the process of developing and implementing these restrictions. This measure is expected to reduce NO_X emissions in the area by 0.003 tons/day. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#3 – Retrofit control technology for 100 Roanoke County school buses. This measure involved the installation of oxidation catalysts on 100 school buses. Roanoke County School Board approved a grant in the amount of $226,644 for the retrofitting of school buses to reduce diesel emissions. The Virginia Department of Environmental Quality (VDEQ) and the United States Environmental Protection Agency (EPA) awarded the grant to retrofit 100 of the 184 buses in the school bus fleet with oxidation catalysts in order to help reduce particulate matter emissions. Roanoke County has agreed to keep these buses in service for at least three years after the projects completion. A contract to perform the retrofits has been awarded and the work is expected to be completed before the 2005 ozone season. The City of Roanoke has also received grant funds to retrofit 102 school buses and the process for contracting the retrofit work is underway. This measure is expected to reduce VOC emissions by 0.003 tons/day and NO_X emissions by 0.009 tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#4 – Purchase and use of bio-diesel compatible solid waste trucks by the City of Roanoke. This measure will involve the conversion of five new garbage trucks to use bio-diesel fuels. In 2003 Roanoke City purchased five new garbage trucks that can be converted to bio-diesel. As the fleet is replaced, the city will purchase additional compatible vehicles. This measure is expected to reduce NO_X emissions in the area by 0.001 tons/day. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#5 – Purchase and use of ethanol compatible alternative fuel vehicles by the City of Roanoke. In 2003, the City of Roanoke purchased eleven (11) sedans and station wagons that are ethanol fuel compatible. By 2007, the City will purchase fifteen (15) additional compatible vehicles. The emission reductions expected from this measure cannot be calculated at this time. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#6 – Purchase of bio-diesel ready trucks by the City of Roanoke. In 2003, the City of Roanoke purchased nine (9) new trucks using bio-diesel fuel. By 2007, the City will purchase twelve (12) additional vehicles. The emission reductions expected from this measure cannot be calculated at this time. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#7 – Purchase of hybrid vehicles by the City of Roanoke. This measure will involve the purchase and use of up to four hybrid vehicles. In the 2003-2004 fiscal year the City will purchase one (1) Toyota Prius hybrid vehicle. By 2007, the City will purchase at least three (3) additional hybrid vehicles. This measure is expected to reduce VOC emissions by <0.001 tons/day and NO_X emissions by <0.001 tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#8 – Purchase of more efficient, low-emission, or alternative fuel vehicles by Roanoke County. The County has purchased three (3) hybrid vehicles and an additional four (4) vehicles are on order. This measure is expected to reduce VOC emissions by <0.001 tons/day and NO_X emissions by <0.001 tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#10 – Educational and training program of vehicle use by Roanoke County. The County has implemented an educational program on “effective environmental driving”. Roanoke County distributed a brochure to all of its employees urging them to reduce the environmental impact of driving both company and personal vehicles. Items focused on car-pooling, planning trips, and reduction of idling. All drivers of

County vehicles will receive "Effective Environmental Driving" classroom training prior to the 2005 ozone season. On a broader scale, the Ride Solutions program has been working throughout the region to raise awareness of "Smart Commuting" practices. Special Events, Public Service Announcements, print materials, lectures and presentations continue to be the primary mediums for this approach. The emission reductions expected from this measure cannot be calculated at this time. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

Air Quality Action Day, Public Education, and Stationary Source Strategies

The center-piece of the local control plan is a comprehensive air quality (ozone) action day program, which requires restrictions on ozone precursor pollutant producing activities by state/local governments and encourages voluntary restrictions of similar activities on local businesses and the public. Through various media sources, email lists, postings, events, and announcements the region's citizens will be informed of Ozone Action Days so that they can plan to participate in implementing steps to reduce ozone. The Roanoke Valley Alleghany Regional Commission has established this communication network and tested its effectiveness. The message reached a far larger audience than expected, and we are pleased with the results thus far.

The DEQ already issues local forecasts of ozone levels for the Roanoke area during the ozone season. An enhanced forecasting tool for the Roanoke area has been developed and will be used as part of this action day program, beginning in 2005. Another key component of this program will be an ongoing public awareness and education program to notify and inform the public on actions that they can take to reduce their individual impact on the area's air quality. The Regional Commission has employed television interviews and commercials, the Clean Commute Day Picnic and activities, a Bike to Workday event, radio commercials and interviews, and printed articles and advertisements, road signage, and marquis announcements to raise public awareness of these initiatives. To facilitate this program, regional and local air quality coordinators will be assigned to implement and coordinate the efforts involved. The main components of the air quality action day program, along with several longer-term support activities are as follows:

#11 – Air quality action day program (hybrid approach). This program consists of two main efforts. First, local governments have made commitments to limit or ban certain ozone precursor forming activities during predicted high ozone days. These activities will include landscaping, pesticide application, refueling vehicles, open burning and use of other solvent based products. The Virginia Department of Transportation, which performs many of the same activities in the local area, has also made this commitment. Secondly, voluntary restrictions on these same activities will be requested of local business and the general public during potential high ozone days. At the same time businesses and the public would be encouraged to make alternative commuter choices such as car or vanpools, public transit, telecommuting, and combining trips.

The Ride Solutions program of the Roanoke Valley Alleghany Regional Commission has established a network of citizens and agencies that are willing to contribute to the efforts on these days. Through the a strong public outreach campaign, promotion of alternative commuting modes, and support services, the Ride Solutions program has grown 58.3 percent from January 1st to July 1st 2004. This percentage reflects approximately 1.5 percent of the commuting public in the region. Furthermore, it does not reflect all of the citizens taking public transit and carpooling in the region. With continuing efforts the program hopes to register, and thus establish regular communication with, three to four percent of the region's commuting public in alternative transportation methods by 2007. Registration in the Ride Solutions program signifies a commitment to the air quality movement and willingness to promote good practices. As a contingency measure, if ozone exceedances continue or a shortfall in emission reductions is identified after plan implementation, the area will reevaluate and determine if additional mandatory restrictions are warranted.

#12 – Early morning or late evening refueling of vehicles. This measure has a mandatory and voluntary component. Ride Solutions' participants, private citizens, neighborhood associations, local governments, and state agencies will refrain from or restrict vehicle refueling during high ozone days until the evening. At the same time, local gasoline distributors are encouraged to provide incentives to the public to refuel early or late in the day during high ozone days. Several fueling stations have submitted pledges to support this initiative by encouraging citizens to "get fuel when it's cool". These companies include: Stop in Food Stores, Kroger, Workman Oil, and Boxley Inc. Furthermore, the localities that compose the 5th P.D.C. have all submitted similar statements for their fleets of vehicles.

#13 – Promotion of alternative fuel vehicles. As part of the public awareness and education program, the environmental and economic benefits of alternative fuel vehicles have been identified as an encouragement to purchase these vehicles. The County of Roanoke has submitted a statement that addresses their intent to purchase alternative fuel vehicles in the coming year. The City of Roanoke has applied for an EPA grant to support a pilot project to fuel its newly acquired duel fuel compatible vehicles.

#14 – Media and public relations concerning air quality action days. A comprehensive and year-round media and public relations program has been implemented and is coordinated by the Ride Solutions Coordinator. The Ride Solutions coordinator has developed a communication network consisting of television, radio, print media, road signs, marquis, presentations, special events, email and telephone trees, and a web site to spread awareness of these issues. All of these media sources work in conjunction to deliver a concise and collaborative message throughout the region. The message is addressed to businesses, agencies, and individual citizens alike. To date, the feedback has been far-reaching and positively received.

#15 – Public transit incentives (transit passes) for college students and local employers. This involves the purchase of at least 300 transit passes to be distributed to students and employers for use during high ozone days or year-round. All government employees in the City of Roanoke now have available to them bus vouchers to encourage them to take public transit. Furthermore, all city employees also have the "Downtown Express" which is a Park and Ride service that will shuttle SOV drivers from the Roanoke Civic Center into the downtown area to relieve congestion and lower emissions in the downtown area. This is a free service provided by the city. Furthermore, we are implementing the "Smart Way", a long distance shuttle along the I-81 corridor to alleviate congestion along that route.

#16 – Bicycle infrastructure and amenities. This program will encourage bicycle use during high ozone days and encourage the expansion of bicycle related infrastructure. The Roanoke Valley Alleghany Regional Commission had completed a Bike Feasibility Study of the roads in Roanoke for publication. This publication is designed to help commuters see the routes they would be able to ride in the area. A rural version of the study will be completed in the next year. Furthermore, there is work being done on greenway mapping of the Roanoke Valley to inform bikers of their routes and alternatives. The Ride Solutions Coordinator is also working with private businesses to encourage biking as an alternative mode of transportation providing bike racks and flex hours for employees.

Actions completed thus far consist of:

- Developed a regional bicycle network that facilitates and promotes alternative transportation and recreational opportunities in the region.
- Conducted fieldwork to collect data required for Level of Service (LOS) modeling. Additional data, beyond what is required for LOS modeling, was also collected. This data was compiled to develop a comprehensive database of roadway design parameters in the Regional Bicycle Suitability Study.
- Evaluated the LOS of the study area network using the Bicycle Compatibility Index (BCI) model and the Bicycle Level of Service (BLOS) model
- Using the BCI model, recommend design alternatives to better accommodate bicyclists for selected portions of the regional network.

- Using GIS technology, produced compatibility/suitability maps for corridors comprising the regional network based on the LOS scores received from both models.
- Reviewed alternative design and operational options for segments in the regional network and LOS achieved by various options, as provided by the models.
- Compared the LOS results provided by both the BCI and LOS models using data and work products from the *Regional Bicycle suitability Study.*
- Prepared to update the 1997 *Bikeway Plan for the Roanoke Valley Area (FY2005).*

#17 – School (K-12 and adult education) based public education. This involves the expansion of an ongoing educational program to identify air quality issues and individual action that can be taken to reduce ozone precursor emissions at area primary and secondary schools.

#18 – Tree canopy/ urban forestry. This involves an area-wide comprehensive tree-planting program with the goal of reducing concentrations of certain pollutants including NO_X and ozone. Roanoke City and Vinton have both support this initiative. Roanoke City has planted 500 trees thus far this year on City owned land. The Town of Vinton has planted 30 trees and 30 seedlings, and Roanoke County has committed to plant 100 trees this year.

#19 – Roanoke to Blacksburg public transit. Establishment of a bus route from Roanoke to Blacksburg (where Virginia Tech is located), and points in between. The bus route is established and began in August 2004. The bus is called the "Smart Way" bus. For three dollars people are able to travel approximately 50 miles from Blacksburg to Roanoke one way. There are also be stops in Christiansburg and Salem. The Ride Solutions Coordinator for the Regional Commission is preparing a survey to research and document ridership for Valley Metro. For the first three years Valley Metro will fund the program with technical support provided by Ride Solutions. After this point, the localities that the bus services will share the cost as determined by ridership. Ride Solutions will also coordinate with Valley Metro to share advertising and clean commuting messages with the "Smart Way".

Although it is very difficult to estimate ozone precursor emission reduction that will be achieved from these individual actions, it is not unreasonable to assume that all these actions combined will have the desired impact of reducing emissions to some extent. Through the evaluation of these types of programs in other areas, a general range of emission reductions that can be expected from the combination of these types of voluntary measures of 3% from affected activities and emissions. Therefore, an initial estimate of a 3% reduction in ozone precursor emissions from these activities in the Roanoke area has been used to estimate the reductions from the combination of these measures during predicted high ozone days. This comprehensive suite of measures is expected to reduce VOC emissions by 0.94 tons/day and NO_X emissions by 0.61 tons/day in the area. This reduction estimate includes the reductions expected from the episodic restrictions on land and garden equipment (measures #22 and #23) usage during predicted high ozone days. This measure is being submitted for SIP credit and was included in the attainment demonstration for the area.

Lawn and Garden Equipment Strategies

#20 – Replacement of gasoline golf carts with electric carts. This measure involves obtaining commitments from up to four local golf courses to replace some or all of their golf carts with electric carts. One or more golf courses in each jurisdiction are being sought to participate in a pilot cart replacement program. This measure is expected to reduce combined VOC and NO_X emissions by <0.001 tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#21 – Gasoline powered lawnmower buyback program. This involves providing incentives for the public to trade in gasoline powered lawnmowers for zero emissions equipment (electric or manual). Cooperative agreements are currently being sought with local hardware/warehouse businesses to begin this program. This measure is expected to reduce VOC emissions by 0.017 tons/day and NO_X emissions by 0.001

tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

#22 & #23 – Restrictions on the use of lawn and garden equipment. This is another two-part control measure with mandatory restrictions of the use of gasoline powered lawn and garden equipment for state/local governments and voluntary restrictions on local businesses and the public during predicted high ozone days. Commitments of all the localities involved have been obtained to implement this episodic measure. This measure is incorporated into the overall Ozone Action Day program that was previously described. This measure is expected to reduce VOC emissions by 0.44 tons/day and NO_X emissions by 0.11 tons/day in the area. This measure is being submitted for SIP credit and was included in the attainment demonstration for the area as part of the overall ozone action days program.

#24 – Open burning bans/restrictions. Several jurisdictions have adopted local rules restricting or prohibiting open burning. The other EAP jurisdictions have committed to ban or restrict open burning during predicted high ozone days. This measure is expected to reduce VOC emissions by 0.56 tons/day and NO_X emissions by 0.24 tons/day in the area. This measure is not being submitted for SIP credit and was not included in the attainment demonstration for the area.

B. State/Federal Control Measures

In addition to the local strategies identified in the preceding discussion, several state and federal actions have or will produce substantial ozone precursor emission reductions both inside and outside of the Roanoke area. These reductions are aimed at reducing local emissions and the movement (transport) of pollution into the area. These strategies, when combined with the local strategies, are expected to lower area ozone concentrations to the level at or below the ozone standard.

State Control & Support Measures

At the state level, five significant actions have been taken to support ozone standard attainment in Virginia and specifically in the EAC area.

- Regional ozone transport control program (i.e., the NO_X SIP Call)
- National Low Emission Vehicle Program (VA early opt-in beginning in 1999)
- Reasonably Available Control Technology (RACT) controls for existing industries
- Enhanced ozone forecasting tool for the Roanoke area
- Stage I vapor recovery at service stations

1. Regional Reduction of NO_X Emissions (NO_X SIP Call)

In response to EPA's call for the reduction of NO_X emissions from large combustion sources (i.e., the NO_X SIP Call), the state has adopted and implemented a program to significantly reduce emissions of NO_X as part of a regional program to reduce ozone transport.

On May 21, 2002, the Virginia Air Pollution Control Board adopted a final state regulation concerning the NO_X Budget and Emissions Trading Program, 9 VAC 5 Chapter 140, in response to the EPA NO_X SIP Call. The final regulation was published in the Virginia Register on June 17, 2002, and became effective on July 17, 2002. On June 25, 2002, the regulation was submitted to EPA along with the initial allocations for the affected units. On November 12, 2002, EPA issued a notice proposing approval of the state program, with the exception of the NO_X allowance banking provisions dealing with the start date of flow control. This deficiency has subsequently been corrected and submitted to EPA for full final approval of the state program.

This program alone is predicted to reduce ozone forming NO_X emissions by up to 30,000 tons per ozone season in Virginia. Beginning on May 31, 2004, facilities and emission units subject to the state NO_X

budget and trading rule must comply with this rule during the control period from May to September of every year hence forth. As part of this program, affected sources must adhere to emission rates and caps unless additional emission allowances are obtained though the EPA administered trading program.

2. National Low Emission Vehicle Program

The National Low Emissions Vehicle (NLEV) program is a voluntary clean vehicle program established by EPA through national regulation on December 16, 1997. Due to the voluntary nature of the program, it was contingent upon agreement by northeastern states (including Virginia) and the major auto manufacturers. Virginia opted into this program for lower vehicle standards, beginning model year 1999 vehicles, as part of the initial startup of this program. Virginia subsequently adopted a state NLEV regulation, 9 VAC 5 Chapter 200, which became effective on April 14, 1999.

This program has and will continue to provide substantial ozone precursor emission reductions in Virginia that will assist regions like the Roanoke area in meeting air quality standards and goals.

3. Reasonably Available Control Technology (RACT) controls for existing industries

To address local emissions, the state has recently adopted Reasonably Available Control Technology (RACT) controls for industries in the area to further reduce the local contribution to ozone formation. This regulation was adopted by the Air Pollution Control Board in October 2003 and became effective on March 23, 2004. Compliance with this rule will be required by November 15, 2005. Because this measure has specifically been adopted to support the Early Action Plan, this measure has been included and modeled as a local control measure.

Regional Office activities relating to RACT implementation:

A. Agency training

- In January, WCRO and VRO conference called with Air Program members of the NRO and Central Office to discuss issues concerning RACT as required for an emission control area.

B. Steps taken to regulate industry

- We expect the regulatory implementations (NO_x RACT) that became effective on March 24, 2004 to have an impact on NO_x concentrations emitted in the compact area.
- Current DEQ databases were searched for facilities that emit nitrogen oxide (NO_x) in the compact area.
- Three potential NO_x RACT sources were identified in the affected geographic area that exceed TPTE of 100 tpy (TPTE = theoretical potential to emit; tpy = tons per year).
- These sources were notified of the impact of the new regulations on their NO_x emissions. All sources submitted their NO_x RACT plans as required on or before June 25, 2004.
- RACT determinations for these facilities have been developed and are being submitted as a separate SIP revision.

General Public Awareness and Education

The DEQ regional office is developing a brochure for public distribution concerning the importance of maintaining an environmentally good record with respect to ozone. The document targets adults who drive on area roads, and who use gasoline powered devices to work on the farm and home. It compliments the educational materials being developed by Early Action Compact members. The brochure will be published and ready for distribution late this summer. Methods of disseminating the brochure are being investigated.

4. Enhanced Ozone forecasting tool for the Roanoke Area

Although not a direct control measure, the DEQ has completed a contract with Sonoma Technology, Inc. to develop an area specific ozone forecast tool to support the local ozone action days program and associated voluntary emission reduction efforts. This tool has been provided and is currently undergoing testing. DEQ is also in the process of filling a second meteorologist/forecaster position to develop and issue area specific ozone forecasts. Full implementation of this program will begin during the 2005 ozone season.

5. Stage I Vapor Recovery at local service stations

Article 37 of 9 VAC 5 Chapter 40 establishes emission standards for petroleum liquid storage and transfer operations. 9 VAC 5-40-5200 B. 3. requires the installation and use of stage I vapor control systems at service stations in Roanoke County and the Cites of Roanoke and Salem, beginning in 1999. The DEQ regional office in Roanoke has recently completed a comprehensive compliance review of affected facilities to ensure compliance with this regulation. The gasoline bulk loading at bulk terminals control requirements have also been extended into Bedford County.

Federal Control Measures

On the federal level, numerous EPA programs have been or will be implemented to reduce ozone pollution. These programs cover all the major categories of ozone generating pollutants and are designed to assist many areas that need to come into compliance with the federal ozone standard. A brief description of these strategies is provided below:

Stationary & Area Source Controls

In addition to the NO_X SIP Call program, 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

The EPA continues to make significant progress in reducing motor vehicle emissions. Several federal programs have established more stringent engine and associated vehicle standards on 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 and 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 and garden equipment, construction equipment, boat engines, and locomotives.

All these measure have been developed to address the creation of ozone producing emissions in the local area as well to lessen the transport of ozone into the area as a comprehensive approach to reducing ozone levels. **A detailed summary and description of all the control measures contained in this plan and the emission reductions and estimation methods are presented in Appendix B to this document.**

4. AIR QUALITY TECHNICAL SUPPORT ACTIVITIES

A. Background

Air Quality analyses are used to simulate the combination of meteorology, emissions, and atmospheric chemistry that promote ozone formation and higher ambient concentrations in a given area. Once a representative scenario (episode) conducive to ozone formation, based on an actual observed ozone event, is selected and validated, various emission reduction strategies can be tested to predict whether they would succeed in reducing ozone and attaining the ozone standard. The major steps involved in photochemical modeling is as follows:

- Selection of type and geographic scale of photochemical model
- Selection of representative ozone episode(s)
- Base case episode modeling and validation
- Future year projection and attainment demonstration modeling

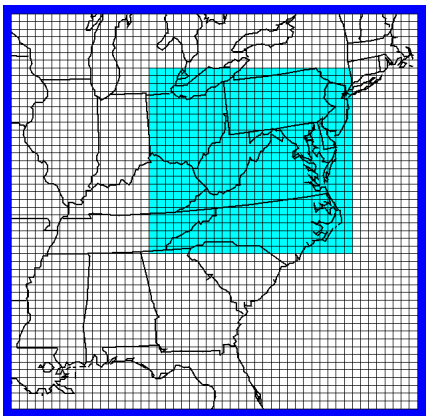
B. Model and Domain Selection

Due to the regional nature of ground level formation and transport that is prevalent in the Eastern United States, combined with the reasonable assumption the early action area is impacted by ozone transport, a regional photochemical modeling exercise has been selected for this project. This selection will allow for the evaluation of the impact of transport on the study area as well as the impact of regional and national control strategies in reducing ozone transport into these areas.

The initial photochemical model selected for this purpose in EPA's MODELS3/CMAQ model that is EPA's latest modeling platform for such analyses. The meteorological inputs required to run the model will be developed using the MM5 meteorology model, and the emissions inputs will be developed using the SMOKE emissions preprocessor model. The purpose of these model data input preprocessors is to temporally and spatially allocate these inputs to a grid system used by the photochemical model to recreate the atmospheric interaction of all these factors in promoting ozone formation.

Due the need to model a larger region for ozone transport assessment, a regional domain that covers a large portion of the Mid-Atlantic States has been chosen to support the early action modeling. This domain has been used in previous analyses by the State to assess transport and the regional effect of emission reductions. The domain will consist of a series of descending grid cells from 36 kilometers (km) at the edges of the domain, to 12 km in the Mid-Atlantic area. In this way the resolution of the model and modeling results will be the highest in and around the early action planning areas. This modeling domain is shown below.

Early Action Modeling Domain of 36 km & 12 km Resolution

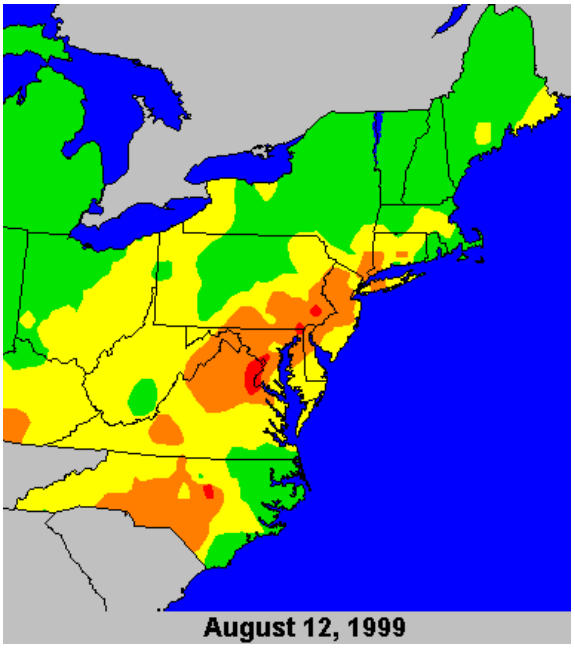


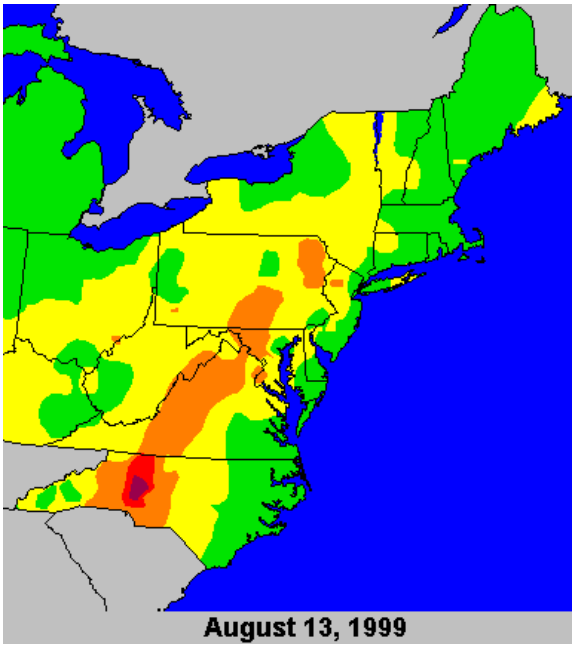
C. Episode Selection

One of the key aspects of a modeling analysis of a particular area and air pollution problem is to select one or more representative episodes to model. The selection process should reflect one or more of the prevailing meteorological and emissions conditions that produce higher levels of ozone in the subject area. An additional consideration for this project is that EPA guidance requires that the baseline emission inventory and subsequent episode(s) selected for an EAP are no older than 1999. Finally, since three states are developing plans in the same general area, an episode common to all three was selected.

The result of this process produced an ozone episode that occurred on August 12th and 13th in 1999. This episode was selected mainly because exceedences of the ozone standard were observed at all the area monitors involved in this effort (including Roanoke), during this period. This episode also involved the transport of ozone into Virginia from both the West and Southwest. To adequately simulate the events leading up and following this episode, a 10 day period from August 8th to the 18th was be modeled. An additional episode, probably in 2002, will be selected and modeled to retest and confirm the results of the EAC modeling and to begin the analysis of other nonattainment areas in Virginia. The EPA ozone maps of the August 12th & 13th, 1999 episode are shown below.

The Ozone Episode of August 12th & 13th, 1999





The episode meteorological conditions of August 12th and 13th in 1999 are listed below.

August 12th

The surface weather map on the morning of August 12th indicated a trough of low pressure extending from coastal New England, through the Delmarva region into central Virginia. South and east of the trough, surface winds were generally from the southeast and higher dew point temperatures, indicative of maritime air. West of the trough, surface winds were calm and variable with lower dew point temperatures, indicative of ozone–conducive continental air. Haze was reported over a large area from Maine into Tennessee and Georgia. Surface winds remained light into the afternoon. Surface and 1500 meter 48-hour back trajectories for Roanoke ending that afternoon indicated that air passed over the Ohio River Valley and West Virginia. The

evening surface weather map indicated the trough of low pressure separating maritime from continental air persisted from New England southwestward through Maryland and Richmond, extending into central North Carolina. Maximum temperatures east of the trough were around 90 degrees. West of the trough, high temperatures reached into the low to mid 90s.

August 13th
The surface weather map on the morning of August 13th indicated the trough extended from Washington, D.C. through central Virginia into central North and South Carolina. Again, higher dew point temperatures and southerly winds east of the trough indicated maritime air. Lower dew points and calm winds west of the trough indicated the presence of a continental air mass. Forty-eight hour surface and 1500 back trajectories for Roanoke ending that afternoon originated from the Great Smokey Mountains region of northeastern Tennessee and north central Tennessee, respectively. The surface trough separating the maritime air from the continental air persisted into the evening. High temperatures reached the mid-to-upper 90s in the region.

D. Emissions Inventory and Control Measures Summary

This section presents the various air pollutant emissions inventories developed to support the Roanoke Valley Ozone Early Action Plan. Typical daily inventories during the ozone season, expressed in tons per day, have been developed for this purpose. These inventories include baseline, interim, and future projection years to determine historic, current, and future emissions levels as part of the air quality plan development process. The major source categories used to present this inventory data are:

- **Stationary Point Sources -** Large utility and industrial facilities with significant individual emissions.
- **Mobile Sources -** Motor vehicles operated on public roads such as interstates, freeways, and local roads.
- **Area Sources -** Small individual sources of emissions such as gasoline distribution and marketing, solvent usage, and others.
- **Non-road Mobile Sources -** Motor vehicles and equipment such as lawn and garden tools, construction equipment, locomotives, and aircraft.

The first inventory developed for this process was the baseline emissions inventory. 1999 was selected for this purpose, since the ozone episode being modeled to support the EAP process occurred during the summer of 1999. This inventory serves as a baseline estimate of area emissions during the time when the modeled episode occurred. This inventory reflects actual emissions in the area during this year.

The second inventory to be developed was the interim (current) year emissions inventory. 2002 was selected for this purpose because this is the latest year for which a comprehensive inventory for all sources has been developed. This inventory serves to represent existing emissions levels in the local area and can also be compared to the baseline inventory to determine emissions trends. This inventory also reflects actual emissions in the area during this year.

The last two inventories developed for this process are predicted future year emissions inventories that represent base case (uncontrolled) and control case (controlled) emissions scenarios. The year selected for this purpose was 2007, which is the year by which the area must come into compliance with the ozone standard. The future base case inventory represents uncontrolled emissions projected with appropriate growth factors. The exception to this is the mobile source inventory that contains some reductions associated with previous federal/state motor vehicle controls. The future control case inventory represents the application of all control expected to be implemented in the local area by the attainment year. This includes the local impact of additional federal/state control measures, and the local control measures selected as part of the EAP process. A summary table and bar graph of these emissions inventories is presented below. The various emissions inventories developed as part of EAP process are also presented. Finally, a table summarizing all emissions control measures and predicted reductions from 2007 uncontrolled levels is presented.

The emissions estimates used in this document were derived using the following method/models:
Point Sources – Actual base and interim estimates obtained for the DEQ Comprehensive Environmental Data System (CEDS). Future point source emissions were estimated using actual historical data and applying appropriate growth factors from the EPA EGAS growth factor model.

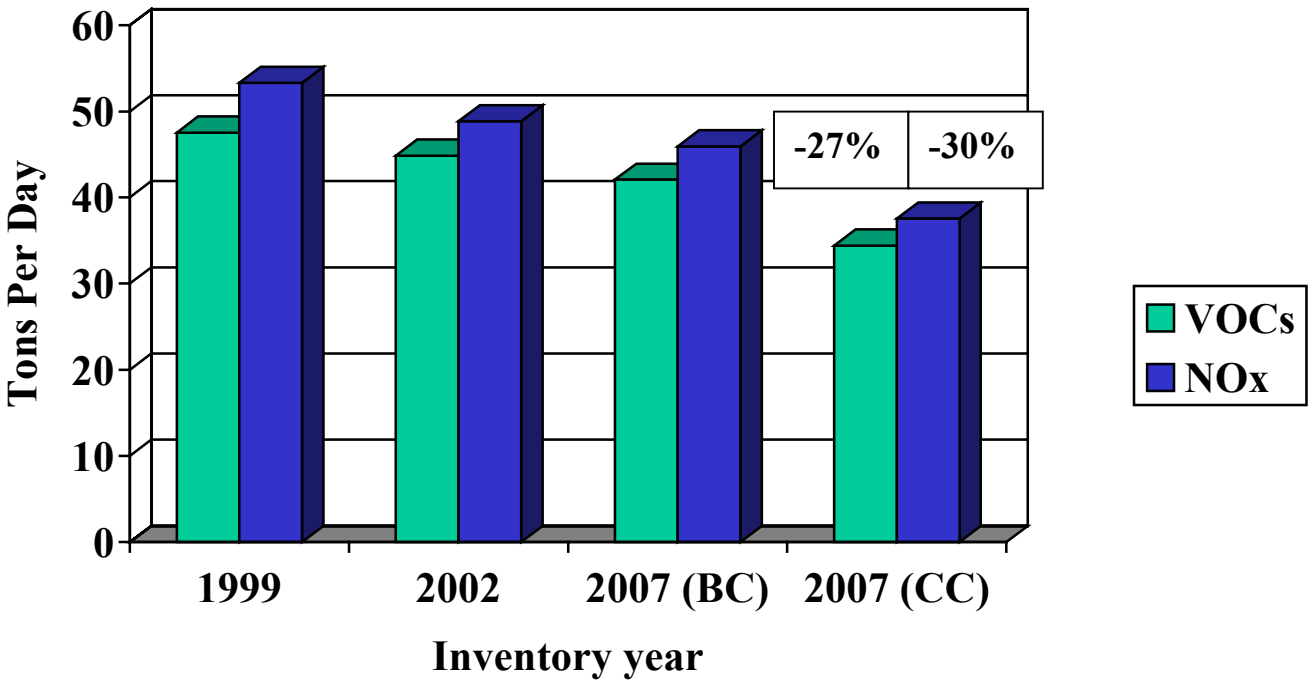
Area Sources – All inventories calculated using established EPA area source emission factors and actual or projected area specific activity data such as population, households, and others.

Mobile Source – All inventories calculated using the EPA MOBILE6 emissions factor model combined with actual or forecasted travel and fuel data.

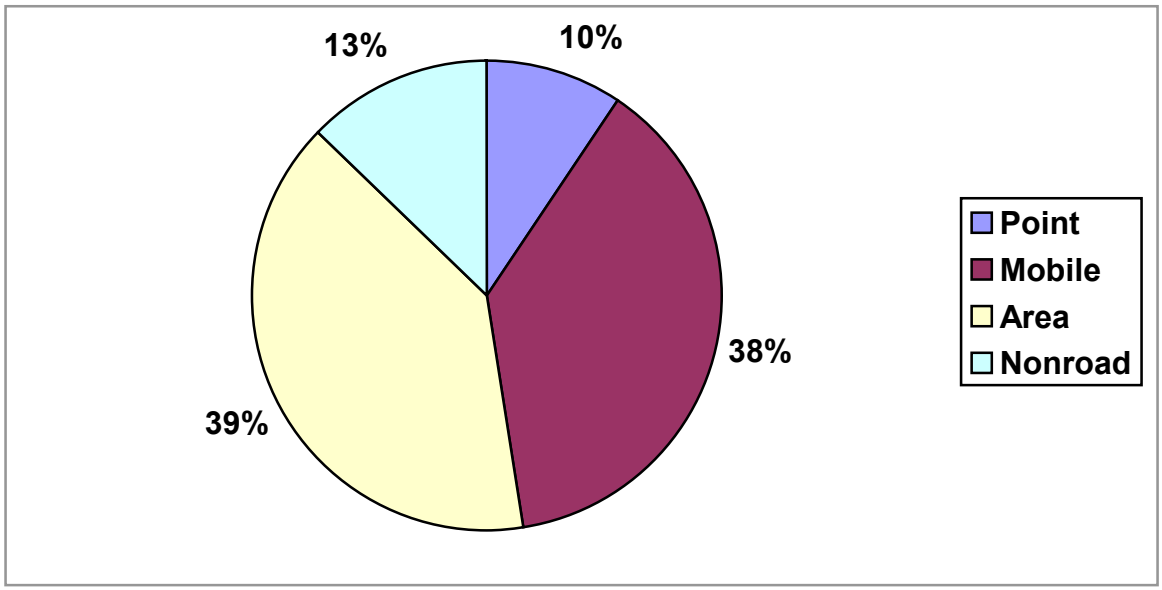
Nonroad Sources – All inventories calculated using the EPA NONROAD model.

Roanoke Valley EAP Emissions Inventory and trends Summaries

Source Category	1999 (Baseline)	2002 (Interim)	2007 (Base Case)	2007 (Control Case)
Volatile Organic Compound (VOC) Emissions in tons/day				
Point Sources	4.551	3.518	3.927	3.927
Area Sources	18.845	19.360	20.044	15.300
Non-road Sources	6.063	5.922	6.367	4.352
Mobile Sources	18.074	16.071	11.731	10.813
Totals:	**47.533**	**44.871**	**42.069**	**34.392**
Oxides of Nitrogen (NO_X) Emissions in tons/day				
Point Sources	9.312	7.231	7.876	7.086
Area Sources	5.091	5.254	5.531	5.293
Non-road Sources	7.877	8.036	9.110	6.424
Mobile Sources	31.036	28.336	23.436	19.481
Totals:	**53.316**	**48.857**	**45.953**	**38.284**

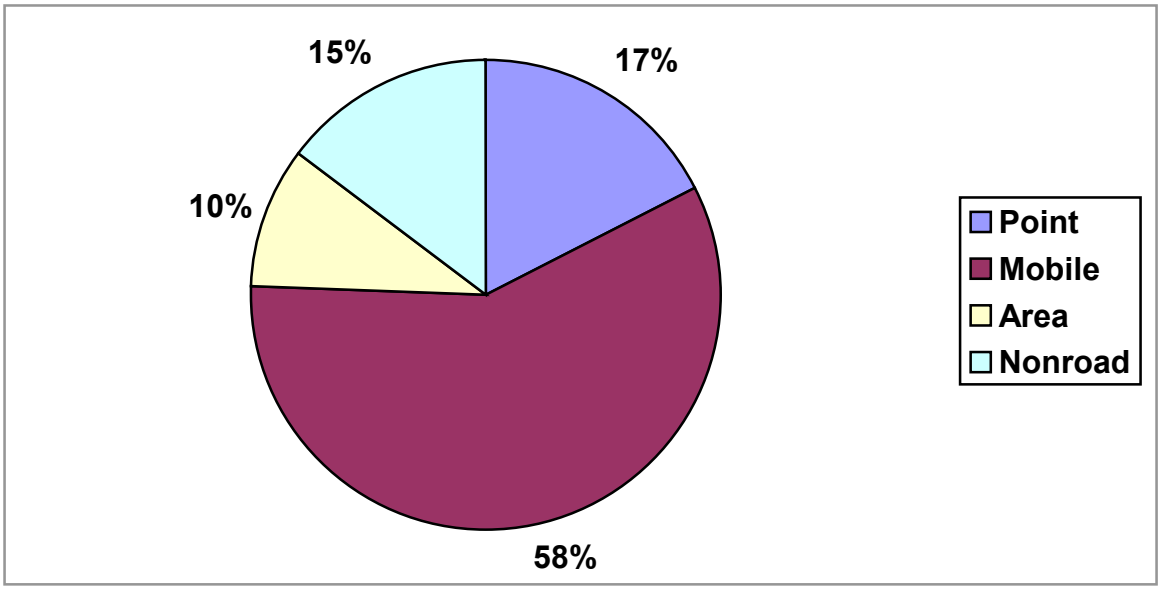


1999 Baseline Ozone Season Daily Emissions of Volatile Organic Compounds (VOC)



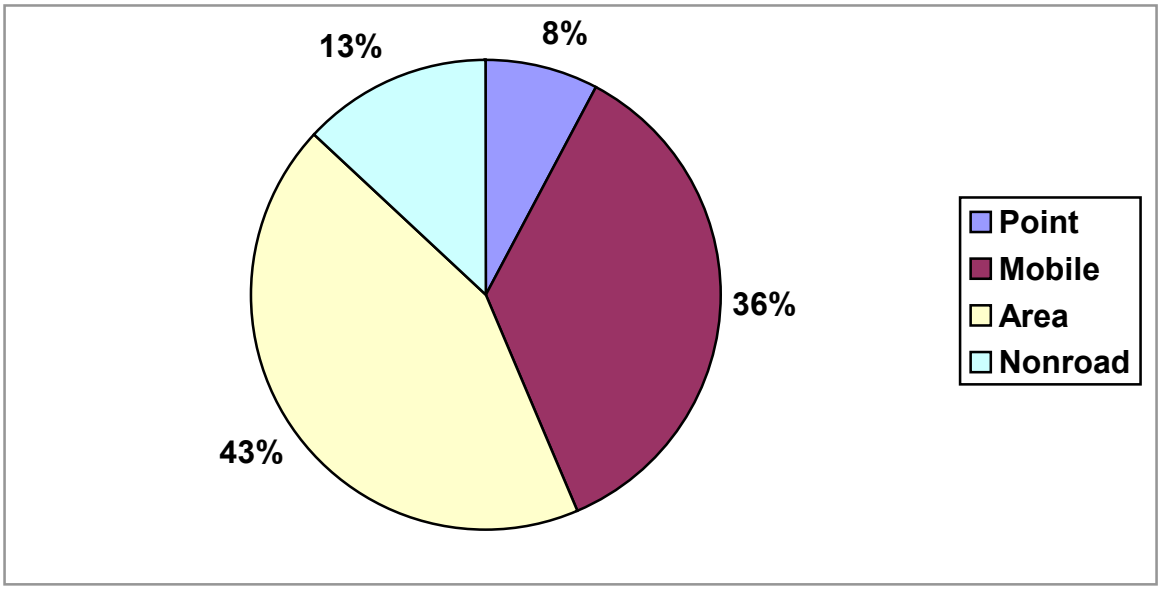
Summary of the Roanoke Valley Baseline VOC Emissions Inventory for Calendar Year 1999	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	4.551 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads – **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	18.074 tpd
Area Sources	
Use of Solvent-based Products – Description: paints, cleaners, consumer products, & others.	11.229 tpd
Gasoline Distribution & Marketing – Description: Gasoline storage & transfer operation at terminals and service stations	5.579 tpd
All Others – description: Open burning, landfills, & others	2.037 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	5.870 tpd
All Others – Description: Locomotives, aircraft, boats	0.193 tpd
Total	**47.533 tpd**

1999 Baseline Ozone Season Daily Emissions of Oxides of Nitrogen (NO_X)



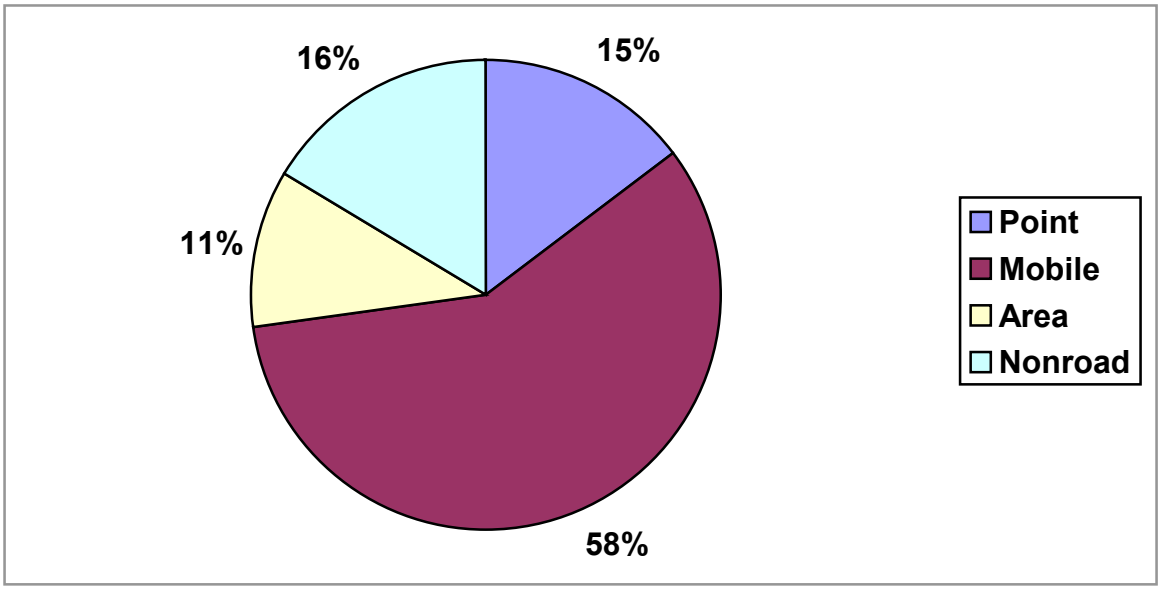
Summary of the Roanoke Valley Baseline NO_X Emissions Inventory for Calendar Year 1999	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	9.312 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads - **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	31.036 tpd
Area Sources	
Fuel Consumption – Description: Fuel consumption for heating, cooling, and other purposes in all sectors.	4.585 tpd
All Others – description: Open burning, landfills, & others	0.506 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	5.520 tpd
All Others – Description: Locomotives, aircraft, boats.	2.357 tpd
Total	**53.316 tpd**

2002 Interim Ozone Season Daily Emissions of Volatile Organic Compounds (VOC)



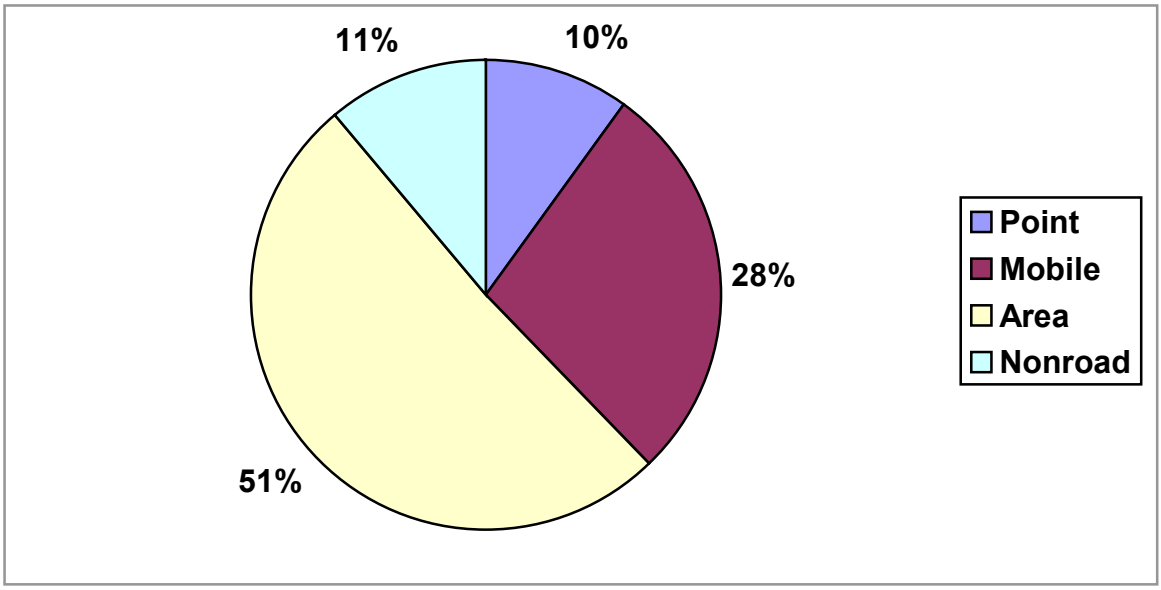
Summary of the Roanoke Valley Interim VOC Emissions Inventory for Calendar Year 2002	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	3.518 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads – **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	16.071 tpd
Area Sources	
Use of Solvent-based Products – Description: paints, cleaners, consumer products, & others.	11.426 tpd
Gasoline Distribution & Marketing – Description: Gasoline storage & transfer operation at terminals and service stations	5.808 tpd
All Others – description: Open burning, landfills, & others	2.126 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	5.720 tpd
All Others – Description: Locomotives, aircraft, boats	0.202 tpd
Total	**44.871 tpd**

2002 Interim Ozone Season Daily Emissions of Oxides of Nitrogen (NO_X)



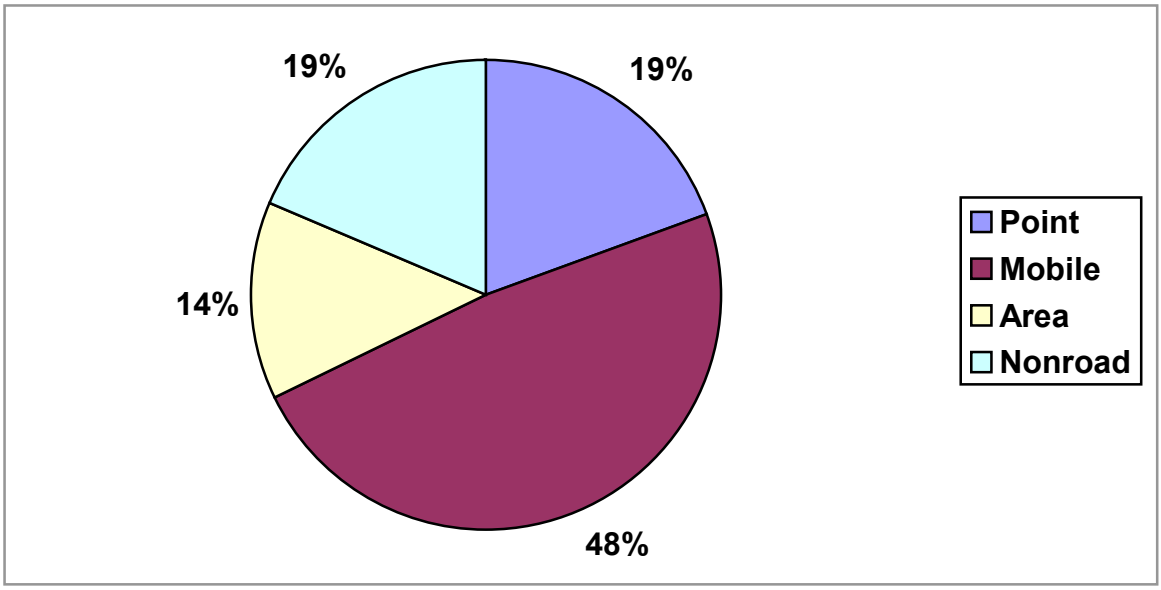
Summary of the Roanoke Valley Interim NO_X Emissions Inventory for Calendar Year 2002	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	7.231 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads - **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	28.336 tpd
Area Sources	
Fuel Consumption – Description: Fuel consumption for heating, cooling, and other purposes in all sectors.	4.724 tpd
All Others – description: Open burning, landfills, & others	0.530 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	5.540 tpd
All Others – Description: Locomotives, aircraft, boats.	2.496 tpd
Total	**48.857 tpd**

2007 Base Case Ozone Season Daily Emissions of Volatile Organic Compounds (VOC)



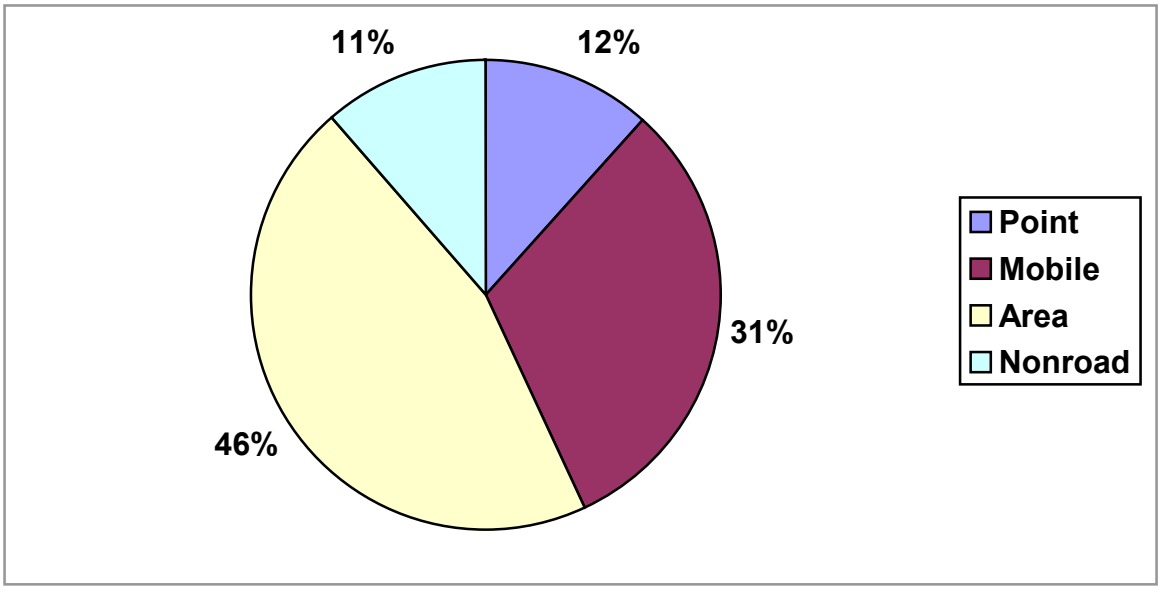
Summary of the Roanoke Valley Base Case VOC Emissions Inventory for Calendar Year 2007	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	3.927 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads – **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	11.731 tpd
Area Sources	
Use of Solvent-based Products – Description: paints, cleaners, consumer products, & others.	11.569 tpd
Gasoline Distribution & Marketing – Description: Gasoline storage & transfer operation at terminals and service stations	6.211 tpd
All Others – description: Open burning, landfills, & others	2.264 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	6.150 tpd
All Others – Description: Locomotives, aircraft, boats	0.217 tpd
Total	**42.069 tpd**

2007 Base Case Ozone Season Daily Emissions of Oxides of Nitrogen (NO_X)



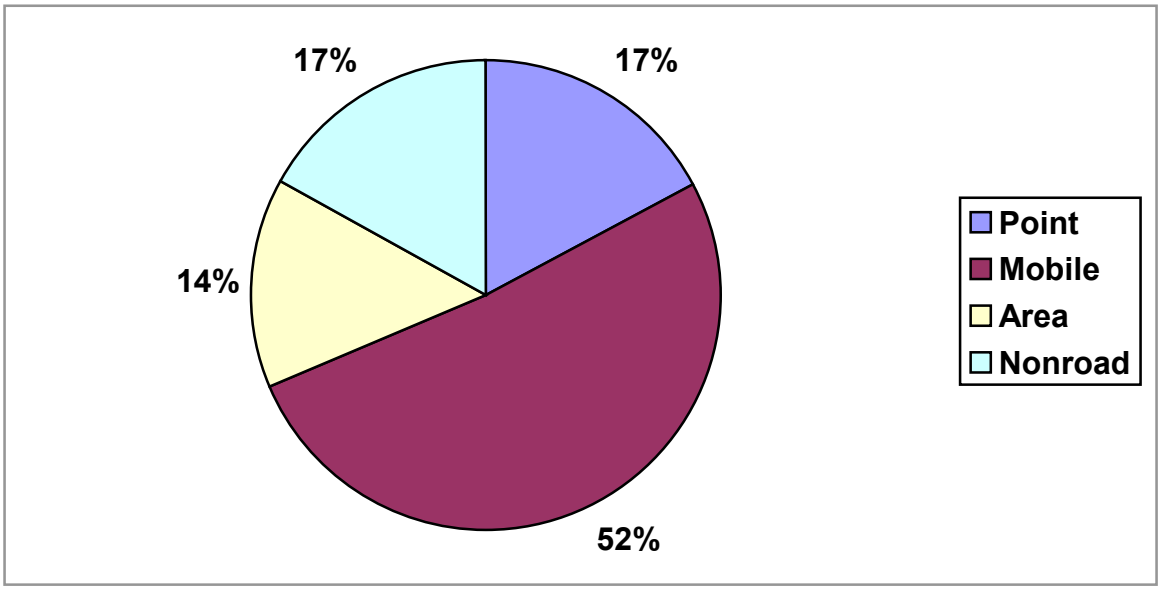
Summary of the Northern Shenandoah Valley Base Case NO_X Emissions Inventory for Calendar Year 2007	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	7.876 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads - **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	23.436 tpd
Area Sources	
Fuel Consumption – Description: Fuel consumption for heating, cooling, and other purposes in all sectors.	4.966 tpd
All Others – description: Open burning, landfills, & others	0.565 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	6.364 tpd
All Others – Description: Locomotives, aircraft, boats	2.746 tpd
Total	**45.953 tpd**

2007 Control Case Ozone Season Daily Emissions of Volatile Organic Compounds (VOC)



Summary of the Roanoke Valley Control Case VOC Emissions Inventory for Calendar Year 2007	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	3.927 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads – **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	10.813 tpd
Area Sources	
Use of Solvent-based Products – Description: paints, cleaners, consumer products, & others.	9.317 tpd
Gasoline Distribution & Marketing – Description: Gasoline storage & transfer operation at terminals and service stations	4.283 tpd
All Others – description: Open burning, landfills, & others	1.700 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	4.150 tpd
All Others – Description: Locomotives, aircraft, boats	0.202 tpd
Total	**34.392 tpd**

2007 Control Case Ozone Season Daily Emissions of Oxides of Nitrogen (NO_X)



Summary of the Roanoke Valley Control Case NO_X Emissions Inventory for Calendar Year 2007	
Major Source Categories	Emissions (tons/day)
Major Stationary Point Sources	
28 individual facilities (Botetourt: 7, Roanoke Co.: 12, Roanoke City: 5, Salem City: 4) - Description: Includes cement production, metal works, minerals production, gas terminals.	7.086 tpd
On-Road Mobile Sources	
Motor Vehicles on Public Roads - **Description**: local and through traffic on the I-81 corridor. Large percentage of heavy-duty diesel trucks. Also, vehicle traffic on all other public roads from major arterials to local roads.	19.481 tpd
Area Sources	
Fuel Consumption – Description: Fuel consumption for heating, cooling, and other purposes in all sectors.	4.966 tpd
All Others – description: Open burning, landfills, & others	0.327 tpd
Non-Road Mobile Sources	
Non-road Equipment – Description: lawn & garden, construction, recreational vehicles.	4.790 tpd
All Others – Description: Locomotives, aircraft, boats	1.634 tpd
Total	**38.284 tpd**

Roanoke Clean Air Plan

Provided below is a comprehensive summary of the controls at all levels that apply to the Roanoke area in the projected 2007 attainment year. The status of each of these measures in terms of federal enforceability and inclusion in the future base case and/or control case modeling is also indicated.

Control Measures & Estimated Emissions Reductions
(From Uncontrolled Levels in 2007)

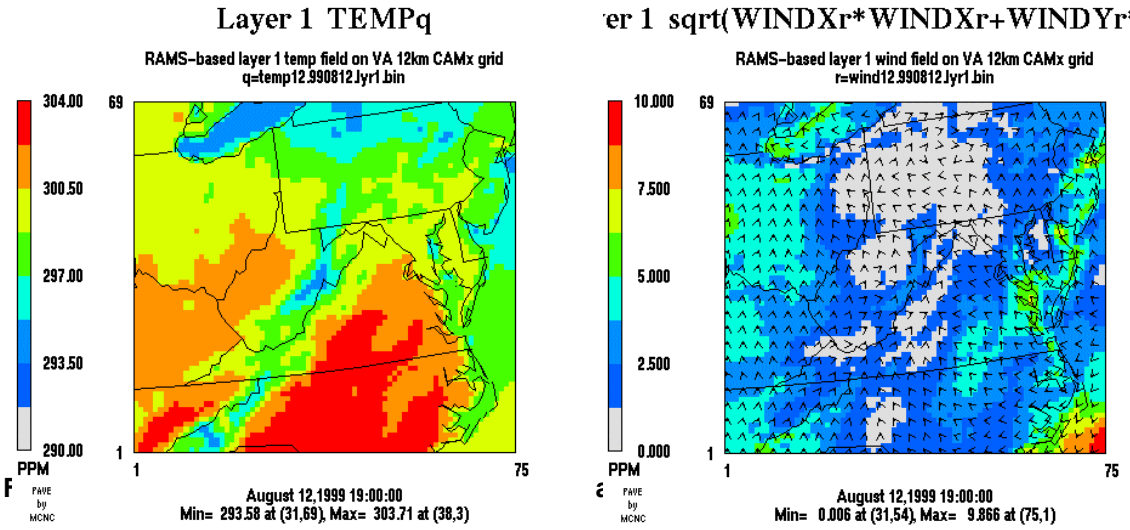
Emissions Control Measures	VOC (tpd)	NO_X (tpd)	Modeled
State/Federal Area Source Controls			
Stage I Vapor Recovery – State Rule (Federally Enforceable)	1.756	0.000	YES
Architectural & Industrial Paints – Federal Rule (Federally Enforceable)	0.372	0.000	YES
Consumer Products – Federal Rule (Federally Enforceable)	0.178	0.000	YES
Metal Cleaning Solvents – Federal Rule (Federally Enforceable)	0.163	0.000	YES
Motor Vehicle Refinishing – Federal Rule (Federally Enforceable)	0.158	0.000	YES
Cutback Asphalt – State Rule (Federally Enforceable)	0.005	0.000	YES
Subtotals:	**2.632**	**0.000**	
Federal Non-Road Source Controls			
Small Gasoline Engine Standards – Federal Rule (Federally Enforceable)	1.681	0.059	YES
Diesel Engine Standards – Federal Rule (Federally Enforceable)	0.158	0.969	YES
Locomotive Engine Standards – Federal Rule (Federally Enforceable)	0.000	1.112	YES
Large Gasoline Engine Standards – Federal Rule (Federally Enforceable)	0.146	0.546	YES
Recreational Engine Standards – Federal Rule (Federally Enforceable)	0.015	0.000	YES
Subtotals:	**1.995**	**2.686**	
Federal Mobile Source Controls			
Previous Motor Vehicle Standards – Federal Rule (Federally Enforceable)	6.343	7.600	YES
Tier 2 Vehicle Standards – Federal Rule (Federally Enforceable)	0.917	3.799	YES
Heavy Duty Diesel Standards – Federal Rule (Federally Enforceable)	0.001	0.156	YES
Subtotals:	**7.261**	**11.555**	
State/Local Early Action Plan Controls			
Existing Source CTG RACT Controls – State Rule (Federally Enforceable)	1.098	0.790	YES
Ozone Action Days Program – State/Local (Mandatory/Voluntary)	0.940	0.610	YES
Open Burning Restrictions – Local (Mandatory/ Voluntary)	0.564	0.238	NO
All Other Local Programs – Local (Voluntary)	0.020	0.228	NO
Subtotals:	**2.622**	**1.866**	
TOTALS:	**14.51**	**16.107**	

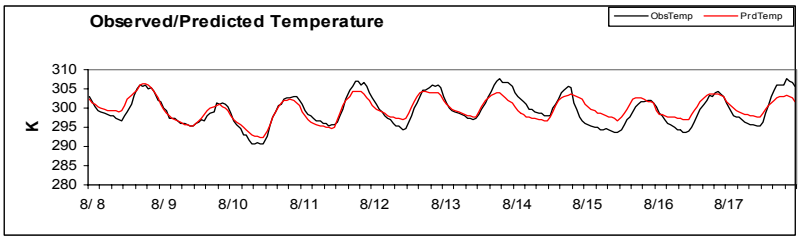
E. Base Case Modeling

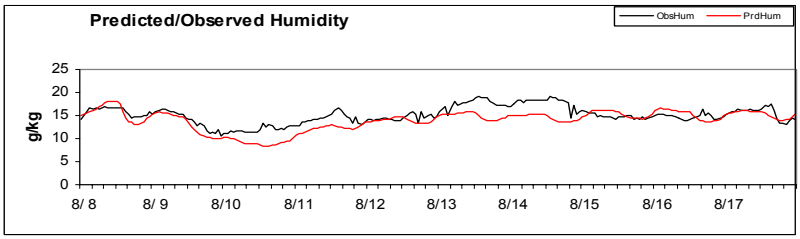
A 1997 episode was originally selected to support the development of the early action plan since emissions and meteorological data were readily available and quality assured. However, subsequent to this decision, EPA EAP guidance required that inventories and episodes no older than 1999 had to be used in this effort. As a result, the episode described above as been selected to support the air quality planning effort.

DEQ has obtained the necessary meteorological data for the 1999 episode and successfully completed the processing of the data through the MM5 meteorological model. Several MM5 runs were required to adequately simulate the relatively complex meteorological conditions that existed during the selected ozone episode as previously described. Selected results of the meteorological modeling used as input into the regional air quality model are provided below.

Meteorological Modeling – Selected Results for Temperature and Winds



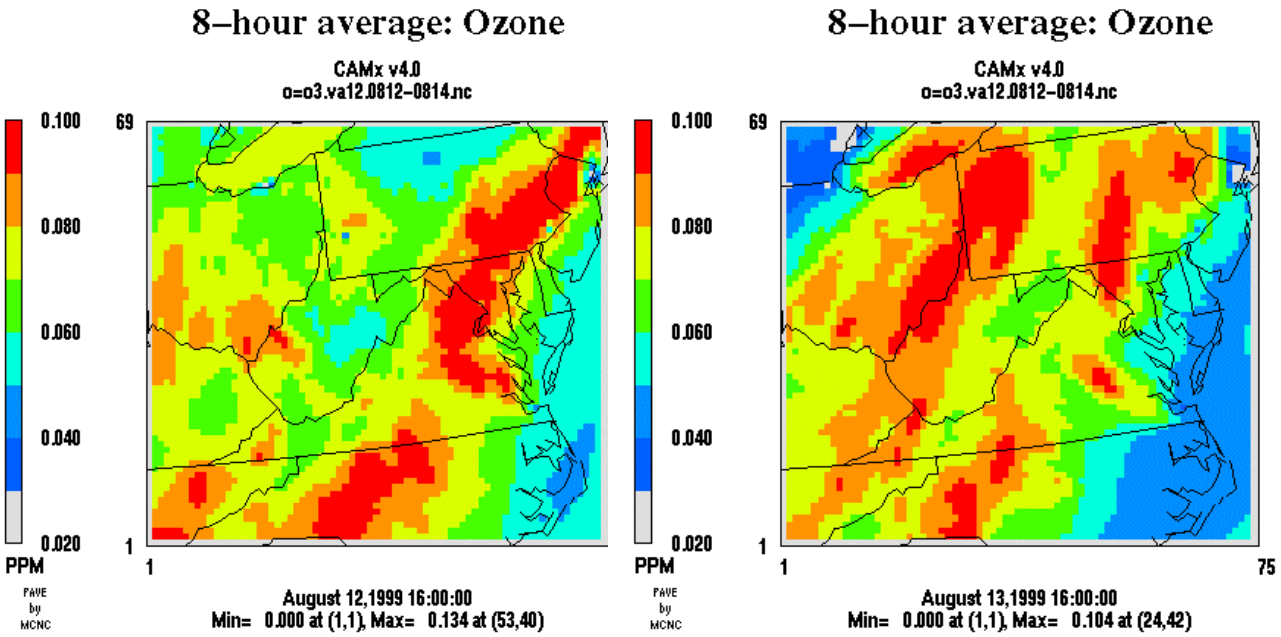




Emissions data for 1999 from all state in the modeling domain has also been obtained from the NEI. This emissions data has been supplemented with state specific data from Virginia and West Virginia. The conversion of this data to SMOKE input files and the preprocessing of this data through the SMOKE emission model has also been completed. Several problems were encountered during the processing of the emissions data that delayed the commencement of base case modeling efforts. The most difficult problem dealt with the EPA requirement that all EAC modeling efforts used MOBILE6-based emissions for mobile sources. To do this we had to use the latest draft version of the SMOKE emissions preprocessor (Version 1.5). Numerous problems were encountered in attempting to install and run the mobile emissions through this version of the emissions model. Ultimately, the DEQ contracted the developers of SMOKE (Carolina Environmental Program to solve these problems and process the emissions data through this latest version of the emissions preprocessor. With this external assistance, the emissions preprocessing step was completed.

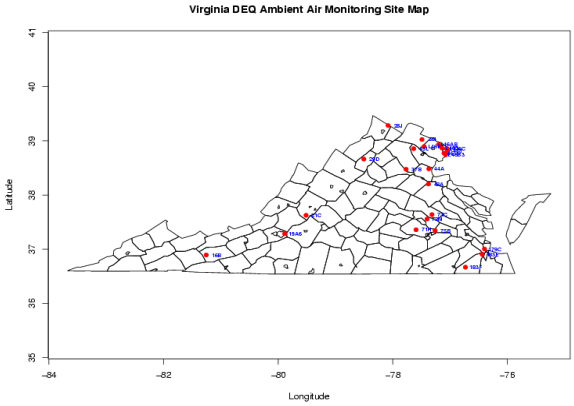
Once all the preprocessing steps were completed, the regional photochemical modeling exercise was begun. After several runs using the CMAQ model were completed, it became obvious that the performance of the model was not up to EPA standards using the selected episode. After internal consultations, it was decided to change photochemical models from CMAQ to the Comprehensive Air Quality Model with Extensions (CAMx). The modeling platform was thus changed to use this alternative air quality model. After several runs using CAMx, base case modeling results were produced that meet or exceed EPA's acceptance criteria for model performance. The base case results of the validated CAMx model are presented below in graphic form showing the simulation of the ozone episode days of August 12th and 13th, 1999. Also presented below are selected comparisons of observed and model predicted ozone concentrations at several area monitors .

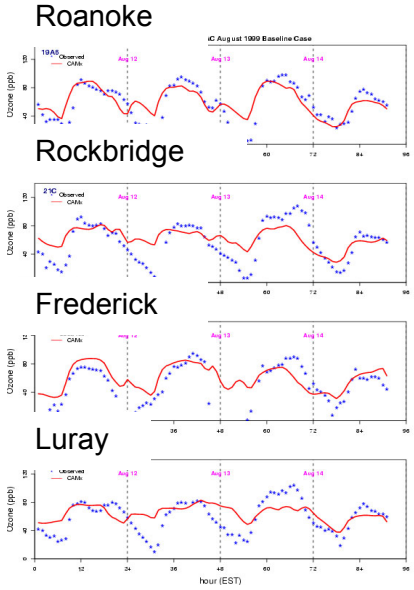
CAMx Photochemical Model Results – Base Case Modeling



Air Quality Model Validation – Observed & Predicted Ozone Concentrations

Monitoring Stations for Model Validation





In summary, the base case modeling was completed for the selected ozone episode and the performance evaluation of the model indicates that:

- The EPA performance goals established for air quality models have been met.
- The model performance is acceptable for use in future and control case modeling.

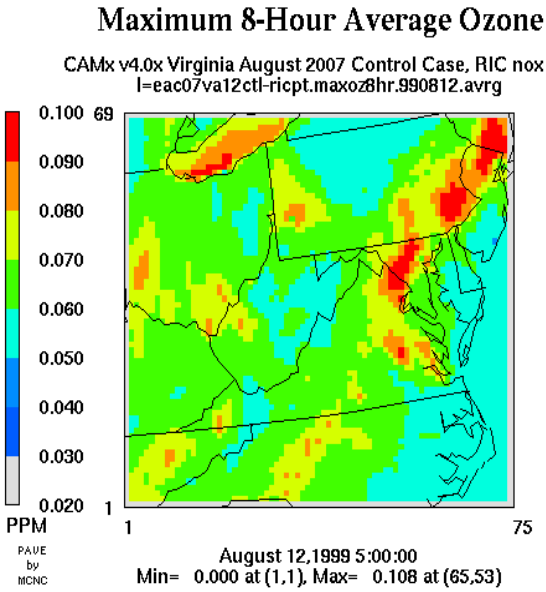
F. Future Case Modeling

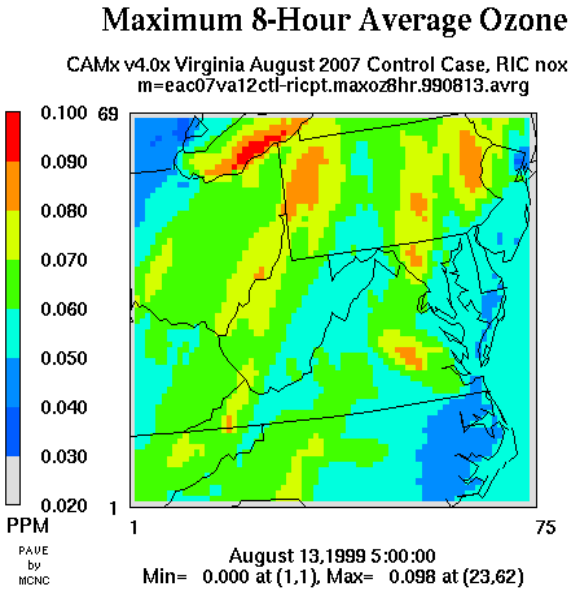
Once the base case modeling and associated performance evaluation and validation was completed, work began on the future base and control case modeling scenarios. In order to do this, a future year modeling emissions inventory had to be developed to predict future ozone precursor emissions levels in the EAC areas and the overall modeling domain to account for both anticipated growth in unregulated emissions sources and reduction in emissions from sources subject to local, state, and federal control strategies. In developing these future year inventories, the DEQ worked with neighboring EAC states to ensure the consistency of these future estimates. Standard emissions projection and control techniques were used to develop the projected emissions inventories for this purpose.

First, the future base case scenario was modeled based on the assumption of emissions growth from unregulated or uncontrolled source categories. Also included in this scenario were controlled estimates for source categories subject to State/Regional/National strategies already promulgated for the control of ozone precursor emissions that were not directly relating to the strategies to be implemented through the local control program. This modeling showed substantial reductions in predicted ozone concentrations in the EAC area and throughout the entire modeling domain. **In fact, the base case controls were predicted to be sufficient to bring the Roanoke EAC area into compliance with the ozone standard.**

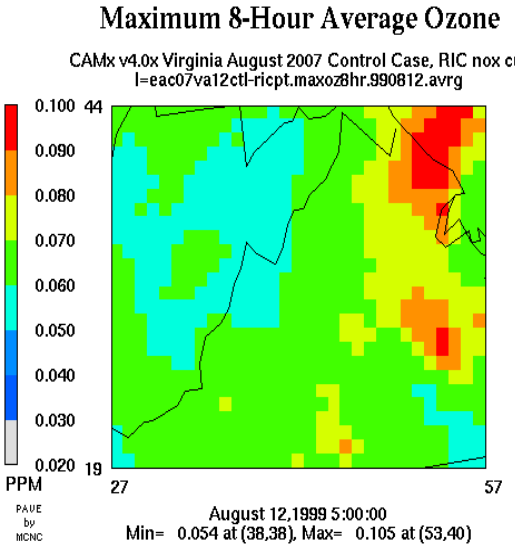
The second future modeling scenario involved the addition of the local control strategies contained in the EAP to serve as the control case inventory for this project. The combination of all the controls at all applicable levels (local, state, federal) produced the results shown below.

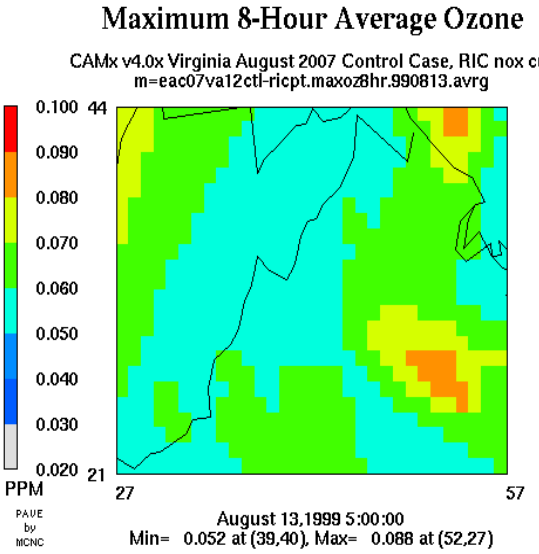
Regional Modeling Results – Future Control Case Predictions (Full Domain)





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





The results of the control case modeling shows that most areas within the modeling domain would be at or below the 8-hour ozone standard in 2007 under this episode scenario as a result of the control strategies to be implemented during this time period. **Specifically, the Roanoke area is predicted to experience a 20% reduction in local ozone concentrations. It is also predicted that the base case design value for the area of 90 parts per billion will be reduced to 71 parts per billion in 2007**. Therefore, the modeling exercise indicates that the desired result of reducing ozone concentrations to levels below the 8-hour ozone standard will be achieved by the implementation of the controls included in this EAP, when combined with the control strategies being implemented on the state and federal levels. A summary of the attainment demonstration results are presented in the table below:

Determination of Current Design Value for Roanoke

County/City	AIRS ID	1998-2000 Design Value, ppb	2001-2003 Design Value, ppb	Current Design Value
Roanoke Co.	510410004	90	85	90

Attainment Test Results for the Roanoke EAC Area (Maximum 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	Number of Analysis Days	Pass/Fail Status
Roanoke	82.93	65.72	0.793	90	71.4	5	PASS

Nonattainment Attainment

5. MAINTENANCE FOR GROWTH

A. Background

Beyond the attainment demonstration provided above, the Early Action Compact also calls for a mechanism and demonstration that the area can continue to attain the ozone standard after 2007. This section addresses this demonstration of maintenance and establishes a contingency plan and associated measures that may be needed to address future unanticipated problems in the implementation of this air quality plan or worsening air quality in the Roanoke area. The following supporting information is provided to demonstrate that the area will remain in attainment for a substantial time after the predicted attainment date of 2007. It also serves to demonstrate that sufficient contingencies are available to address any potential plan or air quality setbacks or problems.

B. Demonstration of Maintenance

A demonstration of maintenance consists of a demonstration that a given area in compliance or predicted to be in compliance with a air quality standard will remain in compliance with that standard for a period of time. These demonstrations are generally made using one of two methods:

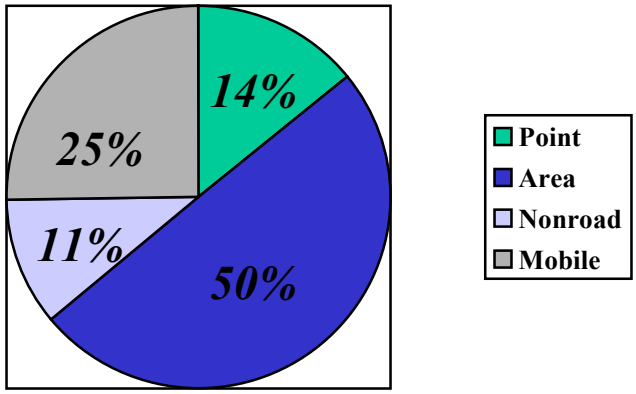
- An air quality modeling analysis that predicts that the area will remain in compliance, or
- An emissions analysis that predicts that emissions will remain below "attainment" levels.

Given the time and data constraints involved in the EAP process, it was not possible to perform an additional modeling analysis for a future year other than 2007. Therefore, an emissions analysis has been developed and is presented below.

A future 2012 ozone precursor emissions inventory has been developed for the Roanoke area using the same methods as those used to develop the other inventories in this document. A summary of this 2012 inventory is provided below along with a comparison to the base (1999), interim (2002), and attainment (2007) inventories for the area.

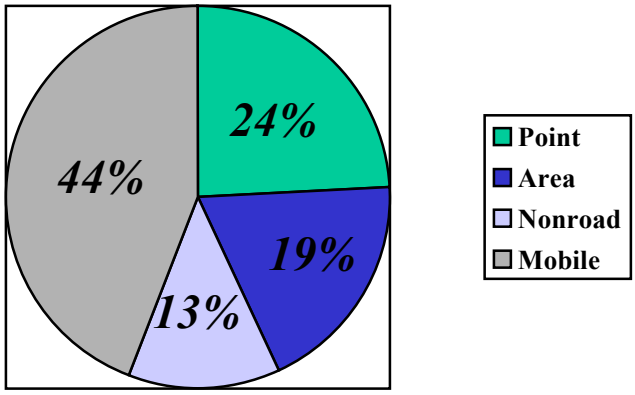
2012 Projected VOC Emissions:

CATEGORY	*DAILY EMISSIONS*
Point	4.45 tons
Area	15.76 tons
Nonroad	3.40 tons
Mobile	7.97 tons
TOTAL:	**31.58 tons**

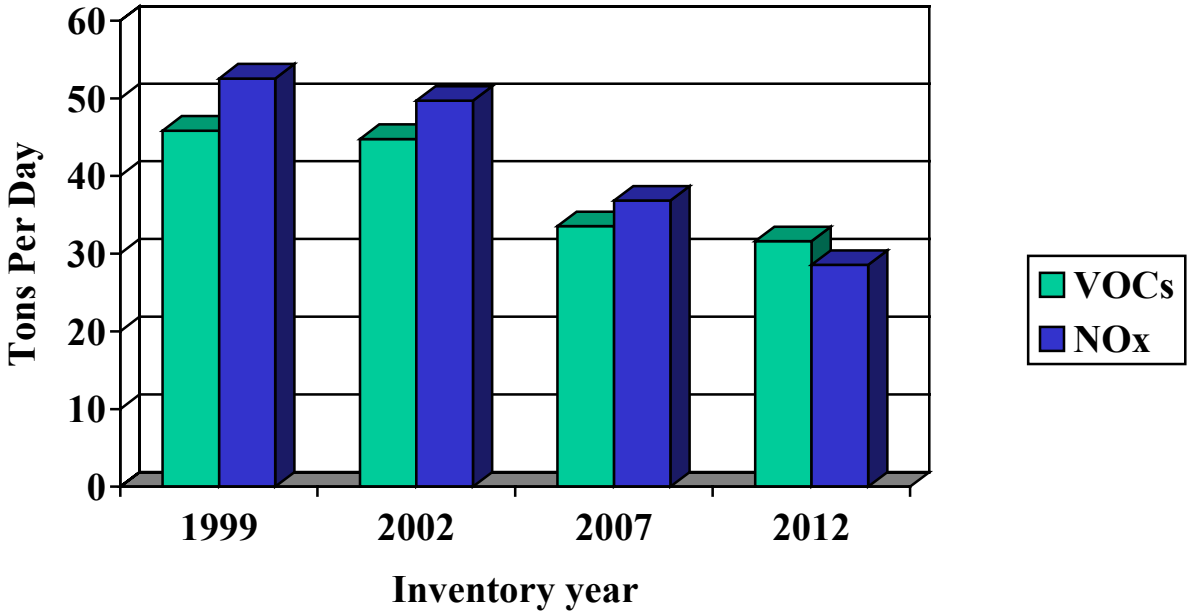


2012 Projected NO_X Emissions:

CATEGORY	*DAILY EMISSIONS*
Point	6.86 tons
Area	5.45 tons
Nonroad	3.66 tons
Mobile	12.57 tons
TOTAL:	**28.54 tons**



Ozone Emissions Inventory Comparisons for Roanoke (1999 to 2012)



As demonstrated by the charts presented above, it is predicted that ozone precursor emissions in 2012 for the Roanoke area will remain below attainment year (2007) levels. Thus this analysis serves as an indicator that the Roanoke area is likely to continue to be in compliance with the ozone standard based on local predicted emissions trends.

C. Other Air Quality Modeling Exercises

Although specific modeling of an additional future maintenance year has not been performed as part of this project, other recent modeling exercises performed by the EPA to support regional or national programs provide some indication that many areas of the Country will attain the ozone standard in the near term. These same modeling exercises also indicate that most of these areas will remain in attainment for at least ten years after their projected attainment date. The latest of these EPA modeling projects, used to support the national Clean Air Interstate Rule (CAIR), indicates that most areas in Virginia will attain the ozone standard by 2010 and will remain in attainment at least out to 2020, even without the implementation of this rule.

Several regional modeling exercise have been performed by EPA to support various rulemaking actions, most recently in support of the Clear Skies Act (CSA) and Clean Air Interstate Rule (CAIR). Although these modeling exercises were performed for different reasons, they 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	2010	2015	2020
Roanoke	73 PPB (CSA)	69PPB (CAIR)	59 PPB (CSA)

As can be seen above, all of these EPA modeling exercises predict attainment in the Roanoke area from 2010 out to 2020. In addition, these results show that predicted ozone design values will continue to

decrease during this period. The specific prediction of these results for the Roanoke area is that the design value in 2015 will be at 69 parts per billion, and decrease to 59 parts per billion in 2020.

D. Contingency Measures

As part of the local EAP, a mechanism and commitment is in place to monitor the progress towards implementing the local controls and assessing their effectiveness. Furthermore, as part of this SIP submittal, the local area commits to continue to submit periodic updates in the form of semi-annual status reports to DEQ and EPA on the implementation status and results of the local control program with sufficient details to make program sufficiency determinations.

If it is found that progress is not being made or the level of emissions reductions expected have not been achieved, the Task Force will reevaluate the existing strategies to enhance their effectiveness or recommend the adoption of additional control measures. This mechanism represents the local contingency measure portion of the local EAP. One or more enhanced or new strategies would be implemented in response to continuing exceedances of the ozone standard or a shortfall in anticipated emission reductions from the initial EAP. These additional strategies would be developed and implemented if the situation warranted or called for additional local emission reductions in response to worsening air quality or an unexpected shortfall in local emission reductions. These measures would require additional lead-time for implementation as well as additional work with an expanded group of stakeholders.

Beyond the possible implementation of additional local controls as discussed above, the DEQ will be prepared to implement one or more of the "Ozone Transport Commission" (OTC) rules in the Roanoke area as contingency and/or maintenance measures. One or more of these rules may be implemented if a substantial failure occurs in the local control plan in terms of failure to implement controls or in response to worsening air quality. DEQ will begin the regulatory process to enable implementation of the following additional measures as needed:

<u>OTC Portable Container Rule</u>

The portable container rule would reduce emissions that result from either gas container spillage or permeation. Additional benefits include potential reduction of water contamination and reduction of potential fire hazards. The estimated emissions reduction benefits from this measure are 0.01 tpd VOC.

<u>OTC Architectural/Industrial Maintenance Coatings Rule</u>

This rule would require reformulated coatings to meet lower VOC content limits than under the current federal rule. Manufacturers would be required to assume the primary responsibility to produce coatings that meet or exceed VOC content limits for sale and use at the retail and wholesale levels. The estimated emissions benefits from this measure are approximately 0.47 tpd VOC.

<u>OTC Mobile Equipment Repair and Refinishing Rule</u>

This rule would require lower VOC content for paints and use of improved transfer efficiency application and cleaning equipment. The rule would apply primarily to small businesses that apply refinishing materials and to a variety of mobile equipment repair and refinishing facilities. The approximate emissions reduction for this strategy is estimated to be 0.12 tpd VOC.

<u>OTC Solvent Cleaning Operations Rule</u>

This rule would establish additional hardware and operating requirements for vapor cleaning machines used to clean metal parts. It also includes volatility restrictions for cold cleaning solvents. Degreasing and solvent cleaning operations are performed by many commercial and industrial facilities. The estimated emissions benefit for this rule is 0.97 tpd VOC.

OTC Consumer Products Rule

This rule would establish additional VOC content restrictions on various consumer products sold in the area. This rule mainly impacts the manufacturers and users of these products. The estimated emissions benefit for this rule is 0.23 tpd VOC.

A detailed summary and description of all these contingency measures and the emission reductions and estimation methods is presented in Appendix B to this document.

The specific triggers that will prompt the implementation of the contingency measures in this section are as follows:

1. Failure to implement one or more local control measures.

If the area is unable to implement one or more local controls, the area will develop and implement one or more equivalent control measures.

2. Failure to substantially implement or support the local air quality plan.

If the area fails to substantially implement or support the local air quality plan, one or more state "OTC" rules will be adopted and implemented by DEQ as expeditiously as possible.

3. For a new violation of the 8-hour ozone standard.

If a violation of the standard occurs after to the submission and approval of this plan, one or more state "OTC" rules will be adopted and implemented by DEQ as expeditiously as possible.

DEQ reserves the right to substitute equivalent measures for use as contingency measures as part of this plan if and when needed.

APPENDIX A

ROANOKE EARLY ACTION PLAN

LOCAL CONTROL IMPLMENTAITON STATUS UPDATE

December 31, 2004

Roanoke Valley Area Ozone Early Action Plan (EAP)
Implementation Schedule

Strategy: Reducing Locomotive Idling

Commitment: Norfolk Southern Railway Company

Brief Description: Norfolk Southern Railway Company has implemented an operating policy to reduce emissions from idling locomotives as is allowed by ambient air temperature being greater then 32 degrees Fahrenheit.

Progress to Date:

Conservative Assumption #1: 2002 Base Year

Conservative Assumption #2: 20 switching units operated in the five county Roanoke maintenance area that have a utilization rate of 55%. This number is further reduced by 20% for times the unit is not immediately switched off or ambient temperature is less then 32 degrees Fahrenheit.

Thereby, our emission reductions are estimated as follows:

- 55% utilization, 45% not utilized and therefore turned off and not idling. [45% * (24 hours / day) * 365] = 3,942 hours not idling and turn off annually

  [3,942 * (1-.2)] = 3,153.6 hours not idling including 20% safety factor per unit.

- Each locomotive is therefore not idling an average of 3,154 hours annually. Assuming 20 units at 5 gallons diesel fuel per hour equates as follows (most burn closer to 6 gallons per hour such that again a safety factor is present):

- 3,153.6 hours * 5 gal/ hour * 20 units historically operated within the Valley = 315,360 gal diesel not combusted.

Implementation Schedule: Norfolk Southern has fully implemented the locomotive idling reduction policy and they are committed to keeping the policy in place.

Status: Fully implemented.

Contact: Mark McCaskill (Regional Commission) 540-343-4417
Gibson Barbee (Norfolk Southern Railway Company) 540-381-5185

Strategy: Limiting Idling Times for School Busses

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke

Brief Description: Local governments have agreed to enforce idling restrictions for their own school bus fleets during normal operations.

Progress to Date:

City of Roanoke: Citywide idling policy can be found at:

(http://www.roanokeva.gov/WebMgmt/ywbase61b.nsf/CurrentBaseLink/6F62B6C34CAAD2C285256EBD00723F4D/$File/EngineEquipPolicy%202004.pdf)

City vehicles are provided with a key chain that reminds employees of idling policy each time the vehicle goes in for service.

City of Salem: School system is under the same idling and fueling restrictions as the rest of the City. No idling during the Ozone season.

County of Botetourt:

County of Roanoke: School system has guidelines to minimize both warm-up and idling times of school busses. School system also has fuel saving (fuel cost saving) guidelines, which don't allow non-essential fuel consumption.

Implementation Schedule:

City of Roanoke: Implemented July 2004

City of Salem: Implemented Summer of 2004

County of Botetourt:

County of Roanoke: Currently Implemented

Strategy: Retrofit Roanoke County School Busses

Commitment: County of Roanoke

Brief Description: Roanoke County will be retrofitting 100 school buses with:

• Diesel oxidation catalysts—pollutants and particulate matter are chemically oxidized to water vapor and carbon dioxide.

Progress to Date: County has a contract with Cummins Atlantic. One hundred diesel oxidation catalysts are on order and are expected by December 2004.

Implementation Schedule: Before Summer of 2005

Contact: Danny Carroll (Roanoke County Schools) 540-387-6577
Jim Ponticello (VDOT) 804-698-4405

ADDITIONAL SUCCESS NOT ORIGINALLY INCLUDED IN OZONE EAP

Strategy: Retrofit City of Roanoke School Busses

Commitment: City of Roanoke

Brief Description: The City of Roanoke has applied for and obtained additional funds from VDEQ to retrofit approximately 102 of its school busses in a similar manner as Roanoke County (see above). This is an additional success that has been pursued after the local government adoption of the Ozone EAP (01-22-2004). We strive to pursue additional success whenever possible to go above and beyond the original commitments of the Ozone EAP.

Progress to Date: The City of Roanoke has been approved for funds. However, there is not yet a contract and an order with the private sector.

Implementation Schedule: By the end of calendar year 2005

Contact: Jim Ponticello (VDOT) 804-698-4405
Chaun Dooley

Strategy: City of Roanoke – Purchase of BioDiesel Compatible Solid Waste Trucks.

Commitment: City of Roanoke

Brief Description: In 2003, Roanoke city purchased five new garbage trucks, which can be converted to bio-diesel (Heil automated trucks with Python method).

Progress to Date:

All 5 garbage trucks have been purchased. Additional bio-diesel compatible trucks will be purchased as garbage trucks are replaced in the fleet.

Implementation Schedule: Implemented

Status: Implemented

Contact: Paul Truntich (City of Roanoke) 540-853-1173

Strategy: City of Roanoke – Purchase and Use of Ethanol Compatible Vehicles.

Commitment: City of Roanoke

Brief Description: In 2003, City of Roanoke purchased eleven sedans and station wagons that are ethanol fuel compatible. By 2007, the city will purchase an additional fifteen ethanol fuel compatible vehicles.

Progress to Date:

Progress on schedule for purchase of additional fifteen ethanol compatible vehicles by 2007.

Implementation Schedule: 2007

Status: On schedule

Contact: Paul Truntich (City of Roanoke) 540-853-1173

Strategy: City of Roanoke – Purchase of Biodiesel Compatible Fleet Trucks.

Commitment: City of Roanoke

Brief Description: In 2003, City of Roanoke purchased nine new trucks that will operate using bio-diesel fuel. By 2007, City of Roanoke will purchase an additional twelve bio-diesel fuel compatible vehicles.

Progress to Date:

Progress on schedule for purchase of additional twelve biodiesel compatible vehicles by 2007.

Implementation Schedule: 2007

Status: On schedule

Contact: Paul Truntich (City of Roanoke) 540-853-1173

Strategy: City of Roanoke – Purchase/Use of Hybrid Vehicles.

Commitment: City of Roanoke

Brief Description: In 2003-2004 fiscal year, City of Roanoke will purchase one 2004 Toyota Prius hybrid vehicle. Dependent upon favorable evaluation and field-testing, the city will purchase additional Toyota Prius or similar vehicles.

Progress to Date:

A Ford Escape hybrid vehicle has also been ordered.

City of Roanoke Parking is working on a plan to implement preferred parking spots for low-emission vehicles in City owned parking garages.

Implementation Schedule: 2004

Status: Implemented

Contact: Paul Truntich (City of Roanoke) 540-853-1173

Strategy: County of Roanoke – Purchase of Low Emission Vehicles.

Commitment: County of Roanoke

Brief Description: Roanoke County purchased one hybrid electric vehicle for evaluation with the option to purchase additional vehicles.

Progress to Date:

One Honda Civic Hybrid has been purchased and two Ford Escape Hybrids, one more Honda Civic Hybrid and one Toyota Prius Hybrid have been ordered.

Note: The additional four hybrid vehicles that have been ordered as of October 2005 are above and beyond the stipulations of the Ozone EAP.

Implementation Schedule: 2004

Status: Implemented

Contact: Jim Vodnik (County of Roanoke) 540-387-6155

Strategy: County of Roanoke – Education and Information Training.

Commitment: County of Roanoke

Brief Description: On August 8, 2003, Roanoke County distributed a brochure to all its employees urging them to reduce the environmental impact of driving both County and personal vehicles. Items focused on car-pooling, planning trips, and reduction of idling and warm up periods. In addition, all drivers of County vehicles will receive "effective environmental driving" classroom training by June 30, 2004.

Progress to Date:

Strategy has been implemented and employee education concerning environmental issues is continuous and ongoing.

Implementation Schedule: 2004

Status: Implemented

Contact: Jim Vodnik (County of Roanoke) 540-387-6155

Strategy: Replacement of Gasoline Golf Carts with Zero Emission Carts.

Commitment: County of Roanoke, City of Roanoke, City of Salem, County of Botetourt

Brief Description:
Voluntary pilot program at area golf courses to replace gasoline-powered golf carts and turf equipment with low emitting or electric equipment. Each jurisdiction will commit to obtaining a voluntary commitment from one or more golf courses to make the transition from gasoline-powered to electric equipment. Program could have two phases with a firm initial commitment to be included in the early action plan, and a longer second phase as a maintenance measure.

Progress to Date:

City of Roanoke: On track for 2005 implementation

Implementation Schedule: End of 2005

Status:

Contact:	Jim Vodnik (County of Roanoke)	540-387-6155
	Paul Truntich (City of Roanoke)	540-853-1173

Strategy: Replacement of Gasoline Golf Carts with Zero Emission Carts.

Commitment: Private Sector Voluntary Program

Brief Description:

Gasoline-powered lawn mowers and other lawn care equipment used local governments, private companies, and the general public, are collectively a significant source of VOC, NOx and CO. A local control strategy would consist of a cash incentive program to buyback older working lawn & garden equipment with electric or manual equipment. We will work with willing local governments to commit to the purchase of a certain percent of electric/manual equipment as part of their normal purchasing process.

Progress to Date:

Independent funding source has not yet been secured. Identification of funding source scheduled by the end of 2005

Implementation Schedule: End of 2005

Status: On track for funding source identification

Contact: Mark McCaskill 540-343-4417

Strategy: Voluntary Private Sector Restriction of Lawn and Garden Equipment Use on Predicted Non-attainment days.

Commitment: Private Sector Voluntary Program

Brief Description:

Voluntary program to restrict the use of gas-powered lawn & garden equipment on ozone action day (days when high ozone is predicted). Program would be voluntary for the general public and private companies. Each jurisdiction will attempt to obtain voluntary compliance of one or more private companies as part of this program.

Progress to Date:

On track for end of 2005 implementation. Marketing/talks with various private organizations are expected to yield results by the end of 2005.

Implementation Schedule: End of 2005

Status: On track

Contact: Mark McCaskill 540-343-4417

Strategy: Mandatory Restriction of Lawn and Garden Equipment Use on Predicted Non-attainment days.

Commitment: City of Roanoke, City of Salem, Town of Vinton, Counties of Roanoke and Botetourt, VDOT and VDEQ

Brief Description:

Mandatory program to restrict the use of gas-powered lawn & garden equipment on ozone action day (days when high ozone is predicted). Program would be mandatory for state and local governments.

Progress to Date:

Implemented as administrative policy at all local governments and applicable state agencies.

Implementation Schedule: 2004

Status: Implemented

Contact: Mark McCaskill 540-343-4417

Roanoke Valley Area Ozone Early Action Plan (EAP)
Implementation Schedule

Strategy: Air Quality Action Day (Hybrid Approach)

Commitment: Counties of Roanoke, and Botetourt, Cities of Roanoke, Vinton, and Salem.

Brief Description: The localities have agreed to participate in Air Quality Awareness announcements to inform them of days with high ozone levels. On these days, they will follow the "Ten simple steps to cleaner Air" and not mow, get fuel when it's cool, etc., to lower ground level ozone emissions. The hybrid approach outlines a public/private partnership in these strategies. The public sector will make these steps as policy, where as the private sector will agree to them voluntarily to support the initiatives and work regionally to improve air quality. The public sector companies who have agreed to participate include: Stop in Food Stores, Kroger, Workman Oil, Boxley Inc., East Coasters, Pebble Creek Apartments, Valley Metro, Firestone Tires, and Goodwill Industries.

Progress to Date: There is a network of emails, calls, and public announcements in place to inform the public of days when we will need them to adhere to Air Quality Action Day Commitments. The emails reach approximately 2000 government employees and their staff and work crews. TV and radio news programs, the Roanoke Times weather page, and the Roanoke Civic Center Marquis, have agreed to help spread the word on ozone alert days to inform people that they should take steps to lower ground level ozone.

Implementation Schedule: Fully implemented summer 2004.

Status: Fully Implemented.

Contact: Mark McCaskill (Regional Commission) 540-343-4417
Erin Hofberg (Regional Commission) 540-343-4417

Strategy: Early Morning or Late Evening Refueling

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke

Brief Description: This measure will also have a mandatory and voluntary component. Local governments have agreed to fuel their fleet vehicles before 8 am and after 5 PM on days of ozone non-attainment. Several fueling stations have submitted pledges to support this initiative by encouraging citizens to "get fuel when it's cool". These companies include stop in food stores, Kroger, Workman Oil, and Boxley Inc.

Progress to Date: Each of the local governments as well as many private sector companies have agreed to adopt this measure**.** The will hear from the office of Ride Solutions on days of Ozone Non-attainment and spread the word through the communications network.

Implementation Schedule: Fully implemented, summer of 2004

Contact: Mark McCaskill (Regional Commission) 540-343-4417
Erin Hofberg (Regional Commission) 540-343-4417

Strategy: Promotion of Alternative Fuel Vehicles

Commitment: County of Roanoke

Brief Description: As part of the public awareness and education program, the environmental and economic benefits of alternative fuel vehicles will be identified as an encouragement to purchase these vehicles. The County of Roanoke has submitted a statement that addresses their intent to purchase alternative fuel vehicles in the coming year. Please see section I of III (Heavy Duty Diesel and Diesel Equipment Strategies).

Progress to Date: Localities and public sector businesses, neighborhood associations and the Ride Solutions program have worked to improve public awareness through publications and announcements of the environmental and economic benefits of alternative fuel vehicles.

Implementation Schedule: Implemented and on-going

Contact: Mark McCaskill (Regional Commission) 540-343-4417
Erin Hofberg (Regional Commission) 540-343-4417

Strategy: Media and Public Relations Concerning Air Quality Action Days

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke, Roanoke Civic Center, Radio: K92, Vibe 100, WUVT. TV: WBDJ. Print: Roanoke Times, New River Current, Roanoke Times On-Line.

Brief Description: A comprehensive and year-round media and public relations program has been implemented and is monitored and developed by the Ride Solutions Coordinator. The Ride Solutions coordinator has developed a communication network consisting of television, radio, print media, road signs, marquis, presentations, special events, email and telephone trees, and a web site to spread awareness of these issues. All of these media sources work in conjunction to deliver a concise and collaborative message throughout the region. The message is addressed to businesses, agencies, and individual citizens alike. To date, the feedback has been far-reaching and positively received.

Progress to Date: Each local government as well as many private sector companies and news sources have agreed to adopt this measure**.**

Implementation Schedule: Fully implemented, implemented summer of 2004

Contact:	Mark McCaskill	(Regional Commission)	540-343-4417
	Erin Hofberg	(Regional Commission)	540-343-4417

Strategy: Public Transit Incentives

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke, Valley Metro, Roanoke Valley-Alleghany Regional Commission, Ride Solutions

Brief Description: Public transit incentives (transit passes) for college students and local employers. This measure will involve the purchase of at least 300 transit passes to be distributed to students and employers for use during high ozone days or year-round. All government employees in the City of Roanoke now have bus vouchers to encourage them to take public transit. Furthermore, all city employees also have the "Downtown Express" a Park and Ride service that will shuttle SOV drivers from the Roanoke Civic Center into the downtown area to relieve congestion and lower emissions in the downtown area. This is a free service provided by the city. Furthermore, we are implementing the "Smart Way" a long distance shuttle along the I-81 corridor to alleviate congestion along that route to lower SOV drivers and improve air quality along the corridor.

Progress to Date: We did not have any ozone non-attainment days this season, so we did not have the opportunity to apply this measure. However, the infrastructure is established to provide alternative transportation via transit and we have been promoting transportation options throughout the region.

Implementation Schedule: Implemented summer of 2004, but not used yet.

Contact:	Mark McCaskill	(Regional Commission)	540-343-4417
	Erin Hofberg	(Regional Commission)	540-343-4417

Strategy: Bicycle Infrastructure and Amenities

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke, Roanoke Valley-Alleghany Regional Commission, Ride Solutions

Brief Description: This program will encourage bicycle use during high ozone days and encourage the expansion of bicycle related infrastructure. The Roanoke Valley Alleghany Regional Commission had completed a Bike Feasibility Study of the roads in Roanoke for publication. This publication is designed to help commuters see the routes they would be able to ride in the area. A rural version of the study will be completed in the next year. Furthermore, there is work being done on greenway mapping of the Roanoke Valley to inform bikers of their routes and alternatives. The Ride Solutions Coordinator is also working with private businesses to encourage biking as an alternative mode of transportation through providing bike racks, and flex hours for employees.

- Developed a regional bicycle network that facilitates and promotes alternative transportation and recreational opportunities in the region.
- Conducted fieldwork to collect data required for Level of Service (LOS) modeling. Additional data, beyond what is required for LOS modeling, was also collected. This data was compiled to develop a comprehensive database of roadway design parameters in the Regional Bicycle Suitability Study.
- Evaluated the LOS of the study area network using the Bicycle Compatibility Index (BCI) model and the Bicycle Level of Service (BLOS) model
- Using the BCI model, recommend design alternatives to better accommodate bicyclists for selected portions of the regional network.
- Using GIS technology, produced compatibility/suitability maps for corridors comprising the regional network based on the LOS scores received from both models.
- Reviewed alternative design and operational options for segments in the regional network and LOS achieved by various options, as provided by the models.

Progress to Date: We have developed the Regional bike Feasibility Study, and mapped the region. We are working to develop the rural bike plan now.

Implementation Schedule: Urban Bike Plan implemented, Rural Plan in progress

Contact: Mark McCaskill (Regional Commission) 540-343-4417
Erin Hofberg (Regional Commission) 540-343-4417

Strategy: School (K-12 and Adult Education) Based on public education

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke, Roanoke Valley-Alleghany Regional Commission, Ride Solutions

Brief Description: Through public awareness and outreach we will educate the citizens of our region about the ozone Early Action Plan and how they can assist in reaching our clean air goals. Television and radio interviews, print and on-line media, neighborhood and civic league meetings and classrooms will be the focus for this measurement.

Progress to Date: The Ride Solutions coordinator had worked with numerous citizen groups, media sources, and neighborhood associations to promote awareness and education of the Ozone early Action Plan and its implementation. We are currently developing a class program to take to the school in the region to teach the students of the program and what they can do as citizens to help. The Clean air message relates to the Standard of Learning (SOL) LS.12 section. "The student will investigate and understand the relationship between ecosystem dynamics and human activity. Key concepts include…air quality". We have prepared a presentation to share with regional schools. We are now in the process of contacting he schools to try and fit into their syllabi.

Implementation Schedule: Implemented with continuous public outreach and involvement

Contact:	Mark McCaskill	(Regional Commission)	540-343-4417
	Erin Hofberg	(Regional Commission)	540-343-4417

Strategy: Tree Canopy and Urban Forestry

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke

Brief Description: This measure involves an area-wide comprehensive tree- planting program with the goal of reducing concentrations of certain pollutants including ozone and NO_X Roanoke City and Vinton have both expressed support for this initiative. Roanoke City expects to plant 500 trees this year.

Progress to Date: Vinton has planted 30 trees and 30 seedlings. The county of Roanoke has committed to plant 100 trees and is in the process of doing so. Roanoke City has also committed to planting trees, and is in the process of doing so.

Implementation Schedule

Contact:	Mark McCaskill	(Regional Commission)	540-343-4417
	Erin Hofberg	(Regional Commission)	540-343-4417

Strategy: Roanoke to Blacksburg Public Transit

Commitment: Ride Solutions, Valley Metro

Brief Description: Establishment of a bus route from Roanoke to Blacksburg (where Virginia Tech is located), and points in between. This will reduce vehicle trips within the compact area and produce a 0.9 ton/year reduction of NO_X and 2 ton/year reduction of VOC. The bus is called the "Smart Way" bus. For three dollars people can travel approximately 50 miles from Blacksburg to Roanoke one way. There are stops in Christiansburg and Salem. For the first three years Valley Metro will fund the program with technical support provided by Ride Solutions. After this point, the localities that the bus services will share the cost as determined by ridership.

Progress to Date: The bus route is established and began in August 2004. The Ride Solutions Coordinator for the Regional Commission has conducted a survey of ridership satisfaction and demand over three months to review how the service is being received. These findings will be presented in a joint MPO meeting between the Roanoke region and the New River valley region, Thursday Nov. 4th. The bus has received a lot of good feedback and responses. Ride Solutions has also coordinated with Valley Metro to share advertising and clean commuting messages with the "Smart Way".

Implementation Schedule: Fully implemented

Contact:	Mark McCaskill (Regional Commission)	540-343-4417
	Erin Hofberg (Regional Commission)	540-343-4417

Strategy: Open Burning

Commitment: City of Roanoke, City of Salem, County of Botetourt, County of Roanoke

Brief Description: Several jurisdictions have adopted local rules restricting or prohibiting open burning. The other EAP jurisdictions will ban or restrict open burning during predicted high ozone days. This will reduce area emissions by 0.56 tons/day of VOC, and 0.24 tons/day of NO_X.

Progress to Date: These commitments stand and localities will not grant permits for open burning on days with high ozone levels.

Implementation Schedule: Fully implemented

Contact:	Mark McCaskill (Regional Commission)	540-343-4417
	Erin Hofberg (Regional Commission)	540-343-4417

ADDITIONAL SUCCESS NOT ORIGINALLY INCLUDED IN OZONE EAP

Strategy: Cradle to Cradle (C2C) Design Competition

Commitment: Roanoke Redevelopment and Housing Authority, Smith Lewis Architecture.

Brief Description: The Cradle to Cradle (C2C) Design Competition is based on concepts articulated by William McDonough at the University of Virginia. The concepts are numerous and integrated. The basic intention of the Competition is to produce housing designs, which incorporate building materials that are in a continuous cycle of reuse and re-adaptation (hence Cradle to Cradle) and which integrate within the natural systems contexts that they are found. Successful designs should capture and re-use energy and minimize their ecological footprint. This is an international scale competition, which seeks to implement winning designs in partnership with the Roanoke Redevelopment and Housing Authority.

Progress to Date: SmithLewis Architecture firm is the local contact for the competition. The competition is international in scale (participating design teams) and successful designs will be implemented on vacant land owned by the Roanoke Redevelopment and Housing Authority. It is estimated that construction of wining designs will begin in the summer of 2005 and could included up to 30 designs constructed.

Implementation Schedule: By the end of calendar year 2005

Contact: Gregg A. Lewis, AIA 540-343-5500

Strategy: Retrofit City of Roanoke School Busses

Commitment: City of Roanoke

Brief Description: The City of Roanoke has applied for and obtained additional funds from VDEQ to retrofit approximately 102 of its school busses in a similar manner as Roanoke County (see above). This is an additional success that has been pursued after the local government adoption of the Ozone EAP (01-22-2004). We strive to pursue additional success whenever possible to go above and beyond the original commitments of the Ozone EAP.

Progress to Date: The City of Roanoke has been approved for funds. However, there is not yet a contract and an order with the private sector.

Implementation Schedule: By the end of calendar year 2005

Contact: Jim Ponticello (VDOT) 804-698-4405

APPENDIX B

Summary of Control Measures for the Roanoke EAC

Control Measure Category	Control Measure Description	Emission Reductions VOC		NOx		VOC + NOx	
Local/County Government -- Heavy Duty Diesel and Diesel Equipment Strategies	Reduction of locomotive idling and resulting emissions			0.153 tpd	55.7 tpy		
	Limitation of idling times for local school bus fleets.			0.003 tpd	0.524 tpy		
	Retrofits of Diesel School Buses with CatOx/reflashing	0.003 tpd	0.586 tpy	0.009 tpd	1.67 tpy		
	Purchase and use of 5 new bio-diesel compatible solid waste trucks by the City of Roanoke.			0.001 tpd	0.275 tpy		
	Purchase and use of up to 26 ethanol compatible alternative fuel vehicles by the City of Roanoke.	NQ	NQ	NQ	NQ	NQ	NQ
	Purchase of biodiesel ready trucks by the City of Roanoke.	NQ	NQ	NQ	NQ	NQ	NQ
	Purchase of Hybrid Vehicles by City of Roanoke.	<0.001 tpd	<0.001 tpy	<0.001 tpd	0.013 tpy		
	Purchase of more efficent, low-emission, or alternative fuel vehicles by Roanoke County.	<0.001 tpd	0.001 tpy	<0.001 tpd	0.033 tpy		
	Removed.						
	Educational and training program on vehicle use by Roanoke County. "Effective Environmental Driving"	NQ	NQ	NQ	NQ	NQ	NQ
Local/County Government -- Comprehensive Air Quality Action Day Strategy	Air Quality Action Day Program	***With the exception of the new bus route from Roanoke to Blacksburg, it is difficult to estimate ozone precursor emission reductions achieved by these strategies. Through evaluation of these types of programs in other areas, a general range of emission reductions that can be expected from the combination of these types of voluntary mreasure is up to 3% to 4% from affected activities. For this evaluation, the goal of 3% reduction has been used. In total this equates to a daily reduction of 0.94 ton/day of VOC and 0.61 tons/day of NOx for control measure numbers 11 through 19 when combined with the episodic lawn and garden restrictions (measure numbers 22 &23).***					
	Early Morning/Late Evening refueling of vehicles						
	Promotion of alternative fuel vehicles						
	Media and public relations concerning air quality action days						
	Public transit incentives for college students and local employers. (300 transit passes minimum)						
	Bicycle infrastructure and amenities						
	School based public education						
	Tree canopy/urban forestry						
	Roanoke to Blacksburg public transit	0.009 tpd	2.32 tpy	0.004 tpd	0.923 tpy		
Local/County Government -- Lawn and Garden Equipment Strategies	Replacement of 100 gas golf carts with electric carts.					<0.001 tpd	0.061 tpy
	Gasoline powered lawnmower buyback program	0.017 tpd	3.57 tpy	0.001 tpd	0.248 tpy		
	Voluntary ban on use by residential/local businesses of lawn equipment on predicted ozone exceedence days.	0.072 tpd	0.217 tpy	0.016 tpd	0.049 tpy		
	Mandatory ban on use by state/local governments of lawn equipment on predicted ozone exceedence days.	0.366 tpd	1.1 tpy	0.094 tpd	0.282 tpy		
	Local rules restricting and/or mandatory bans on open burning during predicted high ozone days.	0.56 tpd	1.68 tpy	0.24 tpd	0.72 tpy		
State Control Measures	Stage I	1.756 tpd	640.9 tpy				
	CTG RACT	0.94 tpd	355.5 tpy	0.79 tpd	288.4 tpy		
	State Cutback Asphalt Restriction	0.005 tpd	1.75 tpy				
Federal Nonroad Control	Federal Small Gasoline Engine Standards	1.68 tpd	613.2 tpy	0.059 tpd	21.5 tpy		
	Federal Nonroad Diesel Engine Standards	0.158 tpd	57.7 tpy	0.969 tpd	353.7 tpy		
	Federal Locomotive Emission Standards			1.11 tpd	405.8 tpy		

NQ=Not Quantifiable

Summary of Control Measures for the Roanoke EAC

Control Measure Category	Control Measure Description	Emission Reductions				
		VOC		NOx		VOC + NOx
Measures	Federal Large Gasoline Engine Standards	0.146 tpd	53.3 tpy	0.546 tpd	199.3 tpy	
	Federal Spark Ignition Marine Engine Standards	0.015 tpd	5.48 tpy			
	Federal Onroad Motor Vehicle Standards	7.26 tpd	2650.3 tpy	11.6 tpd	4217.6 tpy	
Federal Area Control Measures	AIM	0.382 tpd	139.6 tpy			
	Consumer/Commercial Products	0.179 tpd	65.2 tpy			
	Metal Cleaning Solvents	0.163 tpd	59.6 tpy			
	Motor Vehicle Refinishing Paint	0.159 tpd	58.2 tpy			
Contingency Measures	OTC AIM	0.474 tpd	173.0 tpy			
	OTC Consumer Products	0.228 tpd	83.3 tpy			
	OTC Metal Cleaning Solvents	0.970 tpd	353.8 tpy			
	OTC Motor Vehicle Refinishing	0.108 tpd	39.3 tpy			
	OTC Portable Gas Containers	<0.100tpd	36.0 tpy			

NQ=Not Quantifiable

Measure 1: Reduction of Locomotive Idling

Measure Number: 1
Measure Name: Reduction of Locomotive Idling

Description:
Norfolk Southern Railroad Company will implement an internal policy to limit locomotive idling.

NOx

Estimated Reductions (tpd)	0.15
Estimated Reductions (tpy)	55.7

PM

Estimated Reductions (tpd)	0.005
Estimated Reductions (tpy)	1.8

Issues

·Local voluntary agreement with Norfolk Southern Railroad Company.

· Agreement requires that units are switched off when the ambient air temperature is greater than 32 degrees F.

Assumptions

· Norfolk Southern Railway Company operates 20 switching units in the area.
· Utilization rate of these switching units is 55%. Therefore 45% of the time engines are turned off and not idling.
· Assume an 80% rule effectiveness.
· Engines burn between 5 and 6 gallons of diesel/hour when idling.
· Emission factors from *"Guidance for Quantifying and Using Long Duration Switch Yard Locomotive Idling Emission Reductions in State Implementation Plans."*
'· 26 grams PM/hour
'· 800 grams NOx/hour

Emission Reductions

Annual hours reduced idling = 8760 hrs/yr * 45% idling restricted times * 80% effectiveness * 20 units
Annual hours reduced idling = 63072 hrs/yr

Daily Reductions (NOx) = 63072 hrs/yr * 800 gr NOx/hr * 1 ton/906000 grams * 1 year/365 days
Daily Reductions (NOx) = *0.15* *tpd NOx*
Annual Reductions (NOx) = 63072 hrs/yr * 800 gr NOx/hr * 1 ton/906000 grams
Annual Reductions (NOx) = *55.69* *tpy NOx*

Daily Reductions (PM) = 63072 hrs/yr * 26 gr PM/hr * 1 ton/906000 grams * 1 year/365 days
Daily Reductions (PM) = *0.0050* *tpd PM*
Annual Reductions (PM) = 63072 hrs/yr * 26 gr PM/hr * 1 ton/906000 grams
Annual Reductions (PM) = *1.8* *tpy PM*

Implementation Schedule and Status

Norfolk Southern has fully implemented the locomotive idling reduction policy, and they are committed to keeping the policy in place. It should be noted that a conservative assumption for fuel savings would calculate 315,360 gallons of diesel fuel not expended annually due to this policy. (3153.6 hours/yr/unit * 5 gal/hr * 20 units)

Measure 2: Limit Idling Times for School Buses

Measure Number: 2
Measure Name: Limit Idling Times for School Buses

Description:
Apply school bus idling restrictions to Roanoke County, Botetourt, & Vinton. City of Roanoke and City of Salem already have these in place.

NOx

Estimated Reductions (tpd)	0.003
Estimated Reductions (tpy)	0.524

VOC

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

Issues

· School Buses burn 1/2 gallon of fuel for each hour it idles.

Assumptions

· Approximately 211 school buses in Roanoke County, Botetourt, and Vinton.
· Idle 30 minutes/day per bus.
· Assume exhaust rate of 25 grams/hour NOx;
· School year equates to 180 days/year.

Emission Reductions

Daily Reductions (NOx) = 211 school buses * 0.5 hour/day/bus * 25 grams/hour * 1 ton/906000 grams
Daily Reductions (NOx) = 0.003 tpd NOx

Annual Reductions (NOx) = 0.0029 tpd * 180 days per year
Annual Reductions (NOx) = 0.524 tpy NOx

Implementation Schedule and Status

The cities of Roanoke and Salem implemented this program in the summer of 2004. The county of Roanoke has completed an implementation schedule. The county of Botetourt is currently working on implementing this program.

Measure 3: Diesel Retrofits: School Buses

Measure Number: 3
Measure Name: Diesel Retrofits: School Buses

Description:
Retrofit 100 Roanoke County school buses with oxidation catalysts. Retrofit 102 Roanoke City school buses with oxidation catalysts. Additionally, retrofit 40 of these buses with reflashing technology for NOx reduction.

NOx

Estimated Reductions (tpd)	0.009
Estimated Reductions (tpy)	1.67

VOC

Estimated Reductions (tpd)	0.003
Estimated Reductions (tpy)	0.586

CO

Estimated Reductions (tpd)	0.011
Estimated Reductions (tpy)	1.90

Issues

· Though not calculated here, the catalysts will also result in a PM reduction.

· Almost every retrofit requires use of ultra-low sulfur diesel fuel (ULSD) at additional cost of $0.08 per gallon

· Immediate benefits will be greatest for oldest buses. However, these buses may be less cost-effective in the long run if they are nearing the end of their useful lives

Assumptions

· Approximately 100 school buses to be retrofitted in County of Roanoke. 102 school buses to be retrofitted in the City of Roanoke. 40 of these will also be retrofitted with reflashing technology for additional NOx reduction.
· For the catalytic oxidizers, assume VOC reduction of 50%; a CO reduction of 40%; and a PM reduction of 20%.
· For the reflashing technology, assume a NOx reduction of 25%.
· The average diesel school bus emission factor in the Roanoke area in 2007 is 0.4866 g/mile for VOC and 14.3896 g/mile NOx.
· The average diesel school bus emission factor in the Roanoke area in 2007 is 1.9771 g/mile for CO.
· School days are assumed to be 180 days/year.
· Assume average fuel economy is 6.5 mpg
· Assume Roanoke County buses average 11,100 miles/year (data from Roanoke County annual mileage report).
· Assume Roanoke City buses average 10,500 miles/year (data from Roanoke City fleet assessment)

Emission Reductions

Annual Reductions (VOC) = (100 buses*11,100 miles/yr+102 buses*10,500 miles/yr)*0.4866 g/mile*1 ton/906000 gr*50% reductio
Annual Reductions (VOC) = 0.586 tpy VOC

Daily Reductions (VOC) = Annual Reductions/180 days/year
Daily Reductions (VOC) = 0.003 tpd VOC

Annual Reductions (NOx) = 40 buses*10500 miles/year*14.3896 g/mile*25% reduction*1ton/906000 gr
Annual Reductions (NOx) = 1.67 tpy NOx

Daily Reductions (NOx) = Annual Reduction/180 days/year
Daily Reductions (NOx) = 0.009 tpd NOx

Annual Reductions (CO) = (100 buses*11,100 miles/yr+102 buses*10,500 miles/yr)*1.9771 g/mile*1 ton/906000 gr*40% reductio
Annual Reductions (CO) = 1.90 tpy CO

Daily Reductions (CO) = Annual Reduction/180 days/year
Daily Reductions (CO) = 0.011 tpd CO

The county of Roanoke has a contract with Cummins Atlantic. 100 diesel oxidation catalysts are on order and are expected to be installed by the summer of 2005. The city of Roanoke has been approved for the necessary funds. Work toward a contract is ongoing.

Measure 4: Bio-diesel compatible solid waste trucks

Measure Number: 4

Measure Name: Bio-diesel compatible solid waste trucks

Description:
Will involve the conversion of five new garbage trucks to use bio-diesel fuels by the City of Roanoke.

NOx

Estimated Reductions (tpd)	0.001
Estimated Reductions (tpy)	0.275

PM

Estimated Reductions (tpd)	4.14E-05
Estimated Reductions (tpy)	0.009

Issues

· City believes these trucks are cost-effective.

· City of Roanoke has already purchased 5 new trucks that are capable of being converted to bio-diesel.

· City of Roanoke currently has 13 garbage trucks, 10 of which are generally in use at any one time.

Assumptions

· Conversion of 5 trucks.
· Trucks will be more efficient, allowing a 20% time savings on each route. Currently, trucks operate 4 days/week.
· Routes will be adjusted to reduce driving time. New trucks will save 1 to 1.5 hours each day.
· Assume average speed is 20 mph.
  · NOx = 8 grams/mile Where did these emission factors come from? Are on page 5/33.
  · PM = 0.25 grams/mile

Emission Reductions

Mileage Reduction = 5 trucks * 1.5 hrs/day * 4 days/week * 52 weeks/year * 20 miles/hr
Mileage Reduction = 31200 miles/year
Mileage Reduction = 5 trucks * 1.5 hrs/day * 20 miles/hr
Mileage Reduction = 150 miles/day

Total NOx Reduced= 8 gr/mile * 150 miles/day * 1 ton/906000 gram
Total NOx Reduced= 0.001 tons/day
Total NOx Reduced= 0.275 tons/year

Total PM Reduced= 0.25 gr/mile * 150 miles/day * 1 ton/906000 grams
Total PM Reduced= 4.14E-05 tons/day
Total PM Reduced= 0.009 tons/year

Implementation Schedule and Status

In 2003, the city of Roanoke purchased five new garbage trucks. Additional bio-diesel compatible trucks will be purchased as garbage trucks are replaced in the fleet

Measure 5: City of Roanoke: Ethanol Compatible Vehicles

Measure Number: 5

Measure Name: City of Roanoke: Ethanol Compatible Vehicles

Description:

This measure will involve the purchase and use of up to 26 alternatively fueled vehicles.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Due to the nature of the program, it is not possible to quantify reductions of emissions for this strategy. However, purchase and use of ethanol compatible vehicles can only benefit the environment in the long run.

Implementation Schedule and Status

· In 2003, the city of Roanoke purchased 11 sedans and station wagons that are ethanol fuel compatible. By 2007, the city will purchase an additional 15 ethanol fuel compatible vehicles. This strategy is considered on schedule in its implementation.

Measure 6: City of Roanoke: Biodiesel Compatible Fleet Trucks

Measure Number: 6

Measure Name: City of Roanoke: Biodiesel Compatible Fleet Trucks

Description:

This measure involves the purchase and future purchases of waste trucks utilizing biodiesel fuels.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Due to the nature of the program, it is not possible to quantify reductions of emissions for this strategy. However, purchase and use of biodiesel compatible trucks can only benefit the environment in the long run.

Implementation Schedule and Status

· In 2003, the city of Roanoke purchased 9 new trucks that will operating using biodiesel fuel. By 2007, the city of Roanoke will purchase an additional twelve biodiesel fuel compatible vehicles. This strategy is considered on schedule in its implementation.

Measure 7: City of Roanoke: Purchase of hybrid vehicles

Measure Number: 7
Measure Name: City of Roanoke: Purchase of hybrid vehicles

Description:
Purchase by City of Roanoke of up to 4 hybrid vehicles.

NOx

Estimated Reductions (tpd)	3.66E-05
Estimated Reductions (tpy)	0.013

VOC

Estimated Reductions (tpd)	8.29E-07
Estimated Reductions (tpy)	3.03E-04

Issues

· Analysis is for 2 hybrid vehicles. Benefits would increase as more vehicles are purchased.

Assumptions

· Purchase 2 hybrid vehicles instead of 2 LEVs
· Emissions from replacement vehicles will be equivalent to emissions from 2003 Toyota Prius
· Current vehicles are similar to Dodge Neon/Chevy Cavalier and have emission rates equivalent to LEV standards
· MSRP for 2003 Vehicles:
  · Dodge Neon $13,480
  · Chevy Cavalier $14,595
  · Toyota Prius $20,480
· Assume vehicle travels 57 mi/day for 250 days/year

Emission Rates	HC	NOx
EPA LEV Standard (g/mi)	0.0090	0.30
2003 Toyota Prius (g/mi)	0.0024	0.01

Emission Reductions

Total NOx Reduced= (0.30 g/mi - 0.01 g/mi) * 57 mi/day * 2 vehicles / 906,000 gram per ton
Total NOx Reduced= 3.66E-05 tons/day

Total VOC Reduced= (0.009 g/mi - 0.0024 g/mi) * 57 mi/day * 2 vehicles / 906,000 gram per ton
Total VOC Reduced= 8.29E-07 tons/day

Implementation Schedule and Status

The city of Roanoke has purchased a Prius and has ordered an Escape hybrid. Additionally the city of Roanoke parking group is working on a plan to implement preferred parking spots for low-emission vehicles in city owned parking garages.

Measure 8: Roanoke County: Purchase of Clean Fuel Vehicles

Measure Number: 8

Measure Name: Roanoke County: Purchase of Clean Fuel Vehicles

Description:

Purchase by Roanoke County of more efficient, low-emission, or alternative fuel vehicles.

NOx

Estimated Reductions (tpd)	9.14E-05
Estimated Reductions (tpy)	0.033

VOC

Estimated Reductions (tpd)	2.07E-06
Estimated Reductions (tpy)	0.001

Issues

· Analysis is for 5 hybrid vehicles. Benefits would increase as more vehicles are purchased.

· Original agreement was for the county to purchase one hybrid. They have purchased one hybrid, and ordered four more hybrids.

Assumptions

· Purchase 5 hybrid vehicles.
· Emissions from replacement vehicles will be equivalent to emissions from 2003 Toyota Prius
· Current vehicles are similar to Dodge Neon/Chevy Cavalier and have emission rates equivalent to LEV standards
· MSRP for 2003 Vehicles:
  · Dodge Neon $13,480
  · Chevy Cavalier $14,595
  · Toyota Prius $20,480
· Average fleet vehicle travels 57 mi/day for 250 days/year

Emission Rates	HC	NOx
EPA LEV Standard (g/mi)	0.0090	0.30
2003 Toyota Prius (g/mi)	0.0024	0.01

Emission Reductions

Total NOx Reduced= (0.30 g/mi - 0.01 g/mi) * 57 mi/day * 5 vehicles / 906,000 grams per ton

Total NOx Reduced= 9.14E-05 tons/day

Total VOC Reduced= (0.009 g/mi - 0.0024 g/mi) * 57 mi/day * 5 vehicles / 906,000 grams per ton

Total VOC Reduced= 2.07E-06 tons/day

Implementation Schedule and Status

· One Civic hybrid has been purchased. Two Escape hybrids, one more Civic hybrid, and one Prius hybrid have been ordered. The four hybrid vehicles that have been ordered as of October 2004 are above and beyond the original agreement.

Measure 10: Roanoke County Education: Effective Environmental Driving

Measure Number: 10

Measure Name: Roanoke County Education: *Effective Environmental Driving*

Description:

Roanoke County has implemented a program of education for its employees entitled "Effective Environmental Driving."

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Issues

· After the training of all employees, gasoline consumption savings may be estimated by yearly gasoline usage numbers.

· Quantification of emission reductions would be challenging; however, the program is directionally correct.

Assumptions

· The County of Roanoke will implement the training.

· All employees will receive training; training will be available as new employees are hired.

Emission Reductions

· It is expected that this type of educational program will increase fuel economy, decrease fuel usage, and decrease emissions to the environment.

Implementation Schedule and Status

· On August 8, 2003, Roanoke County distributed a brochure to all its employees urging them to reduce the environmental impact of driving both county and personal vehicles. Items focused on car-pooling, planning trips, and reduction of idling and warm up periods. In addition, all drivers of county vehicles received *"Effective Environmental Driving"* classroom training by June 30, 2004.

Measure 11: Air Quality Action Day

Measure Number: 11
Measure Name: Air Quality Action Day

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Description:

Localities are making commitments to limit or ban certain ozone precursor forming activities during predicted high ozone days such as landscaping, pesticide application, etc. Secondly, voluntary restrictions on these types of activities will be requested of local business and the general public.

Issues

· If ozone exceedances continue, a contingency measure would be to determine if additional mandatory restrictions are necessary.

Assumptions/Emission Reductions

· The public/private partnership will work to support cleaner air quality.
· It is expected that this type of program will increase awareness during predicted high ozone days, and thereby promote behaviors that will decrease the emissions of ozone precursors to the environment. While emissions cannot be directly quantified, this strategy is a sound approach to reducing ozone precursors on predicted high ozone days and should be beneficial to the environment.

Implementation Schedule and Status

· Public sector companies who have agreed to participate include Stop in Food Stores, Kroger, Workman Oil, Boxley Inc, East Coasts, Pebble Creek Apartments, Valley Metro, Firestone Tires, and Goodwill Industries. There is a network of emails, calls, and public announcements in place to inform the public of days when ozone is predicted to be high. The emails reach approximately 2,000 government employees and their staff and work crews. TV and radio news programs, the Roanoke Times weather page, and the Roanoke Civic Center Marquis have agreed to help inform people on ozone action days. This program was fully implemented during the summer of 2004.

Measure 12: Early Morning/Late Evening Refueling

Measure Number: 12
Measure Name: Early Morning/Late Evening Refueling

Description:

This program will have both a mandatory and voluntary segment. Local governments and state agencies will restrict vehicle refueling during high ozone days to the evening. Local gasoline distributors will be encouraged to provide incentives to the public to refuel early or late in the day on predicted high ozone days.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Refueling during early morning/late evening time periods reduces VOC emissions to the atmosphere on predicted high ozone days.

· Due to the nature of the program, it is not possible to quantify reductions of emissions for this strategy. However, the nature of the program will provide environmental benefit and is a sound environmental management position.

Implementation Schedule and Status

· Each of the local governments as well as many private sector companies have agreed to adopt this measure. They will hear from the office of Ride Solutions on days of predicted high ozone levels and spread the word through the communications network. This program was fully implemented by the summer of 2004.

Measure 13: Promotion of Alternative Fuel Vehicles

Measure Number: 13
Measure Name: Promotion of Alternative Fuel Vehicles

Description:
As part of a public awareness and education program, the environmental and economic benefits of alternative fuel vehicles will be identified as encouragement to purchase these vehicles.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· As the public become more aware of the potential benefits of alternative fuel vehicles, these vehicles may become viewed as viable alternatives to conventionally fueled vehicles.

· Due to the nature of the program, it is not possible to quantify reductions of emissions for this strategy. However, purchase and use of alternative vehicles can only benefit the environment in the long run.

Implementation Schedule and Status

· Localities and public sector businesses, neighborhood associations, and the Ride Solutions program have worked to improve the public awareness through publications and announcements of the environmental and economic benefits of alternative fuel vehicles. This strategy is implemented and on-going.

Measure 14: Media and public relations concerning air quality action days

Measure Number: 14

Measure Name: Media and public relations concerning air quality action days

Description:

A comprehensive and year-round media and public relations program will be implemented and coordinated by a regional air quality and ride-sharing coordinator and assisted by local coordinators.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Due to the nature of the program, it is not possible to quantify reductions of emissions for this strategy. Ongoing educational outreach should serve to heighten the public's awareness of their impact on the environment and provide information on mitigation to decrease emissions year round.

Implementation Schedule and Status

A comprehensive and year-round media and public relations program has been implemented. This program is monitored by the Ride Solutions Coordinator. The Ride Solutions Coordinator has developed a communication network consisting of television, radio, print media, road signs, marquis, presentations, special events, email and telephone trees, and a web site to spread awareness of these issues. All of these media sources work in conjunction to deliver a concise and collaborative message throughout the region. To date, the feedback has been far-reaching and positive. Commitments have been received from all localities, the Roanoke Civic Center, several radio stations (K92, Vibe 100, WUVT), a local TV station (WBDJ) and several newspapers (Roanoke Times, New River Current, Roanoke Times-Online). This program was fully implemented by the summer of 2004.

Measure 15: Public transit incentives

Measure Number: 15
Measure Name: Public transit incentives

Description:
Public transit incentives such as transit passes for college students and local employers.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Quantification of emission reductions would be problematic due to the nature of the program.

Implementation Schedule and Status

· This measure involves the purchase of at least 300 transit passes to be distributed to students and employers for use during high ozone days or year round. All government employees in the City of Roanoke now have bus vouchers to encourage them to take public transit. Further, all city employees also have the "Downtown Express," a park and ride service that will shuttle drivers from the Roanoke Civic Center into the downtown area to relieve congestion and lower emissions in the downtown area. This is a free service provided by the city. Also, "Smart Way" is being implemented, which is a long distance shuttle along the I-81 corridor designed to alleviate congestion and thereby improve air quality. The infrastructure is established to provide alternative transportation via transit, and these options are continuing to be promoted throughout the region. This program was implemented during the summer of 2004.

Measure 16: Bicycle Infrastructure/Amenities

Measure Number: 16
Measure Name: Bicycle Infrastructure/Amenities

Description:
Encourage bicycle use during high ozone days and encourage the expansion of bicycle related infrastructure.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Quantification of emission reductions would be problematic due to the nature of the program. However, encouraging bicycle use not only has environmental benefits, but healthful benefits as well.

Implementation Schedule and Status

· This program will encourage bicycle use during high ozone days and encourage the expansion of bicycle related infrastructure. The Roanoke Valley Allegheny Regional Commission had completed a Bike Feasibility Study of the roads in Roanoke for publication. This publication is designed to help commuters see the routes they would be able to ride in the area. A rural version of the study will be completed in the next year. Furthermore, there is work being done on greenway mapping of the Roanoke Valley to inform bikers of their routes and alternatives. The Ride Solutions Coordinator is also working with private businesses to encourage biking as an alternative mode of transportation through providing bike racks, and flex hours for employees. The Urban Bike Plan has been implemented, and the Rural Plan is in progress.

Measure 17: School Based Public Education

Measure Number: 17
Measure Name: School Based Public Education

Description:
K-12 and adult education identifying air quality issues and individual actions that will reduce ozone precursor emissions.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Quantification of emission reductions would be problematic due to the nature of the program. The approach is directionally sound.

Implementation Schedule and Status

· The Ride Solutions Coordinator had worked with numerous citizen groups, media sources, and neighborhood associations to promote awareness and education of the Ozone Early Action Plan and its implementation. Currently under development is a class program to use in the schools that will teach the students about the EAP, and what they can do as citizens to help. The clean air message relates to the Standard of Learning (SOL) LS.12 section. “The student will investigate and understand the relationship between ecosystem dynamics and human activity. Key concepts include…air quality." The localities have prepared a presentation to share with regional schools. They are in the process of contacting schools to try and fit into their syllabi.

Measure 18: Tree Canopy/Urban Forestry

Measure Number: 18
Measure Name: Tree Canopy/Urban Forestry

Description:
Area wide comprehensive tree-planting program with the goal of reducing concentrations of pollutants including ozone and NOx.

NOx

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

VOC

Estimated Reductions (tpd)	NA
Estimated Reductions (tpy)	NA

Assumptions/Emission Reductions

· Sources such as www.wastediversion.org estimate that trees can remove up to 60 lbs/year of pollutants from the air.

·Ozone = more than 1 lb annually per tree

·Nitrogen Dioxide = more than 2 lbs annually per tree

· While quanitification depends on the number, age, and type of trees planted, this strategy will serve to benefit the environment as well as make the urban areas more esthetically pleasing.

Implementation Schedule and Status

· This measure involves an area-wide comprehensive tree-planting program with the goal of reducing concentrations of certain pollutants including ozone and NOx. Roanoke City and Vinton have both expressed support for this initiative. Roanoke City expects to plant 500 trees this year.

'· Progress to Date: Vinton has planted 30 trees and 30 seedlings. The county of Roanoke has committed to plant 100 trees and is in the process of doing so. Roanoke City has also committed to planting trees, and is in the process of doing so.

Measure 19: Roanoke to Blacksburg Public Transit

Measure Number: 19
Measure Name: Roanoke to Blacksburg Public Transit

Description:
Establishment of a bus route from Roanoke to Blacksburg (VA Tech).

NOx

Estimated Reductions (tpd)	0.004
Estimated Reductions (tpy)	0.923

Issues

· Valley Metro will fund the program for the first three years.

VOC

Estimated Reductions (tpd)	0.009
Estimated Reductions (tpy)	2.32

Assumptions

· New bus route from Roanoke to Blacksburg and points in between will reduce vehicle trips within compact area.
· Established and began in August 2004.
· Transportation estimates for a three year life span are:
  · 2.77 tons of NOx benefit
  · 6.96 tons of VOC benefit
· Assume operation is 5 days/week, 52 weeks year (260 days/year)

Emission Reductions

Total NOx Reduced Annually= 2.77 tons NOx benefit/3 year life span
Total NOx Reduced= 0.923 tons/yr
Total NOx Reduced Daily= 0.92 tons/yr * 1 year/260 days
Total NOx Reduced= 0.004 tons/day

Total VOC Reduced Annually= 6.96 tons VOC benefit/3 year life span
Total VOC Reduced= 2.32 tons/yr
Total VOC Reduced Daily= 2.32 tons/yr * 1 year/260 days
Total VOC Reduced= 0.009 tons/day

Implementation Schedule and Status

· The bus route is established and began in August 2004. The Ride Solutions Coordinator for the Regional Commission has conducted a survey of ridership satisfaction and demand over three months to review how the service is being received. These findings will be presented in a joint MPO meeting between the Roanoke region and the New River Valley region. The bus has received a lot of good feedback and responses. Ride Solutions has also coordinated with Valley Metro to share advertising and clean commuting messages. This program is considered fully implemented.

Measure 20: Replacement of Gasoline Golf Carts w/Electric Carts

Measure Number: 20

Measure Name: Replacement of Gasoline Golf Carts w/Electric Carts

Description:

Replacement of 100 gas carts with electric carts.

CO

Estimated Reductions (tpd)	0.010
Estimated Reductions (tpy)	1.60

VOC + NOx

Estimated Reductions (tpd)	3.80E-04
Estimated Reductions (tpy)	0.061

Issues

· Electric carts appear somewhat less expensive than gasoline counterparts.

· Golf courses will have some capital investment requirements to convert facilities to support he use of electric equipment.

Assumptions

· Purchase and replacement of 100 carts.
· Emissions from replaced vehicles equivalent to standards for nonroad spark ignition engines of 25 hp and below
· EPA420-F-97-014 "Emission Standards Reference Guide for Heavy-Duty and Nonroad Engines"
· Emission factors from above document indicate gasoline engines must meet the following standards:
  · Nonmethane hydrocarbons + NOx = 17.2 grams/bhp-hr
  · CO = 455 grams/bhp-hr
· Assume each cart is approximately 5 hp.
· Assume 4 hours/day of use, 4 days/week, 40 weeks/year.

Emission Reductions

Total CO Reduced= 455 gr/bhp-hr * 5 hp * 4 hr/day/906,000 grams per ton
Total CO Reduced= 0.010 tons/day
Total CO Reduced= 1.60 tons/year

Total NOx + VOC Reduced= 17.2 gr/bhp-hr * 5 hp * 4 hr/day/906,000 grams per ton
Total NOx + VOC Reduced= 3.80E-04 tons/day
Total NOx + VOC Reduced= 0.061 tons/year

Implementation Schedule and Status

· This project is on track for 2005 implementation.

Measure 21: Gasoline Powered Lawnmower Buyback Program

Measure Number: 21
Measure Name: Gasoline Powered Lawnmower Buyback Program

Description:

Offer cash for consumers to turn in lawnmowers and purchase electric or push mowers

NOx

Estimated Reductions (tpd)	0.001
Estimated Reductions (tpy)	0.248

VOC

Estimated Reductions (tpd)	0.017
Estimated Reductions (tpy)	3.57

Issues

· Estimate of benefits is very dependent upon number of 2-stroke lawnmowers turned in. 2-stroke lawnmowers deliver far greater reductions than 4-stroke mowers.

Assumptions

· Measure would assume the removal of 1000 gas powered mowers per year.
· Assume all removed are 4 stroke engines.
· From EPA nonroad equipment study (November 1991), the
  · Average 2-stroke lawnmower operates 27-73 hours per year (assume 50 hrs) at 36% load
  · Average 4-stroke lawnmower operates 33-91 hours per year (assume 60 hrs) at 50% load
· Assume average lawnmower has a 4 hp engine = 3 kW
· From "Exhaust Emission Effects of Fuel Sulfur and Oxygen on Gasoline Nonroad Engines" (EPA Report NR-003, November 1997), 12 4-stroke lawnmowers tested with engines <= 5.5 hp averaged 36.0 g/kW-hr HC emissions and 2.5 g/kW-hr NOx emissions.

· Staff has been unable to find credible data regarding emission rates from 2-stroke lawnmowers. As a proxy, use EPA study of 2-stroke moped from above study
  · 183.6 g/kW-hr HC
  · 2.44 g/kW-hr NOx
· Program costs would be $50 per mower.
· Assume 100% emission reduction for each mower turned in
· Ozone season lasts 153 days
· Mowers operate April - October = 214 days per year

Emission Reductions: 2-Stroke Engines

Annual Reductions (VOC) = 183.6 g/kW-hr HC * 3 kW * 50 hours * 36% load * 0 engines / 906,000 grams per ton
Annual Reductions (VOC) = 0.000 tpy VOC

Daily Reductions (VOC) = 0.0 tons per yr / 214 days of operation per year
Daily Reductions (VOC) = 0.000 tpd VOC

Annual Reductions (NOx) = 2.44 g/kW-hr NOx * 3 kW * 50 hours * 36% load * 0 engines / 906,000 grams per ton
Annual Reductions (NOx) = 0.000 tpy NOx

Daily Reductions (NOx) = 0.0 tons per yr / 214 days of operation per year
Daily Reductions (NOx) = 0.000 tpd NOx

Emission Reductions: 4-Stroke Engines

Annual Reductions (VOC) = 36.0 g/kW-hr HC * 3 kW * 60 hours * 50% load * 1,000 engines / 906,000 grams per ton
Annual Reductions (VOC) = 3.57 tpy VOC

Daily Reductions (VOC) = 3.6 tons per yr / 214 days of operation per year
Daily Reductions (VOC) = 0.017 tpd VOC

Annual Reductions (NOx) = 2.5 g/kW-hr NOx * 3 kW * 60 hours * 50% load * 1,000 engines / 906,000 grams per ton
Annual Reductions (NOx) = 0.248 tpy NOx

Daily Reductions (NOx) = 0.2 tons per yr / 214 days of operation per year
Daily Reductions (NOx) = 0.001 tpd NOx

Implementation Schedule and Status

· Area is on track for securing a funding source, and the implementation schedule is to begin this program in December, 2005.

Measure 22: Lawn & Garden Equipment Use Restrictions: Voluntary Episodic

Measure Number: 22

Measure Name: Lawn & Garden Equipment Use Restrictions: Voluntary Episodic

Description:

Voluntary moratorium on operation of residential and local business lawn & garden equipment on Ozone Action Days

NOx

Estimated Reductions (tpd)	0.016
Estimated Reductions (tpy)	0.049

VOC

Estimated Reductions (tpd)	0.072
Estimated Reductions (tpy)	0.217

Assumptions

· Measure will have 3% compliance rate

· From 2007 non-road inventory for the Roanoke EAC area, emissions from residential/commercial lawn & garden equipment will be:

  · 2.41 tons VOC

  · 0.54 tons NOx

· Region has averaged 3 8-hour exceedence days for 2002-2003

Emission Reductions

Daily Reductions (NOx) = 0.54 tpd * 3% compliance

Daily Reductions (NOx) = 0.016 tpd NOx

Annual Reductions (NOx) = 0.02 tpd * 3 8-hour exceedence days per year

Annual Reductions (NOx) = 0.049 tpy NOx

Daily Reductions (VOC) = 2.41 tpd * 3% compliance

Daily Reductions (VOC) = 0.072 tpd VOC

Annual Reductions (VOC) = 0.07 tpd * 3 8-hour exceedence days per year

Annual Reductions (VOC) = 0.217 tpy VOC

Implementation Schedule and Status

· This program is on track for implementation at the end of 2005. Marketing and talks with various private organizations are expected to yield results in this time frame.

Measure 23: Lawn & Garden Equipment Use Restrictions: Mandatory for State & Local Jobs

Measure Number: 23

Measure Name: Lawn & Garden Equipment Use Restrictions: Mandatory for State & Local Jobs

Description:

Ban use of lawn & garden equipment on state and local projects during Ozone Action Days

NOx

Estimated Cost ($/ton)	
Estimated Reductions (tpd)	0.094
Estimated Reductions (tpy)	0.282

Issues

VOC

Estimated Cost ($/ton)	
Estimated Reductions (tpd)	0.366
Estimated Reductions (tpy)	1.10

Assumptions

· Measure will have 80% compliance rate

· From 2007 Roanoke EAC area non-road emissions inventory, emissions from commercial lawn mowers and lawn tractors will be:

  · 1.83 tons VOC

  · 0.47 tons NOx

· Region averaged 3 8-hour exceedence days for 2002-2003.

· Assume 25% of commercial emissions are from state and local jobs.

Emission Reductions

Daily Reductions (NOx) = 0.47 tpd * 80% compliance * 25% of emissions from state/local

Daily Reductions (NOx) = 0.094 tpd NOx

Annual Reductions (NOx) = 0.09 tpd * 3 8-hour exceedence days per year

Annual Reductions (NOx) = 0.282 tpy NOx

Daily Reductions (VOC) = 1.83 tpd * 80% compliance * 25% of emissions from state/local

Daily Reductions (VOC) = 0.366 tpd VOC

Annual Reductions (VOC) = 0.37 tpd * 3 8-hour exceedence days per year

Annual Reductions (VOC) = 1.10 tpy VOC

Implementation Schedule and Status

· This program has been implemented as an administrative policy at all local governments and applicable state agencies.

Measure 24: Open Burning Bans/Restrictions

Measure Number: 24
Measure Name: Open Burning Bans/Restrictions

Description:
Several jurisdictions have adopted local rules restricting or prohibiting open burning. Other localities will ban open burning during predicted high ozone days.

NOx

Estimated Reductions (tpd)	0.240
Estimated Reductions (tpy)	0.720

VOC

Estimated Reductions (tpd)	0.560
Estimated Reductions (tpy)	1.68

Issues

· Measure is enforced by local fire marshals

Assumptions

· Assume 80% effectiveness of ban.
· Average of 3 high exceedence days for 2002-2003.
· 2007 Roanoke EAC area inventory shows 0.7 tpd VOC emissions and 0.3 tpd NOx emissions.

Emission Reductions

Uncontrolled VOC Emissions = 0.70 tpd VOC
@ 80% compliance = 0.14 tpd VOC
Total Reductions = 0.560 tpd VOC

Annual Reductions (VOC) = 0.56 tpd * 3 days per ozone season
Annual Reductions (VOC) = 1.68 tpy VOC

Uncontrolled NOx Emissions = 0.300 tpd NOx
@ 80% compliance = 0.060 tpd NOx
Total Reductions = 0.240 tpd NOx

Annual Reductions (NOx) = 0.24 tpd * 3 days per ozone season
Annual Reductions (NOx) = 0.720 tpy NOx

Implementation Schedule and Status

· Localities have agreed to not grant open burning permits for days with predicted high ozone concentrations.

Measure State #1: Stage I Vapor Recovery

Measure Number: State #1
Measure Name: Stage I Vapor Recovery

Description:
Applies balanced submerged underground storage tank refilling at gasoline stations in the Roanoke Area. State regulation requires this control in Roanoke city, Roanoke county, and Salem.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

Issues

· Requirements began in 1999.
· Requirements do not apply to Botetourt County.

VOC

Estimated Reductions (tpd)	1.756
Estimated Reductions (tpy)	640.9

Assumptions

· The area source emissions inventory for the city of Roanoke, the county of Roanoke, and the city of Salem show uncontrolled emissions from underground storage tank refilling to be 1.951 tons/day without control in year 2007.
· Estimate includes uncontrolled tank filling, working, and breathing losses.
· Assume a 90% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.951 tons/day * 90% control efficiency
Daily VOC Reductions = 1.756 tpd VOC
Annual VOC Reductions = 1.951 tons/day * 90% control efficiency*365 days/year
Annual VOC Reductions = 640.9 tpy VOC

Implementation Schedule and Status

· This program has been fully implemented in the city of Roanoke, the county of Roanoke, and the city of Salem since 1999.

Measure State #13: CTG RACT

Measure Number: State #13
Measure Name: CTG RACT

Description:
Applies CTG RACT for NOx and VOC to selected point and area sources in the Roanoke area.

NOx

Estimated Reductions (tpd)	0.790
Estimated Reductions (tpy)	287.5

VOC

Estimated Reductions (tpd)	0.936
Estimated Reductions (tpy)	355.5

Issues

· Requirements will be in state regulations by 2005.

Assumptions

· The emissions inventory for the area show uncontrolled emissions from these facilities to be 2.029 tons/day VOC and 7.876 tons/day NOx.

· Assume a 10% reduction in emissions of NOx from selected major sources.

· Assume a 50% to 75% reduction in VOC emissions from solvent cleaning and graphic arts operations, 60% on average.

· Assume an 80% rule effectiveness for the VOC RACT requirements.

Emission Reductions

Daily NOx Reductions = 7.876 tons/day * 10% control efficiency
Daily NOx Reductions = 0.79 tpd NOx
Annual NOx Reductions = 7.876 tons/day * 10% control efficiency * 365 days/year
Annual NOx Reductions = 287.5 tpy NOx

Daily VOC Reductions = 2.029 tons/day * 60% control efficiency * 80% RE
Daily VOC Reductions = 0.936 tpd VOC
Annual VOC Reductions = 2.029 tons/day * 60% control efficiency * 80% RE * 365 days/year
Annual VOC Reductions = 355.5 tpy VOC

Implementation Schedule and Status

· This program will be required by state regulation beginning in 2005.

Measure State #6: State Cutback Asphalt Regulation

Measure Number: State #6
Measure Name: State Cutback Asphalt Regulation

Description:
This measure involves the restriction of the use of cutback asphalt in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.005
Estimated Reductions (tpy)	1.75

Assumptions

· The emission inventory for the Roanoke area show uncontrolled emissions from this source category is 0.006 tons VOC/day.

· Assume a 100% control efficiency, and an 80% rule effectiveness.

Emission Reductions

Daily VOC Reductions = 0.006 tons/day * 100% control efficiency * 80% RE
Daily VOC Reductions = 0.005 tpd VOC
Annual VOC Reductions = 0.006 tons/day * 100% control efficiency * 80% RE * 365 days/year
Annual VOC Reductions = 1.75 tpy VOC

Implementation Schedule and Status

This program will be required by state regulation beginning in 2005.

Measure Federal #7: Federal Small Gasoline Engine Standards

Measure Number: Federal #7
Measure Name: Federal Small Gasoline Engine Standards

Description:

This measure involves EPA's establishment of engine emission standards for small spark ignition gasoline powered nonroad engines. These engine standards have been implemented in two phases by EPA and covers both handheld and nonhandheld equipment.

NOx

Estimated Reductions (tpd)	0.059
Estimated Reductions (tpy)	21.5

VOC

Estimated Reductions (tpd)	1.68
Estimated Reductions (tpy)	613.2

Assumptions

· Emissions calculations provided originate from Mobile6 modeling of the Early Action Compact area.

Emission Reductions

VOC Calculations

EMISSIONS SCENARIO	VOC EMISSIONS
2002 Base Year	3.651 tpd
2007 w/o control	4.034 tpd
2007 w/ control	2.353 tpd
Total daily VOC reductions:	*1.68 tpd VOC*
Total annual VOC reductions:	*Total daily reductions * 365 days/year =* *613.2 tpy VOC*

NOx Calculations

EMISSIONS SCENARIO	NOx EMISSIONS
2002 Base Year	0.315 tpd
2007 w/o control	0.348 tpd
2007 w/ control	0.289 tpd
Total daily NOx reductions:	*0.059 tpd NOx*
Total annual NOx reductions:	*Total daily reductions * 365 days/year =* *21.5 tpy VOC*

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal #8: Federal Nonroad Diesel Engine Standards

Measure Number: Federal #8
Measure Name: Federal Nonroad Diesel Engine Standards

Description:
This measure involves emission reductions from EPA emission standards for nonroad compression-ignition (diesel powered) utility engines. This measure affects diesel powered construction equipment, industrial equipment and other equipment rated at or above 37 kilowatts (about 50 horsepower).

NOx

Estimated Reductions (tpd)	0.969
Estimated Reductions (tpy)	353.7

VOC

Estimated Reductions (tpd)	0.158
Estimated Reductions (tpy)	57.7

Assumptions

· Emissions calculations provided originate from Mobile6 modeling of the Early Action Compact area.

Emission Reductions

VOC Calculations

EMISSIONS SCENARIO	VOC EMISSIONS
2002 Base Year	0.479 tpd
2007 w/o control	0.559 tpd
2007 w/ control	0.401 tpd
Total daily VOC reductions:	*0.158 tpd VOC*
Total annual VOC reductions:	*Total daily reductions * 365 days/year =* *57.7 tpy VOC*

NOx Calculations

EMISSIONS SCENARIO	NOx EMISSIONS
2002 Base Year	3.927 tpd
2007 w/o control	4.579 tpd
2007 w/ control	3.610 tpd
Total daily NOx reductions:	*0.969 tpd NOx*
Total annual NOx reductions:	*Total daily reductions * 365 days/year =* *353.7 tpy VOC*

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal #9: Federal Locomotive Engine Standards

Measure Number: Federal #9
Measure Name: Federal Locomotive Engine Standards

Description:
This measure involves NOx emission standards for locomotive engines manufactured or remanufactured after 2001. This program includes all locomotives originally manufactured from 2002 to 2004, and it also includes the remanufacture of all engines built since 1973.

NOx

Estimated Reductions (tpd)	1.11
Estimated Reductions (tpy)	405.8

VOC

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

Assumptions

· The emission inventory for the Roanoke area shows uncontrolled emissions from these sources are 2.647 tons NOx/day uncontrolled in 2007.

· Assume a 42% control efficiency.

Emission Reductions

Daily NOx Reductions = 2.647 tons/day * 42% control efficiency
Daily NOx Reductions = 1.11 tpd NOx
Annual NOx Reductions = 2.647 tons/day * 42% control efficiency*365 days/year
Annual NOx Reductions = 405.8 tpy NOx

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal #10: Federal Large Gasoline Engine Standards

Measure Number: Federal #10

Measure Name: Federal Large Gasoline Engine Standards

Description:

This measure involves emission standards for large industrial spark-ignition engines, recreational vehicles, and diesel marine engines.

NOx

Estimated Reductions (tpd)	0.546
Estimated Reductions (tpy)	199.3

VOC

Estimated Reductions (tpd)	0.146
Estimated Reductions (tpy)	53.3

Assumptions

· Emissions calculations provided originate from Mobile6 modeling of the Early Action Compact area.

Emission Reductions

VOC Calculations

EMISSIONS SCENARIO	VOC EMISSIONS
2002 Base Year	0.299 tpd
2007 w/o control	0.352 tpd
2007 w/ control	0.206 tpd
Total daily VOC reductions:	*0.146 tpd VOC*
Total annual VOC reductions:	*Total daily reductions * 365 days/year =* *53.3 tpy VOC*

NOx Calculations

EMISSIONS SCENARIO	NOx EMISSIONS
2002 Base Year	1.08 tpd
2007 w/o control	1.271 tpd
2007 w/ control	0.725 tpd
Total daily NOx reductions:	*0.546 tpd NOx*
Total annual NOx reductions:	*Total daily reductions * 365 days/year =* *199.3 tpy VOC*

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal #11: Federal Spark Ignition Marine Engine Standards

Measure Number: Federal #11
Measure Name: Federal Spark Ignition Marine Engine Standards

Description:
This measure involves VOC emission standards for spark ignition marine engines including outboard engines, personal watercraft engines, and jet boat engines.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.015
Estimated Reductions (tpy)	5.48

Assumptions

· Emissions calculations provided originate from Mobile6 modeling of the Early Action Compact area.

Emission Reductions

VOC Calculations

EMISSIONS SCENARIO	VOC EMISSIONS
2002 Base Year	0.059 tpd
2007 w/o control	0.061 tpd
2007 w/ control	0.046 tpd

Total daily VOC reductions: *0.015 tpd VOC*

Total annual VOC reductions: *Total daily reductions * 365 days/year =* *5.48 tpy VOC*

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal #12: Federal Onroad Motor Vehicle Emissions Standards

Measure Number: Federal #12

Measure Name: Federal Onroad Motor Vehicle Emissions Standards

Description:

The following national motor vehicle emission reduction measures have or will be implemented that will reduce mobile source emissions in the Roanoke area. These measures include:

* Federal Tier 1 Vehicle Standards
* National Low Emissions Vehicle Standards
* Federal Tier 2 Vehicle & Low Sulfur Fuel Standards
* Heavy Duty Diesel Engine Standards

NOx

Estimated Reductions (tpd)	11.6
Estimated Reductions (tpy)	4217.6

VOC

Estimated Reductions (tpd)	7.26
Estimated Reductions (tpy)	2650.3

Assumptions

· The following calculations are based on the EPA Mobile6 emissions model for this area of Virginia.

Emission Reductions

VOC Calculations

EMISSIONS SCENARIO	VOC EMISSIONS
1999 Base Year	18.074 tpd
2007 w/ Tier 1 & NLEV	11.732 tpd
2007 w/ Tier 1&2, NLEV	10.815 tpd
2007 w/ Tier 1&2, NLEV, & HDDV	10.814 tpd

Total daily VOC reductions: *7.261 tpd VOC*

Total annual VOC reductions: *Total daily reductions * 365 days/year =* *2650.3 tpy VOC*

NOx Calculations

EMISSIONS SCENARIO	NOx EMISSIONS
1999 Base Year	31.036 tpd
2007 w/ Tier 1 & NLEV	23.436 tpd
2007 w/ Tier 1&2, NLEV	19.637 tpd
2007 w/ Tier 1&2, NLEV, & HDDV	19.481 tpd

Total daily NOx reductions: *11.555 tpd NOx*

Total annual NOx reductions: *Total daily reductions * 365 days/year =* *4217.6 tpy VOC*

Implementation Schedule and Status

Federal implementation schedule.

Measure Federal Measure #13: Federal AIM Rule

Measure Number: Federal Measure #13
Measure Name: Federal AIM Rule

Description:
This measure involves the federal rule for Architectural and Industrial Maintenance (AIM) coatings, which restricts the VOC content of architectural, industrial maintenance, special industrial, and highway markings surface coatings sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.382
Estimated Reductions (tpy)	139.6

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.912 tons VOC/day.

· Assume a 20% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.912 tons/day * 20% control efficiency
Daily VOC Reductions = 0.382 tpd VOC
Annual VOC Reductions = 1.912 tons/day * 20% control efficiency*365 days/year
Annual VOC Reductions = 139.6 tpy VOC

Implementation Schedule and Status

· Federal measure.

Measure Federal #14: Federal Consumer/Commercial Products

Measure Number: Federal #14
Measure Name: Federal Consumer/Commercial Products

Description:
This measure involves the federal rule for commercial and consumer products, which restricts the VOC content of these products sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.179
Estimated Reductions (tpy)	65.2

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.785 tons VOC/day.

· Assume a 10% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.785 tons/day * 10% control efficiency
Daily VOC Reductions = 0.179 tpd VOC
Annual VOC Reductions = 1.785 tons/day * 10% control efficiency*365 days/year
Annual VOC Reductions = 65.2 tpy VOC

Implementation Schedule and Status

· Federal measure.

Measure Federal #15: Metal Cleaning Solvent Controls

Measure Number: Federal #15
Measure Name: Metal Cleaning Solvent Controls

Description:
This measure involves the federal rule for metal cleaning solvents, which restricts the VOC content of these solvents sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.163
Estimated Reductions (tpy)	59.6

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.632 tons VOC/day.

· Assume a 10% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.632 tons/day * 10% control efficiency
Daily VOC Reductions = 0.1632 tpd VOC
Annual VOC Reductions = 1.632 tons/day * 10% control efficiency*365 days/year
Annual VOC Reductions = 59.6 tpy VOC

Implementation Schedule and Status

· Federal measure.

Measure Federal #16: Motor Vehicle Refinishing Paint

Measure Number: Federal #16
Measure Name: Motor Vehicle Refinishing Paint

Description:
This measure involves the federal rule for motor vehicle refinishing paint, which restricts the VOC content of these paints sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.159
Estimated Reductions (tpy)	58.2

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 0.443 tons VOC/day.

· Assume a 36% control efficiency.

Emission Reductions

Daily VOC Reductions = 0.443 tons/day * 36% control efficiency
Daily VOC Reductions = 0.159 tpd VOC
Annual VOC Reductions = 0.443 tons/day * 36% control efficiency*365 days/year
Annual VOC Reductions = 58.2 tpy VOC

Implementation Schedule and Status

· Federal measure.

Measure Contingency #1: OTC AIM Rule

Measure Number: Contingency #1
Measure Name: OTC AIM Rule

Description:
This measure involves the adoption of the OTC rule for Architectural and Industrial Maintenance (AIM) coatings, which restricts the VOC content of architectural, industrial maintenance, special industrial, and highway markings surface coatings sold and used in the area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.474
Estimated Reductions (tpy)	173.1

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.530 tons VOC/day.

· Assume a 31% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.530 tons/day * 31% control efficiency
Daily VOC Reductions = 0.474 tpd VOC
Annual VOC Reductions = 1.530 tons/day * 31% control efficiency*365 days/year
Annual VOC Reductions = 173.1 tpy VOC

Implementation Schedule and Status

· Contingency measure.

Measure Contingency #2: OTC Consumer/Commercial Products

Measure Number: Contingency #2
Measure Name: OTC Consumer/Commercial Products

Description:
This measure involves the OTC rule for commercial and consumer products, which restricts the VOC content of these products sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.228
Estimated Reductions (tpy)	83.3

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.607 tons VOC/day.

· Assume a 14% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.607 tons/day * 14.2% control efficiency
Daily VOC Reductions = 0.228 tpd VOC
Annual VOC Reductions = 1.607 tons/day * 14.2% control efficiency*365 days/year
Annual VOC Reductions = 83.3 tpy VOC

Implementation Schedule and Status

· Contingency measure.

Measure Contingeny #3: OTC Metal Cleaning Solvent Controls

Measure Number: Contingeny #3
Measure Name: OTC Metal Cleaning Solvent Controls

Description:
This measure involves the OTC rule for metal cleaning solvents, which restricts the VOC content of these solvents sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.970
Estimated Reductions (tpy)	353.9

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 1.469 tons VOC/day.

· Assume a 66% control efficiency.

Emission Reductions

Daily VOC Reductions = 1.469 tons/day * 66% control efficiency
Daily VOC Reductions = 0.9695 tpd VOC
Annual VOC Reductions = 1.469 tons/day * 66% control efficiency*365 days/year
Annual VOC Reductions = 353.9 tpy VOC

Implementation Schedule and Status

· Contingency measure.

Measure Contingency #4: OTC Motor Vehicle Refinishing Paint

Measure Number: Contingency #4
Measure Name: OTC Motor Vehicle Refinishing Paint

Description:
This measure involves the OTC rule for motor vehicle refinishing paint, which restricts the VOC content of these paints sold and used in the Roanoke area.

NOx

Estimated Reductions (tpd)	N/A
Estimated Reductions (tpy)	N/A

VOC

Estimated Reductions (tpd)	0.108
Estimated Reductions (tpy)	39.4

Assumptions

· The area source emission inventory for the Roanoke area show uncontrolled emissions from these area sources are 0.284 tons VOC/day.

· Assume a 38% control efficiency.

Emission Reductions

Daily VOC Reductions = 0.284 tons/day * 38% control efficiency
Daily VOC Reductions = 0.108 tpd VOC
Annual VOC Reductions = 0.284 tons/day * 38% control efficiency*365 days/year
Annual VOC Reductions = 39.4 tpy VOC

Implementation Schedule and Status

· Contingency measure.

APPENDIX C

Virginia, West Virginia and Maryland Early Action Compact Modeling Report

Final Report

Virginia Department of Environmental Quality

December 31, 2004

Executive Summary

The purposes of this report are to document the CAMx modeling results for the Early Action Compact (EAC) projects of Virginia, West Virginia and Maryland and to present the calculation of relative reduction factors and future year 8-hour ozone design values associated with monitors in the concerned EAC areas. This modeling project covers five EAC areas in Virginia, West Virginia and Maryland. The Virginia Department of Environmental Quality is the lead agency in conducting this modeling study. The August 8-18, 1999 ozone episode was selected and used for the EAC modeling project. The Comprehensive Air quality Model with extensions version 4.02 (CAMx) model was selected and used for the modeling project. The National Center for Atmospheric Research (NCAR)/ Penn State Mesoscale Model, MM5, was employed to provide spatial and temporal distribution of meteorological fields to the CAMx air quality model. The MM5 simulation was performed with 3 nested domains, with respective grid resolution of 108 km, 36 km, and 12 km. The Sparse Matrix Operator Kernel Emissions (SMOKE) emissions model was used to process emission inventories into the formatted emission files required by the CAMx air quality model.

The CAMx base case model performance has been evaluated using statistical and graphical metrics for both 36 km and 12 km resolution modeling domains. The CAMx photochemical model meets or exceeds established U.S. EPA performance criteria for attainment demonstrations. In some cases such as large urban areas, finer resolution of 4 km grid cells may be required to better account for local emission and ozone variations. However, after further evaluation and discussion, it was decided that 4 km grid resolution for this modeling exercise was not warranted because:

1. This and other regional modeling efforts have shown that there is much less local variation in predicted ozone levels in "rural" areas and that finer resolution is not needed.
2. Local ozone and emissions gradients (variations) in the EAC areas are relatively small.

The 2007 future emission inventories were developed for the modeling domains. The future year CAMx runs were performed with the same model configuration and meteorological fields developed for the base case runs. Relative reduction factors and future year 8-hour ozone design values at four monitors were calculated in accordance with the U.S. EPA's *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS (1999)* and the U.S. EPA's *Protocol for Early Action Compacts (2003)*. The results indicate that the attainment test is passed at all five monitors representing five EAC areas in three states during this modeling episode.

1. Introduction

In December of 2002, the Commonwealth of Virginia, the State of West Virginia, the State of Maryland, along with the local jurisdictions involved, signed and submitted ozone Early Action Compacts (EACs) to the U.S. EPA. The compacts were in turn signed by the EPA to complete the approval process. The purposes of the EACs are to defer the effective date of nonattainment designations for the involved local areas if violations of the 8-hour ozone NAAQS occur in the future. The EACs cover the following geographic areas:

The Roanoke, Virginia Metropolitan Statistical Area (Botetourt County, Roanoke County, Roanoke City, Salem City, and the Town of Vinton)
The Northern Shenandoah Valley Jurisdictions of Frederick County and Winchester City
Washington County, Maryland
Berkley County, West Virginia
Jefferson County, West Virginia

The EAC processes require photochemical dispersion modeling demonstrations to show attainment of the 8-hour ozone standard by December 2007.

The lead agency in the EAC modeling process for the above mentioned EAC areas is the Virginia Department of Environmental Quality (DEQ). Providing assistance to the DEQ are Roanoke/Alleghany Regional Commission (RVARC), local governments, the Maryland Department of Environment, the West Virginia Division of Air Quality, U.S. EPA and the University of North Carolina. The modeling study follows *Air Quality Modeling Analysis for Virginia, West Virginia and Maryland Early Action Ozone Compacts: Modeling Protocol, Episode Selection, and Domain Definition* prepared by Virginia Department of Environmental Quality.

This report documents photochemical modeling study results for 1999 base case and 2007 future case for the EAC areas and demonstrates attainment of the 8-hour ozone standards by all the above mentioned EAC areas by December 2007.

2. Episode Days for Modeling

DEQ recommended eleven episode days for simulations based on the observations of elevated 8-hour ozone concentrations. The episode days are from August 8 to August 18, 1999 wherein high ozone concentrations were measured in the six EAC areas. August 12 and August 13 are selected as primary episode days for 8-hour ozone attainment demonstration.

The ozone episode of August 12-13, 1999 was typical of a regional episode in the area. Eight-hour average ozone concentrations peaked at 85 ppb and 87 ppb at Frederick County and Vinton, Virginia, respectively on August 12th. The eight-hour average at

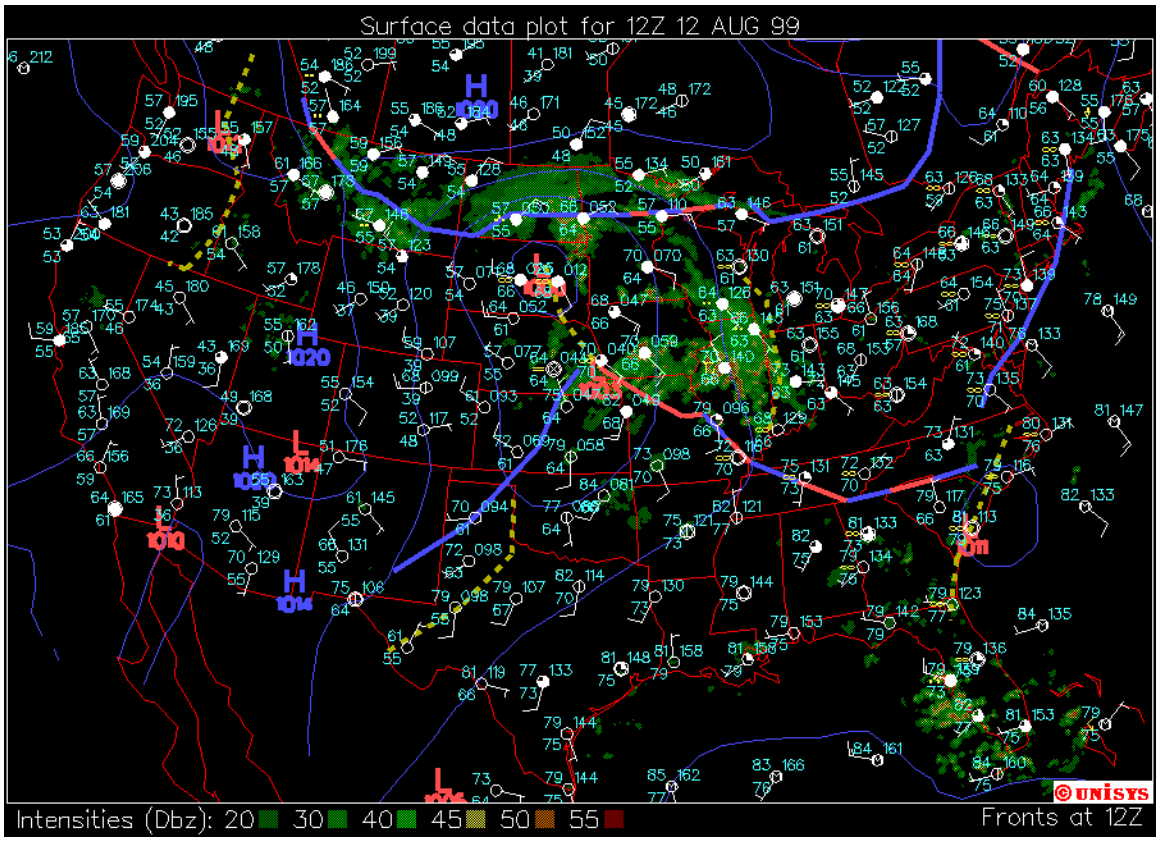
Vinton reached 91 ppb on August 13th. Both concentrations were close to the 2001-2003 eight-hour average design values (85 ppb at both locations). Highest eight-hour averages occurred in Northern Virginia, peaking at 115 ppb on August 12th.

August 12th:

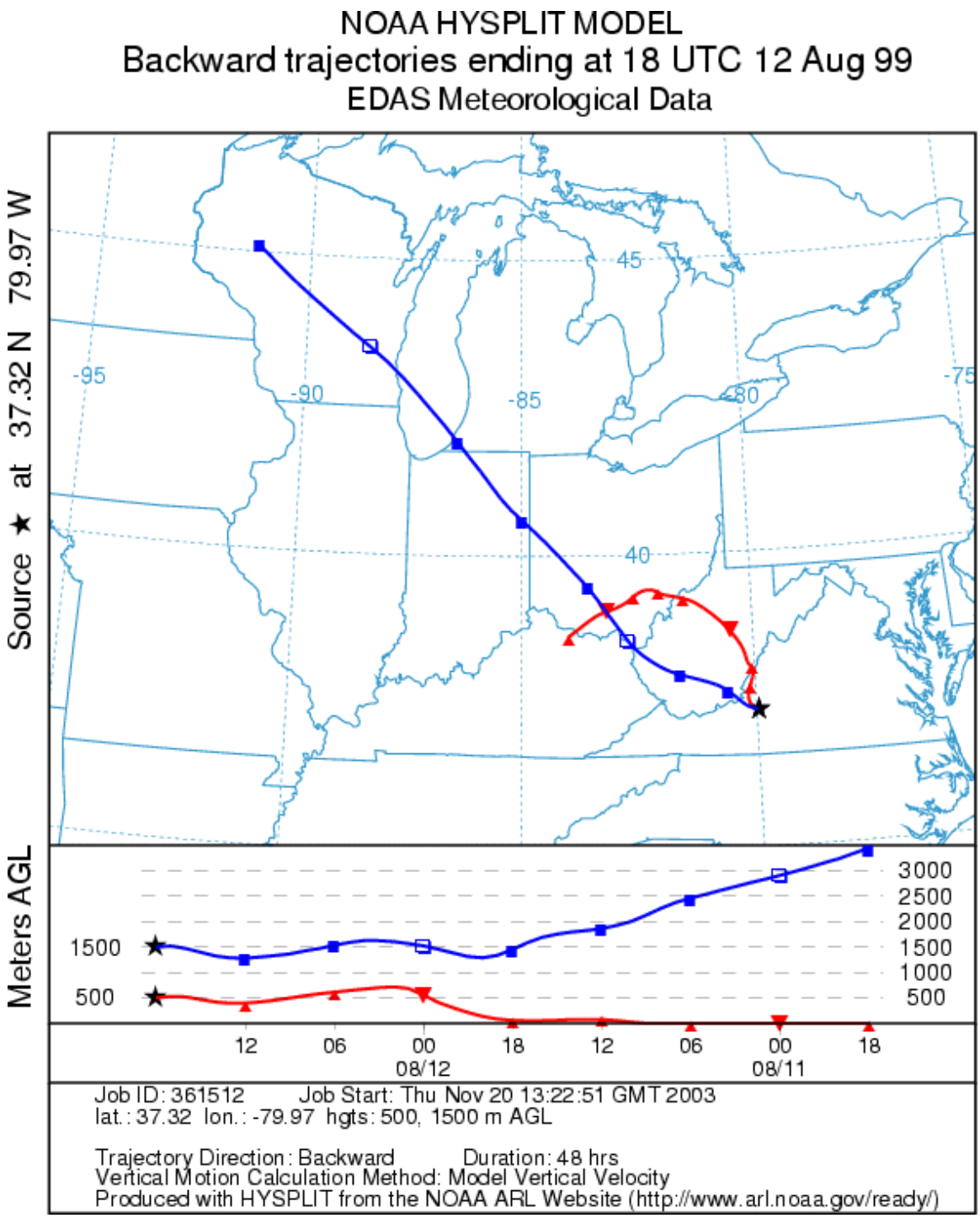
The surface weather map (Figure 2-1) on the morning of August 12th indicated a trough of low pressure extending from coastal New England, through the Delmarva region into central Virginia. South and east of the trough, surface winds were generally from the southeast and higher dew point temperatures, indicative of maritime air. West of the trough, surface winds were calm or light and variable with lower dew point temperatures, indicative of ozone-conducive continental air. Haze ("∞") was reported over a large area from Maine into Tennessee and Georgia. Surface winds remained light into the afternoon. Forty-eight hour 500 and 1500 meter back trajectories for Roanoke and Winchester (18z, 2:00 pm EDT; Figures 2-2 and 2-3) ending that afternoon indicated that air passed over the Ohio River Valley and West Virginia; a typical high ozone, regional air flow pattern. The evening (00z, August 13, 8:00 pm EDT, August 12) surface weather map (Figure 2-4) indicated the trough of low pressure separating maritime from continental air persisted from New England southwestward through Maryland and Richmond, extending into central North Carolina. Maximum temperatures east of the trough were around 90 degrees. West of the trough, high temperatures reached into the low to mid 90s.

August 13th:

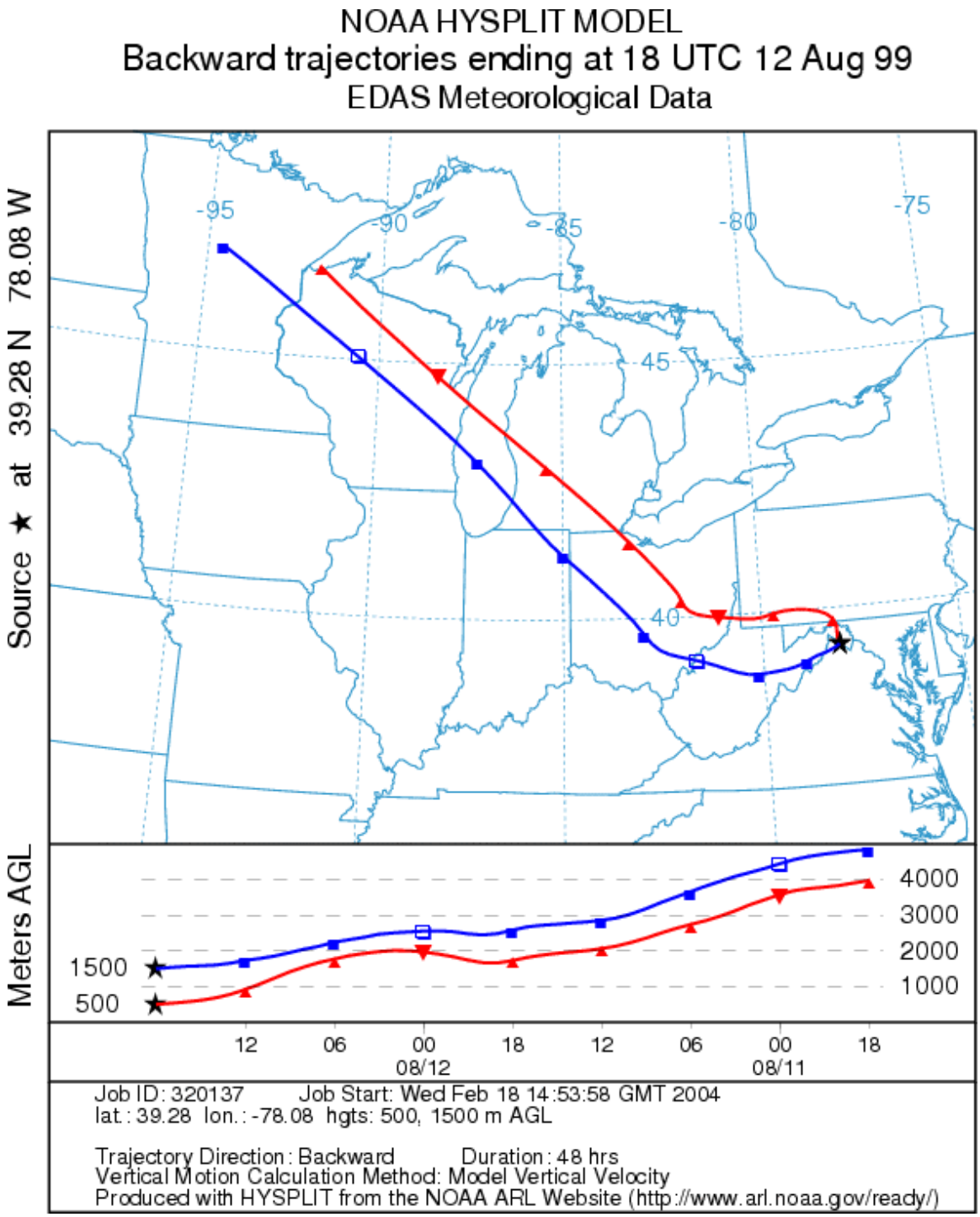
The surface weather map on the morning of August 13th (Figure 2-5) indicated the trough extended from Washington, DC through central Virginia into central North and South Carolina. Again, higher dew point temperatures and southerly winds east of the trough indicated maritime air. Lower dew points and calm winds west of the trough indicated the presence of a continental air mass. Forty-eight hour 500 and 1500 meter back trajectories for Roanoke (Figure 2-6) ending that afternoon originated from the Great Smokey Mountains region of northeastern Tennessee and north central Tennessee, respectively. Forty-eight hour 500 and 1500 meter back trajectories for Winchester ending that afternoon are shown in Figure 2-7. The 500 meter trajectory originated in West Virginia, stagnating and looping over west-central Virginia. The 1500 meter trajectory passed over the Ohio River Valley and West Virginia.. The surface trough separating the maritime air from the continental air persisted into the evening (Figure 2-8). High temperatures reached the mid-to-upper 90s in the region.



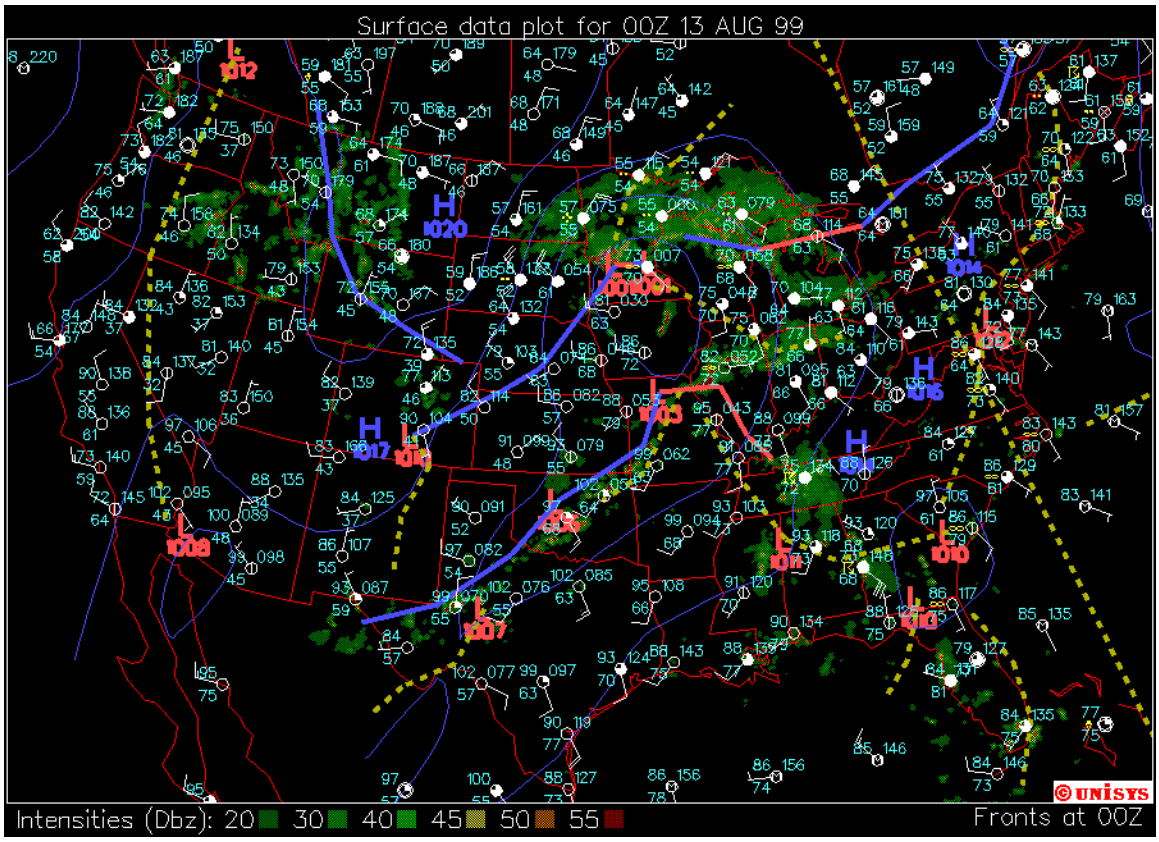
Surface data plot for 12z, August 12, 1999.
Figure 2-1.



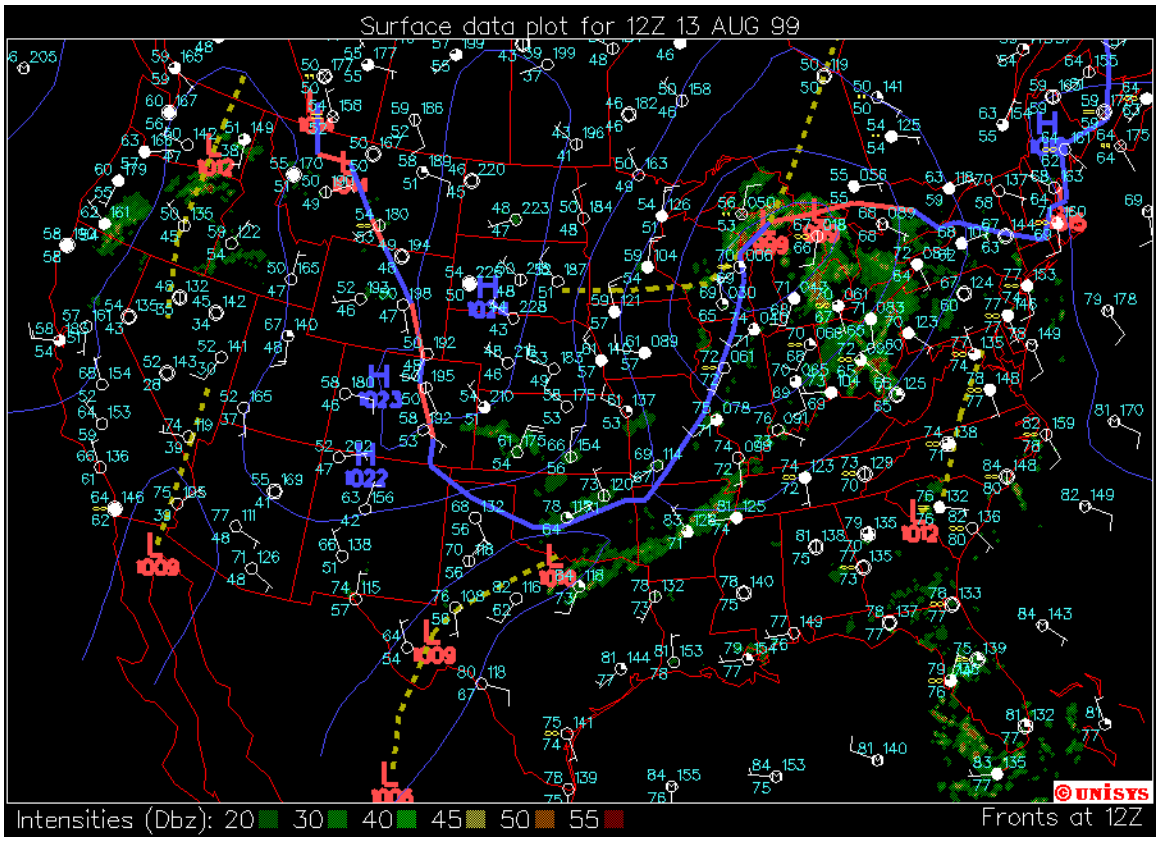
48-hour NOAA HYSPLIT model back trajectory for Roanoke, 18z, August 12, 1999.
Figure 2-2.



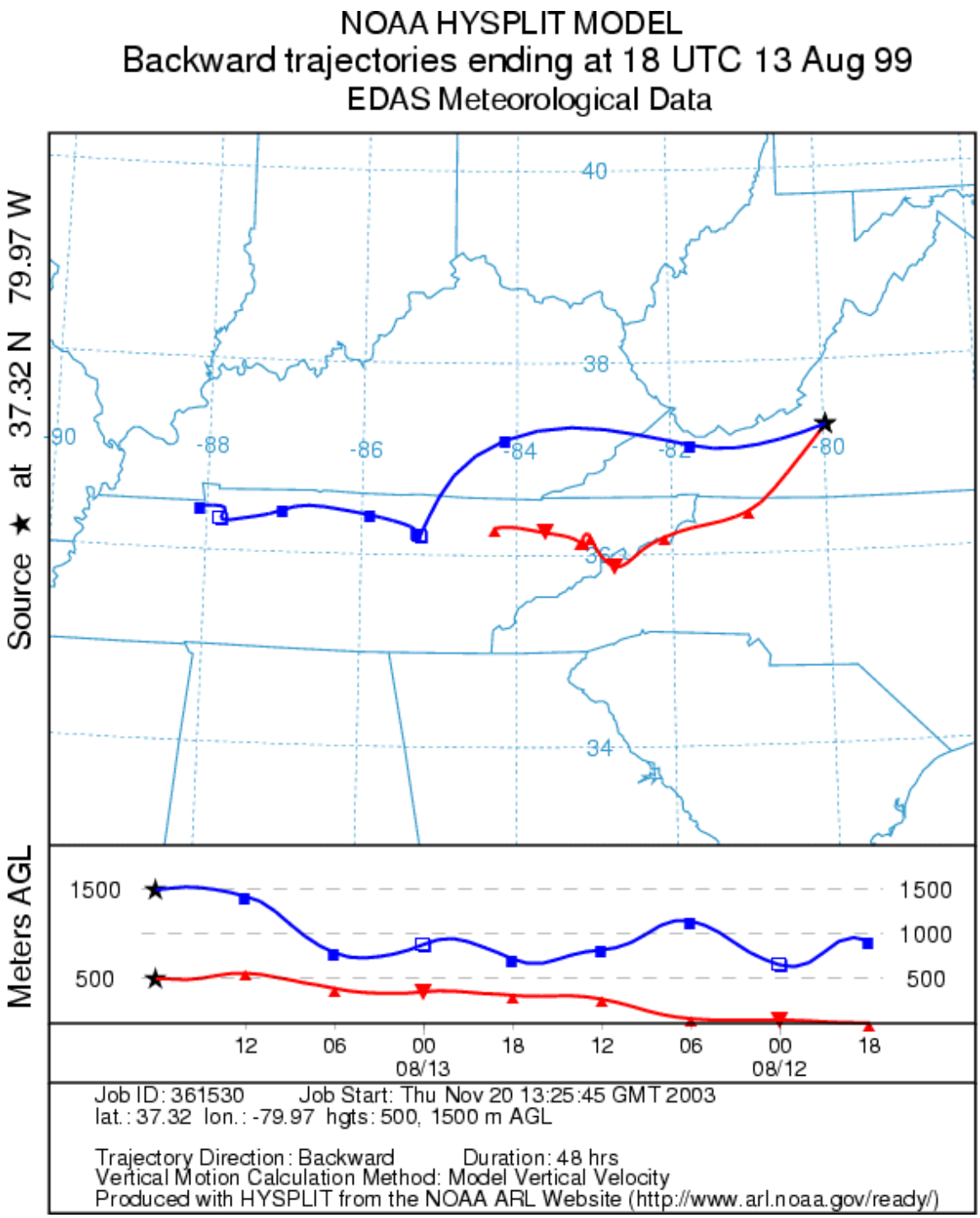
48-hour NOAA HYSPLIT model back trajectory for Winchester, 18z, August 12, 1999.
Figure 2-3.



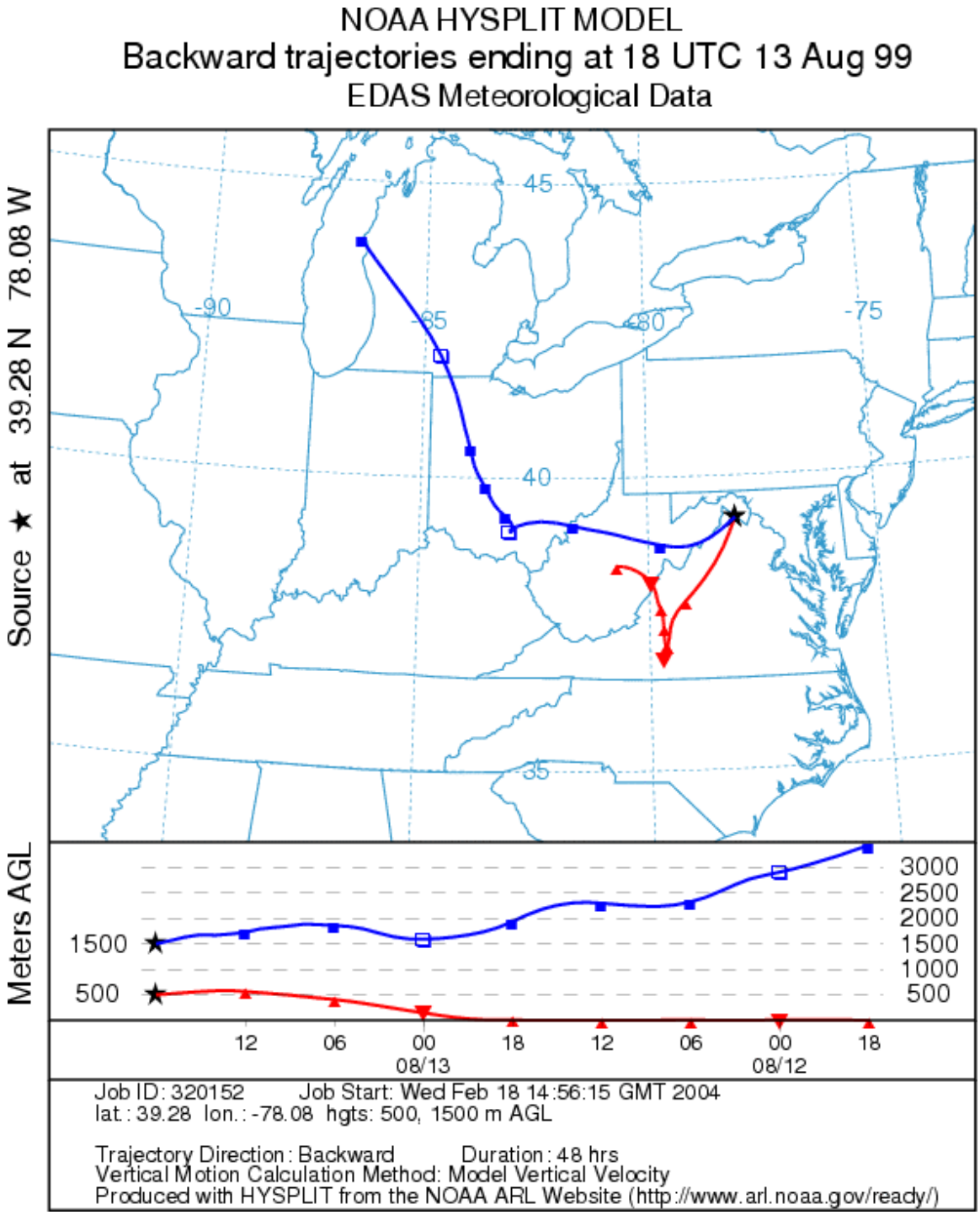
Surface data plot for 00z, August 13, 1999.
Figure 2-4.



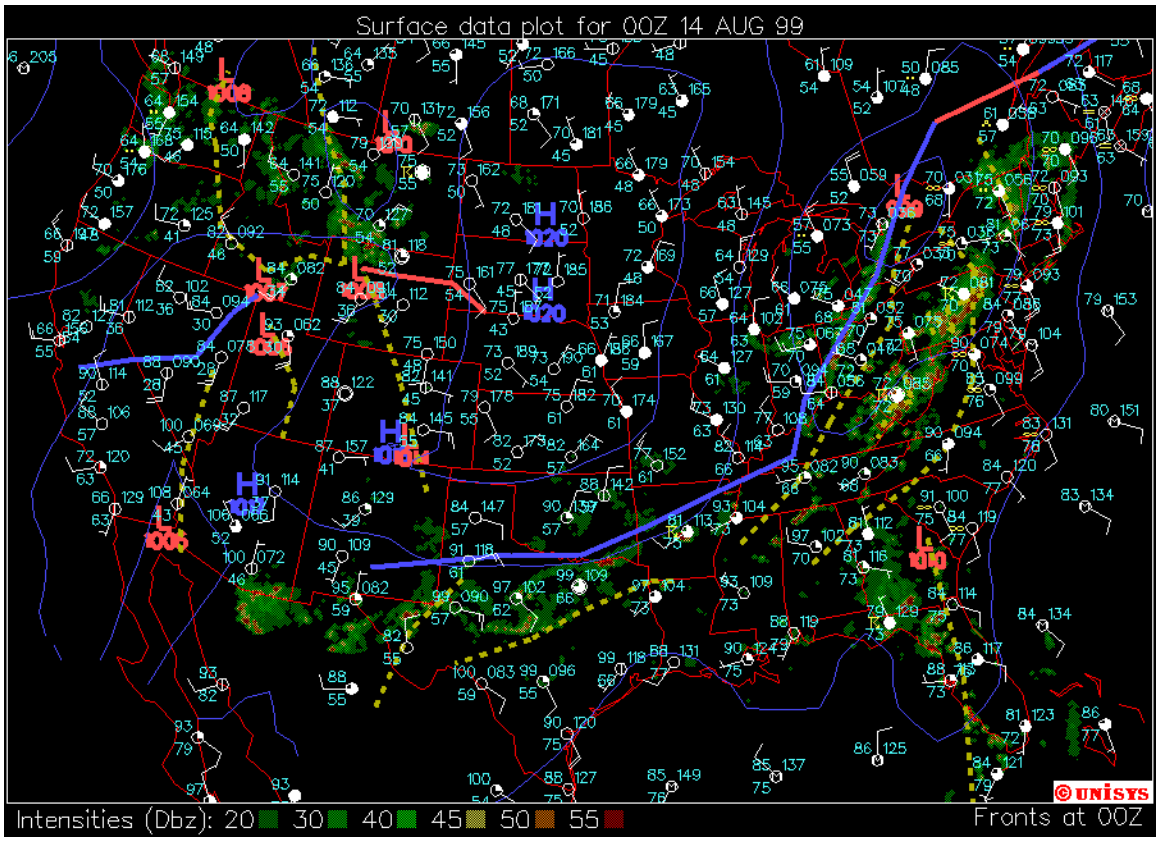
Surface data plot for 12z, August 13, 1999.
Figure 2-5.



48-hour NOAA HYSPLIT model back trajectory for Roanoke, 18z, August 13, 1999.
Figure 2-6.



48-hour NOAA HYSPLIT model back trajectory for Winchester, 18z, August 13, 1999.
Figure 2-7.



Surface data plot for 00z, August 14, 1999.
Figure 2-8.

3. Emission Inventory and Processing

3.1 Emission Inventories

Emission inventories were required for both of the 36 km and the 12 km resolution modeling domains. Base case point source emissions including appropriate stack parameters (stack height, stack diameter, exit temperature and exit velocity), annual county-level area source emissions data including off-road sources, and on-road mobile sources were obtained from the EPA 1999 NEI Version 2 database. The 1999 NEI Version 2 data are in Microsoft Access database format. DEQ developed a converter and converted 1999 NEI Version 2 data into SMOKE IDA format. Biogenic emissions were prepared using SMOKE version 1.5 that includes a version of the Biogenic Emissions Inventory System. DEQ's MM5 meteorological modeling results and existing land use database from previous modeling studies were used for biogenic emissions calculation. The photochemical model ready emissions files were developed for the modeling domains for both the 1999 base year and the 2007 future year. The State of North Carolina provided 2007 future year 2007 emissions inventories. Updated 2007 future-year emission inventories for the EAC areas in Virginia and Maryland were developed by

DEQ and MDE.

3.2 Emissions Processing

The Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system was used to process the EAC emission inventories into the formatted emission files required by the CAMx air quality model. SMOKE supports area, mobile, and point source emission processing and biogenic emissions modeling. The emissions processing used in this EAC modeling study includes the steps of chemical speciation, temporal allocation and spatial allocation of emissions data. These steps are necessary so pollutant data can be converted to chemical model species needed for the CAMx model. These steps also involves converting the county based emissions information to the grid-cell based emissions information and the conversion of daily temporal emissions data to hourly data required by the CAMx model.

The SMOKE model was run for the episode from August 8 to August 18, 1999 using MM5 meteorological modeling results for the same time period. In addition to the temporal allocation of pollutant data, the hourly plume rise was calculated for the point source emissions for CAMx modeling. After the speciation, temporal allocation and spatial allocation processes were finished, emissions data of point, area, mobile and biogenic sources were merged into gridded hourly emissions. Figure 3-1 shows gridded maximum ground level NOx emissions in the 12 km resolution domain during the episode. Figure 3-2 shows gridded maximum NOx emissions at layer 5, which is roughly

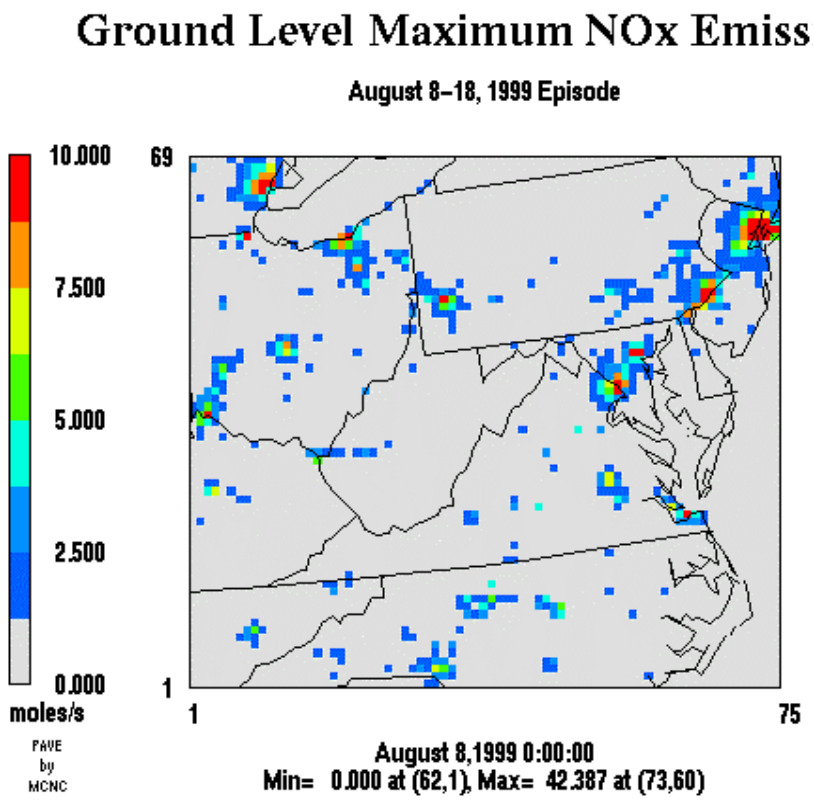


Figure 3-1. Gridded Maximum Ground Level NOx emissions as processed by SMOKE 300 meters above ground level.

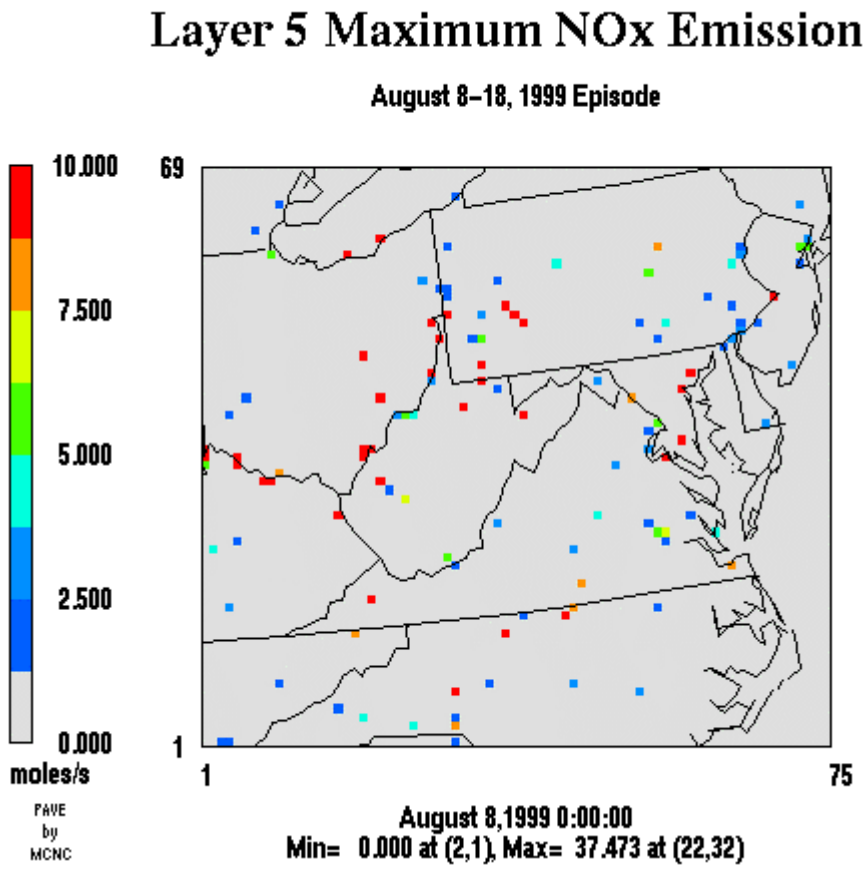


Figure 3-2. Gridded Maximum Layer 5 NOx Emissions

3.3 Biogenic Emissions Modeling

The biogenic emissions were modeled by using SMOKE, which includes a version of the Biogenic Emissions Inventory System 3 (BEIS3) that estimates VOC emissions from vegetation and nitric oxide emissions from soils. Apart from the land use data, the biogenic emissions depend on the meteorological conditions, in particular the air temperature, incoming solar radiation, wind speed and humidity. Those atmospheric variables were provided for each grid cell of the modeling domain by the MM5 simulation results. SMOKE BEIS3 was run for the entire episode from August 8 to August 18, 1999. Figure 3-3 shows gridded maximum biogenic VOC emissions in the 12 km resolution domain. Figure 3-4 shows gridded maximum biogenic NOx in the 12 km resolution domain.

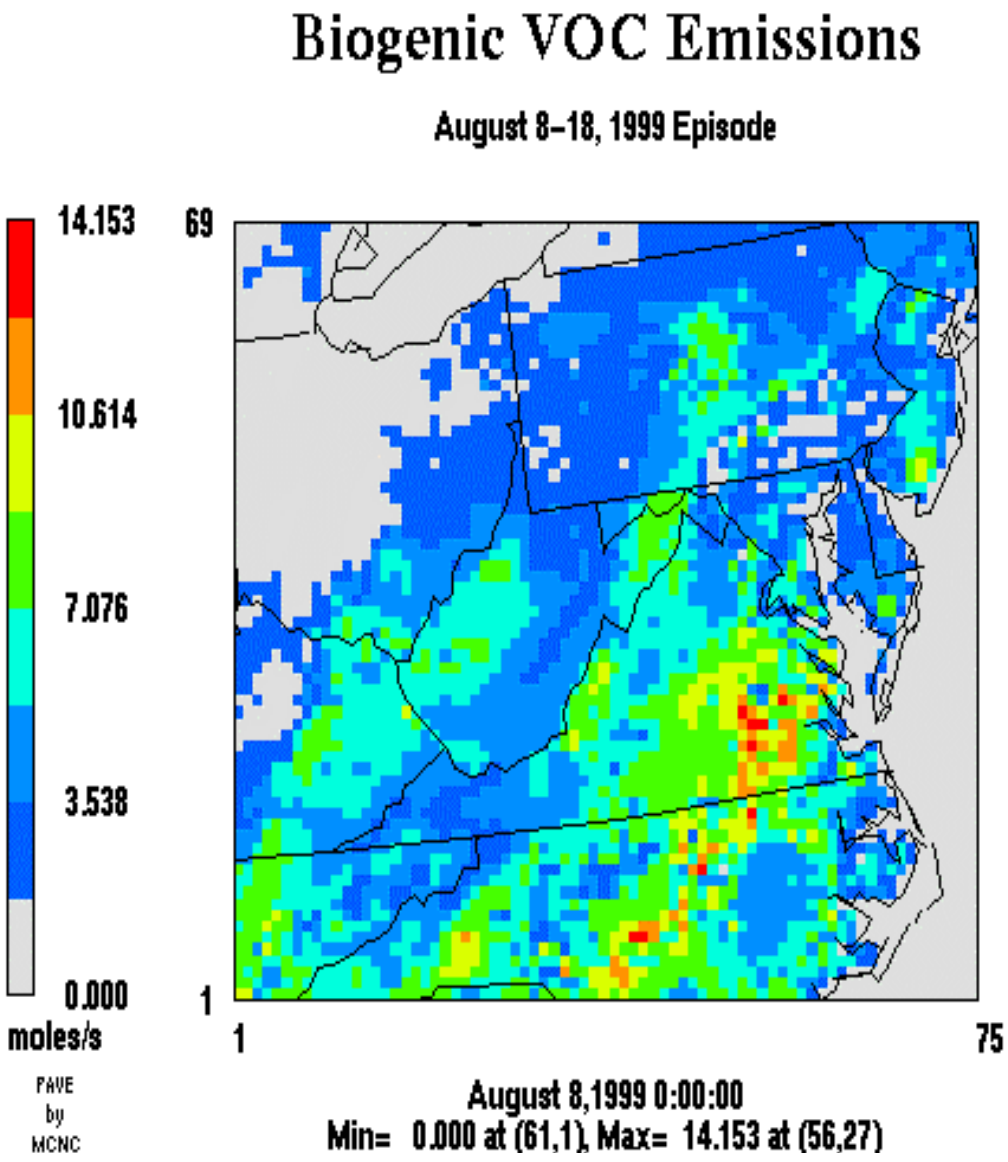


Figure 3-3. Gridded maximum biogenic VOC emissions as modeled by SMOKE

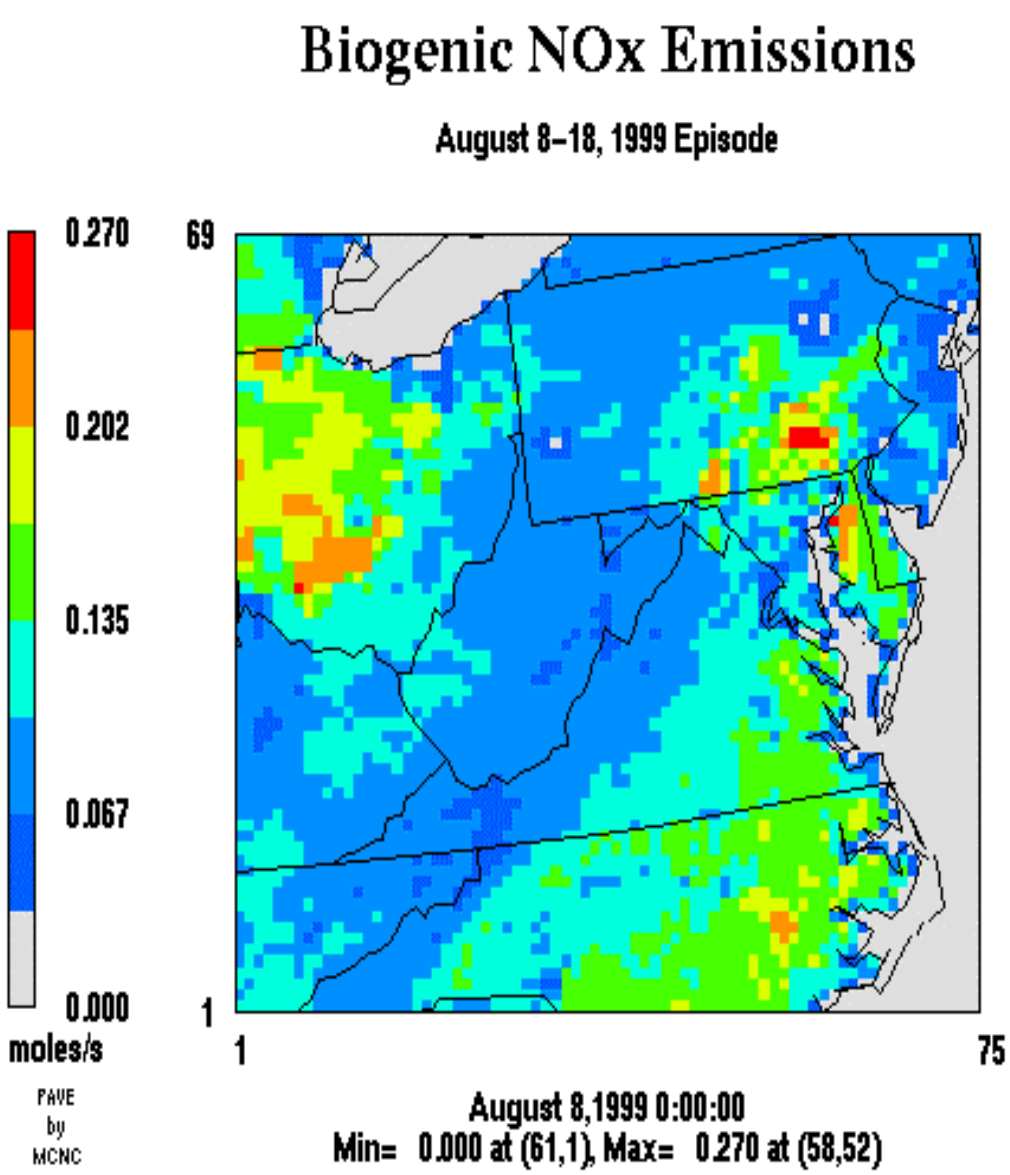


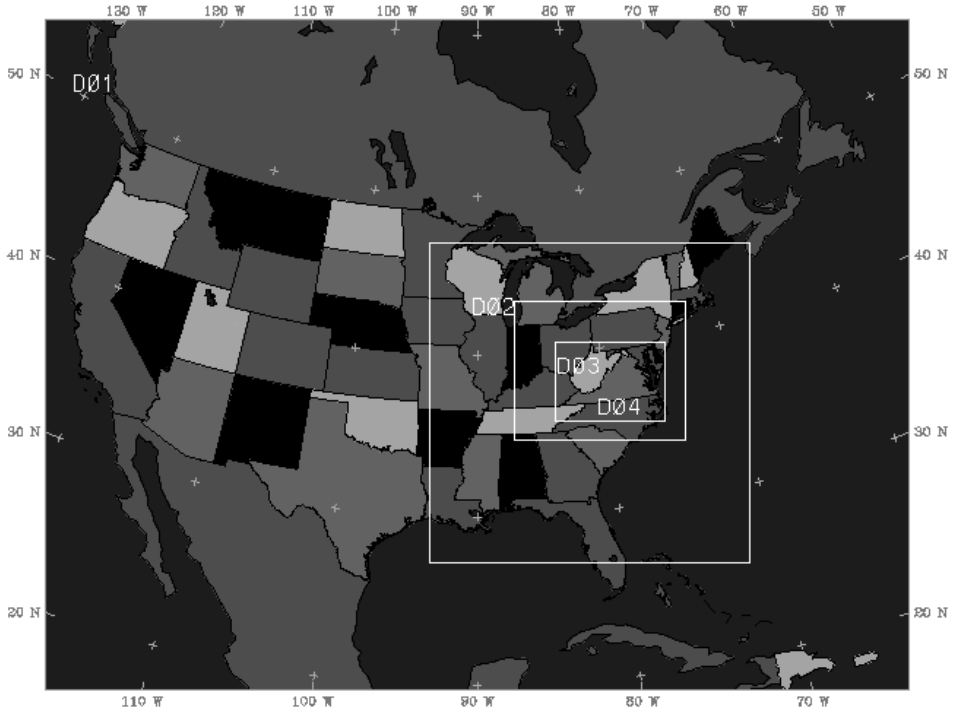
Figure 3-4. Gridded maximum biogenic NOx emissions as modeled by SMOKE

4 Meteorology Modeling

4.1 Numerical Configuration

The Penn State/NCAR Mesoscale Model, MM5, was employed to provide spatial and temporal distribution of meteorological fields to the CAMx air quality model. MM5 has been applied to a broad range of studies, including air quality simulations. The MM5 simulation was performed with 3 nested domains, with respective grid resolutions of 108 km, 36 km, and 12 km. Figure 4-1 shows the MM5 modeling domains for this EAC

Figure 4-1. DEQ MM5 MOdeling Domains



study. It can be seen that the 12 km resolution domain covers the entire state of Virginia and Mid-Atlantic states. The predominant types of meteorological data used in this study were surface and upper air meteorological measurements reported by the National Weather Service (NWS), and large-scale (i.e., regional/global) analysis databases developed by the National Center for Environmental Prediction (NCEP). Both types of data are archived by, and currently available from, the National Center for Atmospheric Research (NCAR). Measurement data include surface and aloft wind speed, wind direction, temperature, moisture, and pressure. Hourly surface data are usually available from many Class I airports, i.e., larger-volume civil and military airports operating 24-hour per day. The standard set of upper air data is provided by rawinsonde soundings launched every 12 hours from numerous sites across the continent. The typical spacing of rawinsonde site is approximately 300 km. The New York State Department of Environmental Conservation has kindly retrieved all necessary above-mentioned data from NCAR and sent the data to DEQ.

Table 4-1 shows the vertical grid structure of the MM5 model. The EAC MM5 simulations were conducted on DEQ's Linux Cluster system consisting of 6 computing nodes with 12 CPUs. The Distributed Memory Parallel Option was employed using the MPICH message-passing software to provide fast turnaround. The paralleling processing of MM5 has shortened run time by 10 times over previous MM5 executions on Sun Enterprise systems. A period of 240 hours was simulated for the EAC episode from August 8 to August 18, 1999. The first 12 hours were considered as the warm-up period, followed by 205 hours of prediction, which included the 48-hour ozone episode from August 12 to August 13, 1999.

4.2 MM5 Simulation Results and Statistical Evaluation

This section shows some MM5 predicted meteorological fields and statistical evaluation results. The METSTAT statistical evaluation package, developed by Environ, is used to compare the modeled temperature, humidity and wind fields with observed data.

METSTAT computes a set of statistical quantities, including bias, gross error, and root mean square error (RMSE, total, systematic, and unsystematic). Figure 4-3 shows the meteorological stations used by METSTAT statistical calculation.

4.2.1 Temperature

Figure 4-2 shows MM5 predicted 12 km domain temperature field on August 12, 1999 at 1900 hours GMT. In general, MM5 predicted temperature fields agree well with observed data at most meteorological

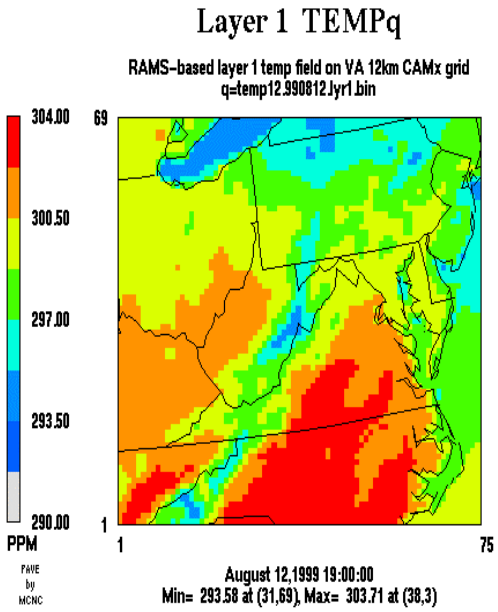


Figure 4-2. MM5 Temperature Field

Table 4-1 Vertical Grid Structures of MM5, CAMx and SMOKE

MM5 Layer K	Sigma	CAMx/SMOKE Layer	Interface Heights (m)
35	0.000	15	12821
34	0.050	15	
33	0.100	15	
32	0.150	15	
31	0.200	15	
30	0.250	15	
29	0.300	15	
28	0.350	15	
27	0.400	14	5812
26	0.440	14	
25	0.480	14	
24	0.520	14	
23	0.560	13	3874
22	0.600	13	
21	0.640	13	
20	0.670	12	2747
19	0.700	12	
18	0.730	11	2185
17	0.760	11	
16	0.785	10	1698
15	0.810	10	
14	0.835	9	1275
13	0.855	9	
12	0.875	8	950
11	0.895	8	
10	0.910	7	675
9	0.925	7	
8	0.940	6	444
7	0.950	6	
6	0.960	5	294
5	0.970	5	
4	0.980	4	146
3	0.086	3	102
2	0.992	2	58
1	0.996	1	29
0	1.000		

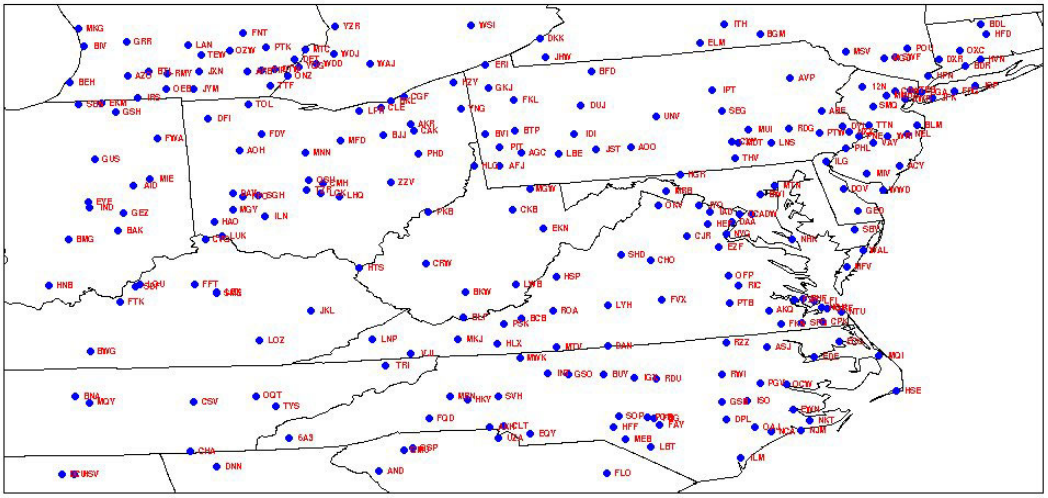


Figure 4-3. Meteorological observation stations

observation sites within the 12 km modeling domain during the episode .

Figure 4-4 shows METSTAT 12 km domain hourly temperature statistics for the August 8 to August 18, 1999 episode. The three RMSE legends in the second graph represent RMSE total, RMSE systematic and RMSE unsystematic.

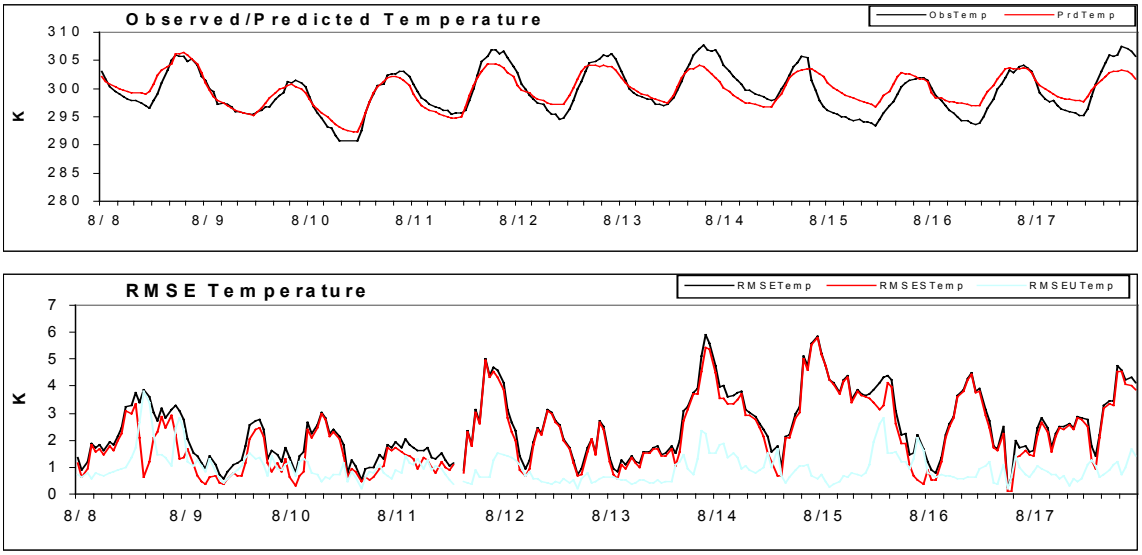


Figure 4-4. METSTAT hourly temperature statistics

4.2.2 Humidity

Figure 4-5 shows METSTAT 12 km domain hourly humidity statistics for the August 8 to August 18, 1999 episode. The predicted humidity fields agree reasonably well with observed humidity fields.

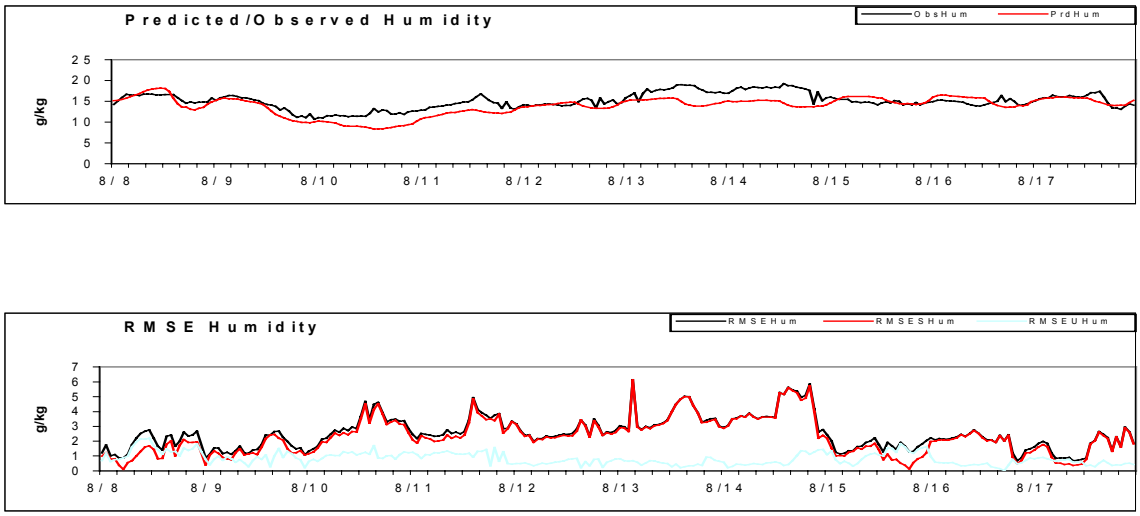


Figure 4-5 METSTAT 12 km domain hourly humidity statistics

4.2.3 Wind Fields

Figure 4-6 shows predicted surface wind on August 12, 1999 at 19:00 GMT. The wind field agrees reasonably well with observed wind field at that hour.

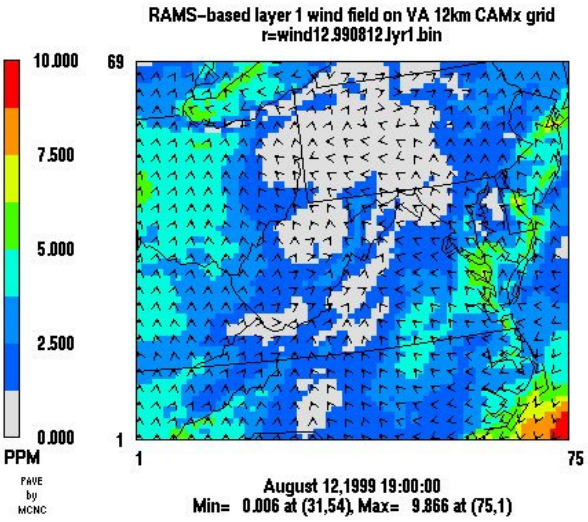


Figure 4-6 MM5 Predicted Surface Wind

Figure 4-7 shows METSTAT 12 km domain hourly wind statistics for the August 8 to August 18, 1999 episode.

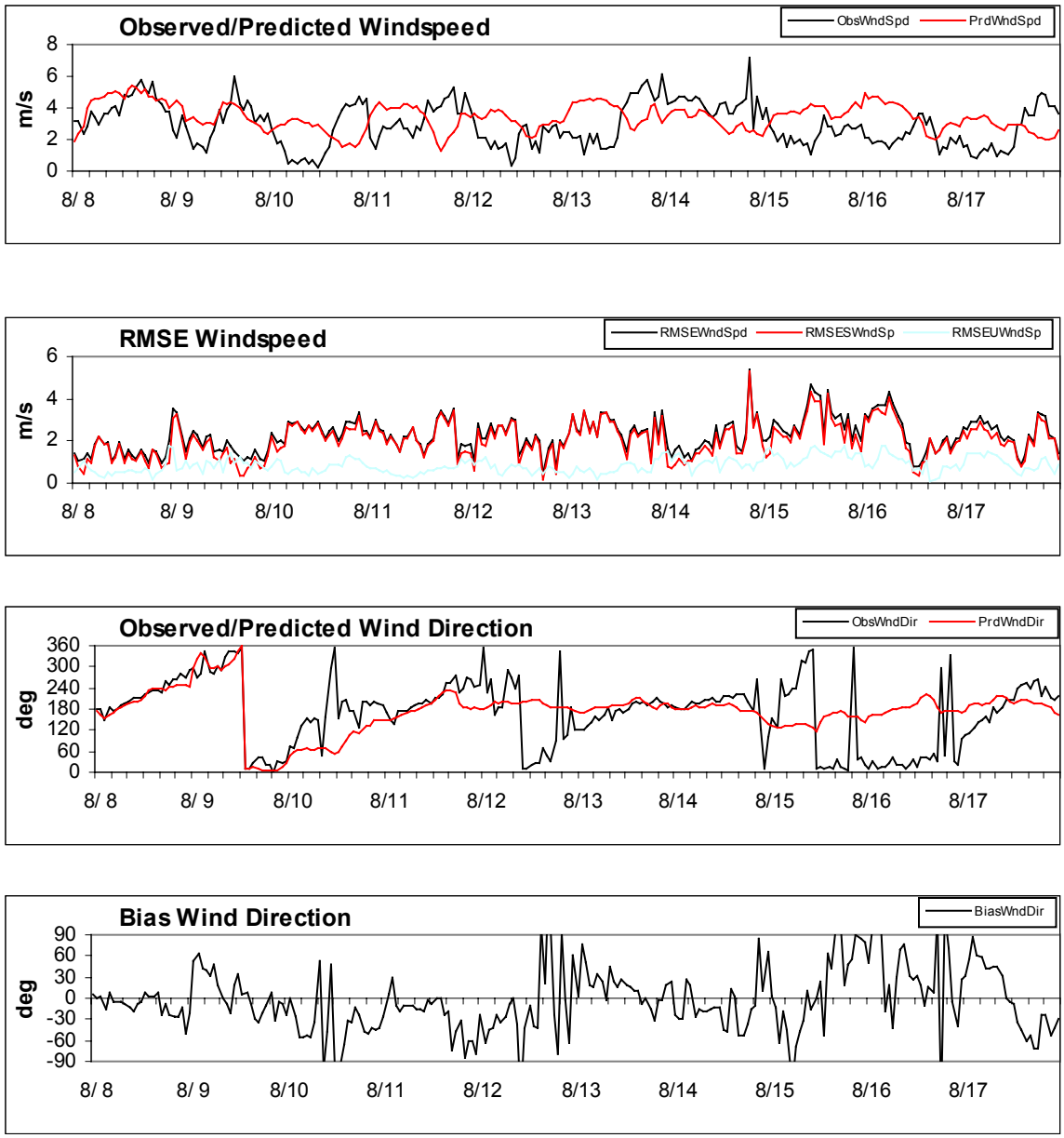


Figure 4-7. METSTAT 12 km domain wind statistics

During the episode, the simulated wind speed is in proper magnitude compare to the observed wind. Wind direction prediction performed fairly well from 8th to 15th even though abrupt wind direction changes were not captured during the 12th and 13th of the episode.

4.2.4 Planetary Boundary Layer Depth

Figure 4-9 through 4-11 shows Planetary Boundary Layer depth for August 12 and August 13, 1999 at 10AM and 2 PM hours. The PBL depth is also called mixing height. The mixing height values during the episode are in reasonable magnitude.

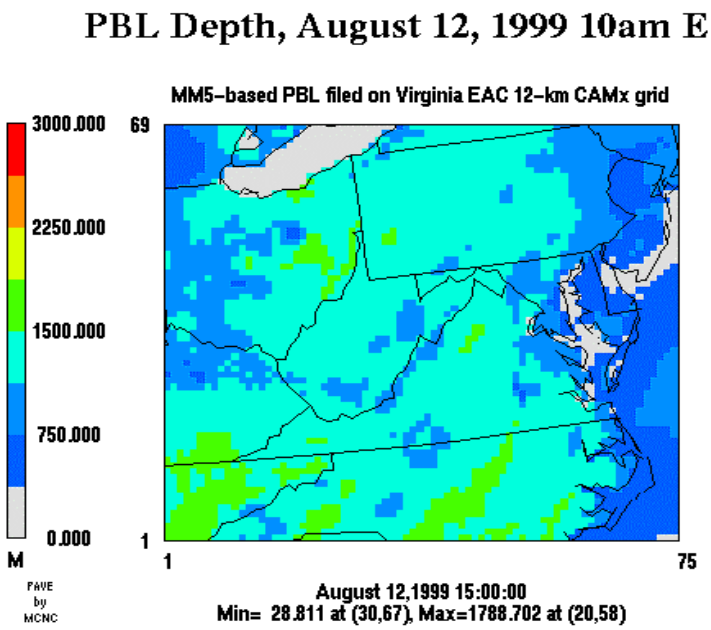


Figure 4-8 PBL Depth, August 12, 1999 10AM EST

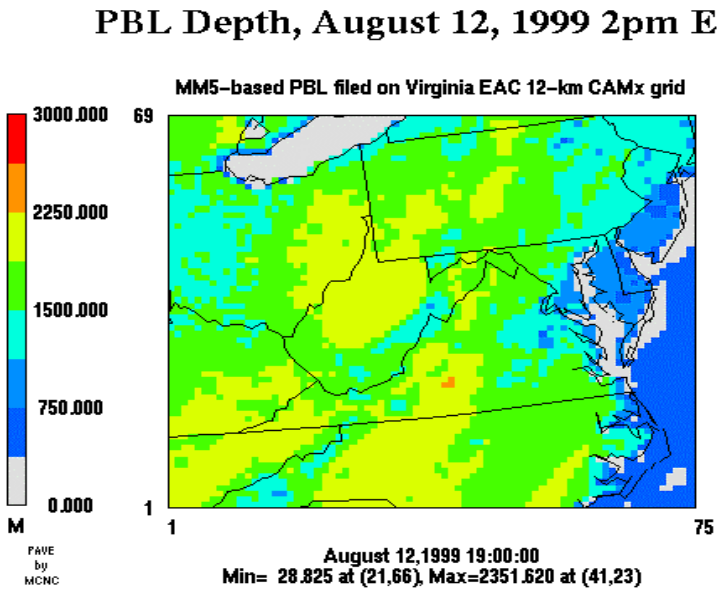


Figure 4-9 PBL Depth, August 12, 1999 2PM EST

PBL Depth, August 13, 1999 10am EST

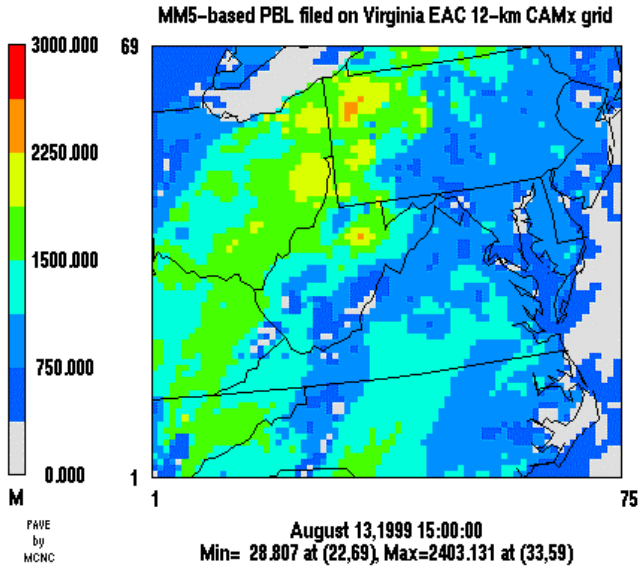


Figure 4-10. PBL Depth, August 13, 1999 10AM EST

PBL Depth, August 13, 1999 2pm EST

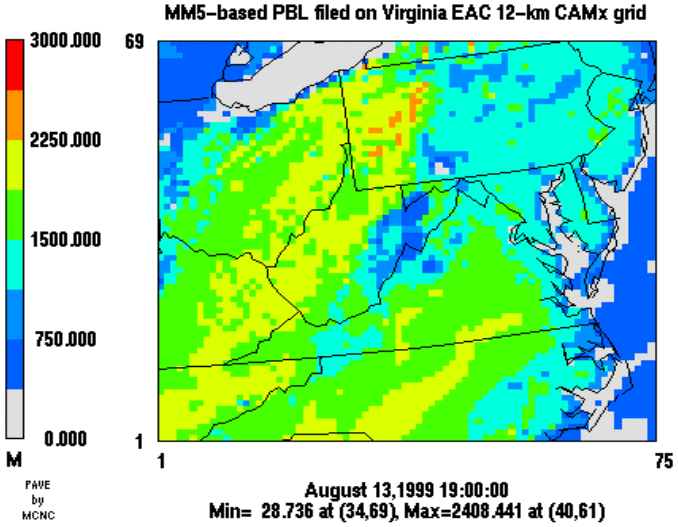


Figure 4-11. PBL Depth, August 13, 1999 2PM EST

5 Ozone Modeling

5.1 CAMx Model Configuration

The Eulerian photochemical model, CAMx modeling system was employed to simulate ozone concentration in the EAC modeling domains. The following is a list of model configuration parameters:

36/12 km grid August 8 – August 18, 1999 period
CB-IV chemistry with CMC fast solver
PPM advection solver
Wet and dry deposition
TUV photolysis rates
TOMS ozone column with default LULC albedo and haze

Figure 5-1 shows the AEC CAMx 36 km and 12 km modeling domains.

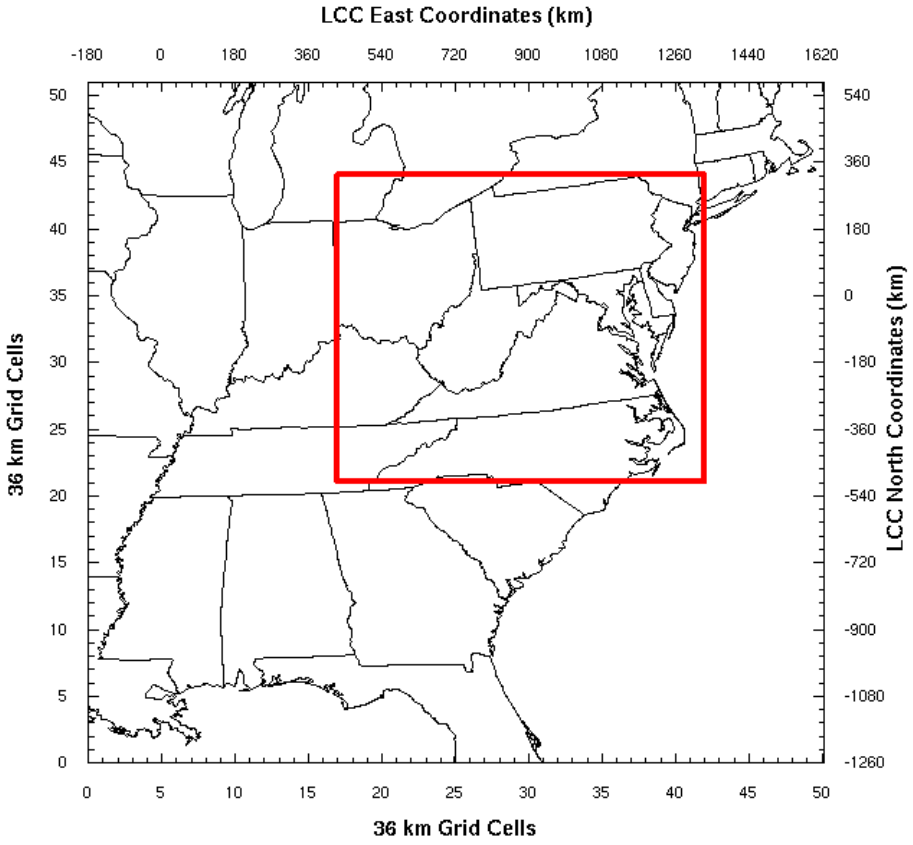


Figure 5-1. EAC CAMx 36 km and 12 km Modeling Domains

5.2 Model Performance Evaluation

Generally, predicted 8-hour ozone concentration agreed very well with observed values at most monitors in the 12 km domain. Figure 5-1 and Figure 5-2 show time series of observed and predicted 8-hour ozone concentrations from August 11 to August 14, 1999 at the Vinton (Roanoke County) and Frederick monitors. Daytime simulations showed good agreement with the observations. Night-time ozone concentrations were systematically over-predicted. However, night-time ozone concentration was not the main focus of this study. Figure 5-3 shows a scatter plot of predicted versus observed ozone concentration for all Virginia sites. Over 90% of predicted values fell within the ±50% bias lines. Most of the predicted values outside the ±50% region were due to night-time over-predictions.

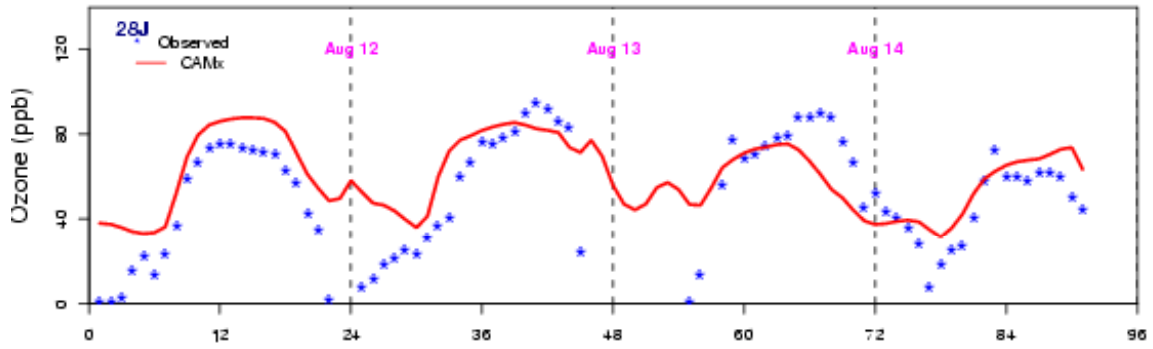


Figure 5-1. Time series of observed and simulated 8-hour ozone concentration at Frederick (Frederick/Winchester City)

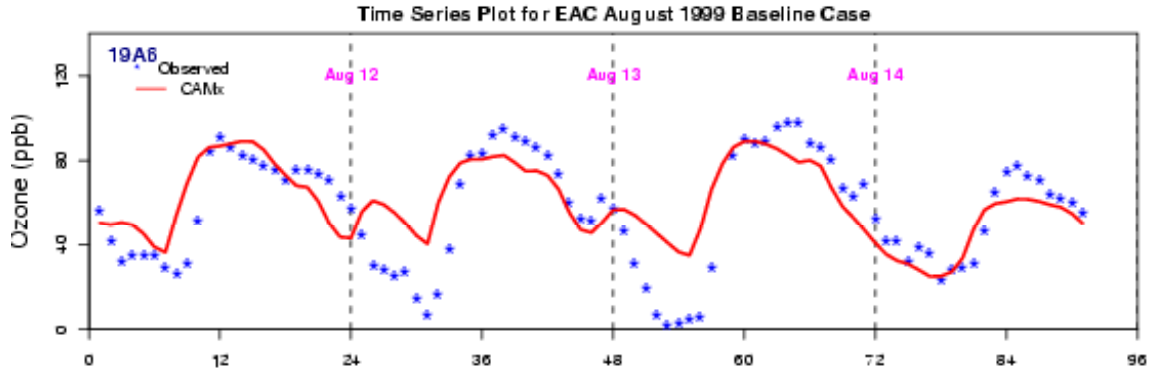


Figure 5-2. Time series of observed and simulated 8-hour ozone concentration at Vinton (Roanoke MSA)

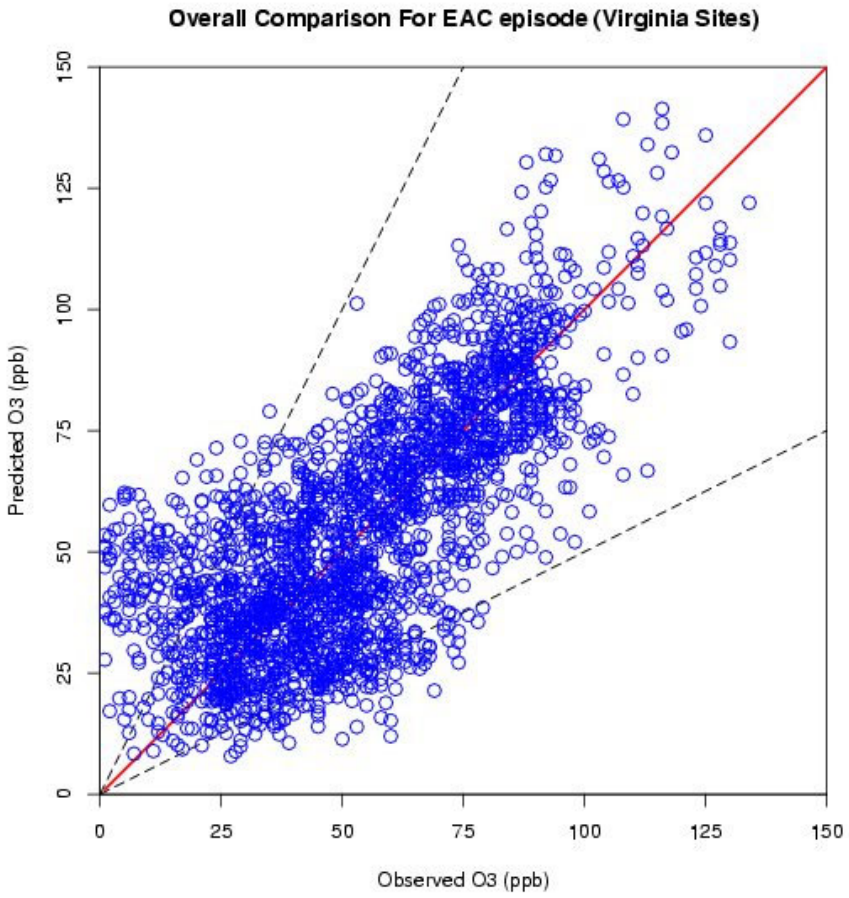


Figure 5-3. Scatter plot of observed and predicted ozone concentration for Virginia sites

Table 5-1 and Table 5-2 provides model performance metrics for August 12 and August 13, 1999 for major performance criteria. For Virginia sites, all performance goals were met for both episode days. For the entire 12 km domain, all performance goals were met for both episode days except the Normalized Bias for the 13th. It was decided based the performance metrics that the model is acceptable for future year modeling for the August 1999 episode.

Figure 5-4 and Figure 5-5 shows 12 km domain predicted base year daily maximum1-hour and 8-hour ozone concentrations, respectively, for the 12th and 13th of the episode.

Table 5-1. O3 performance statistics for August 12, 1999

	(a) 12km (VA Sites)	(b) 12km (Whole Domain)	(c) EPA Criteria
Overall Absolute Peak			
Predicted peak	153.9 ppb	153.9 ppb	
Observed peak	134.0 ppb	143.0 ppb	
Unpaired bias	14.9 %	7.7 %	20.0 %
Peak Prediction (Normalized Bias)			
Paired in space	1.7 %	-1.3 %	
Paired space/time	-4.2 %	-8.7 %	
Peak Prediction (Normalized Error)			
Paired in space	12.9 %	13.9 %	
Paired space/time	11.1 %	16.7 %	
Average Concentration Prediction			
Normalized bias	1.3 %	0.6 %	15.0 %
Normalized error	17.4 %	16.6 %	35.0 %
Mean bias	0.9 ppb	-0.6 ppb	
Mean error	14.1 ppb	13.0 ppb	

Table 5-2. O3 performance statistics for August 13, 1999

	(a) 12km (VA Sites)	(b) 12km (Whole Domain)	(c) EPA Criteria
Overall Absolute Peak			
predicted peak	116.4 ppb	116.4 ppb	
observed peak	113.0 ppb	164.0 ppb	
unpaired bias	3.0 %	-29.0 %	20.0 %
Peak Prediction (Normalized Bias)			
paired in space	-3.4 %	-0.5 %	
paired space/time	-11.6 %	-9.0 %	
Peak Prediction (Normalized Error)			
paired in space	16.9 %	14.2 %	
paired space/time	22.9 %	17.6 %	
Average Concentration Prediction			
normalized bias	-6.7 %	-2.4 %	15.0 %
normalized error	16.5 %	17.3 %	35.0 %
mean bias	-6.5 ppb	-2.9 ppb	
mean error	13.1 ppb	13.0 ppb	

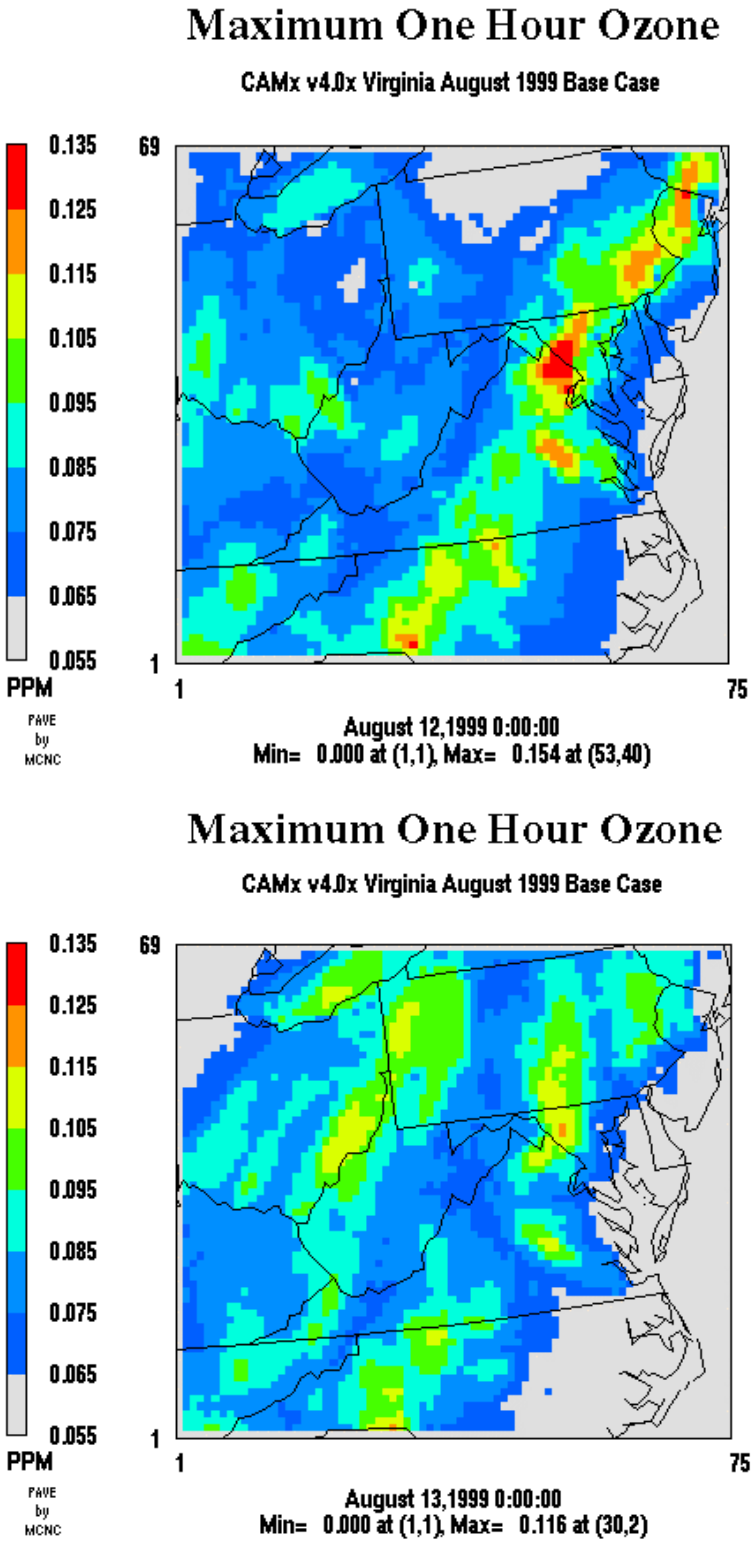


Figure 5-4. CAMx predicted 1-hour daily maximum ozone concentrations

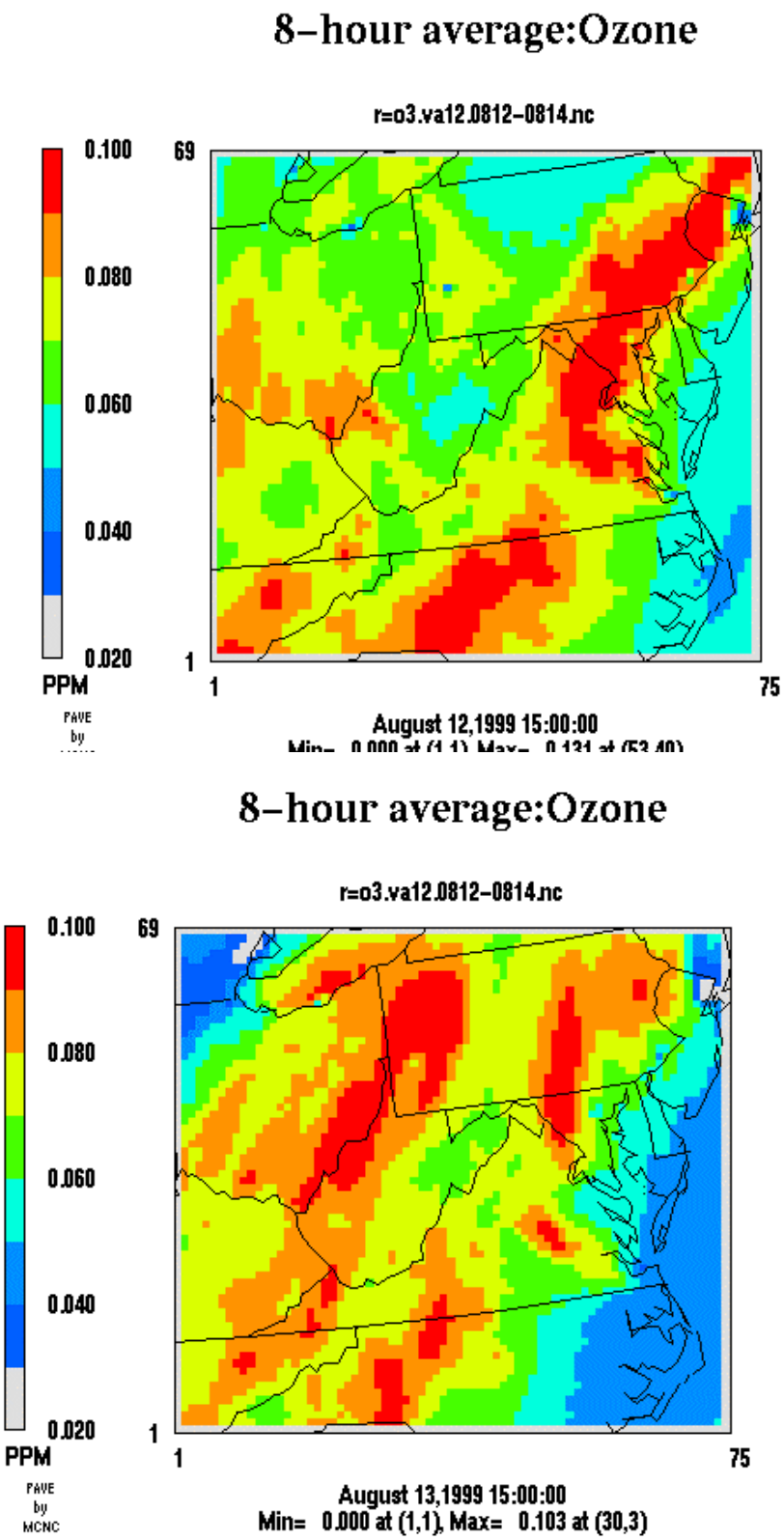


Figure 5-5. CAMx predicted 8-hour daily maximum ozone concentrations

Figure 5-6 and Figure 5-7 shows 12 km domain predicted future year daily maximum1-hour and 8-hour ozone concentrations, respectively, for the 12th and 13th of the episode. All EAC local control measures have been quantified and included in the future year emission inventories.

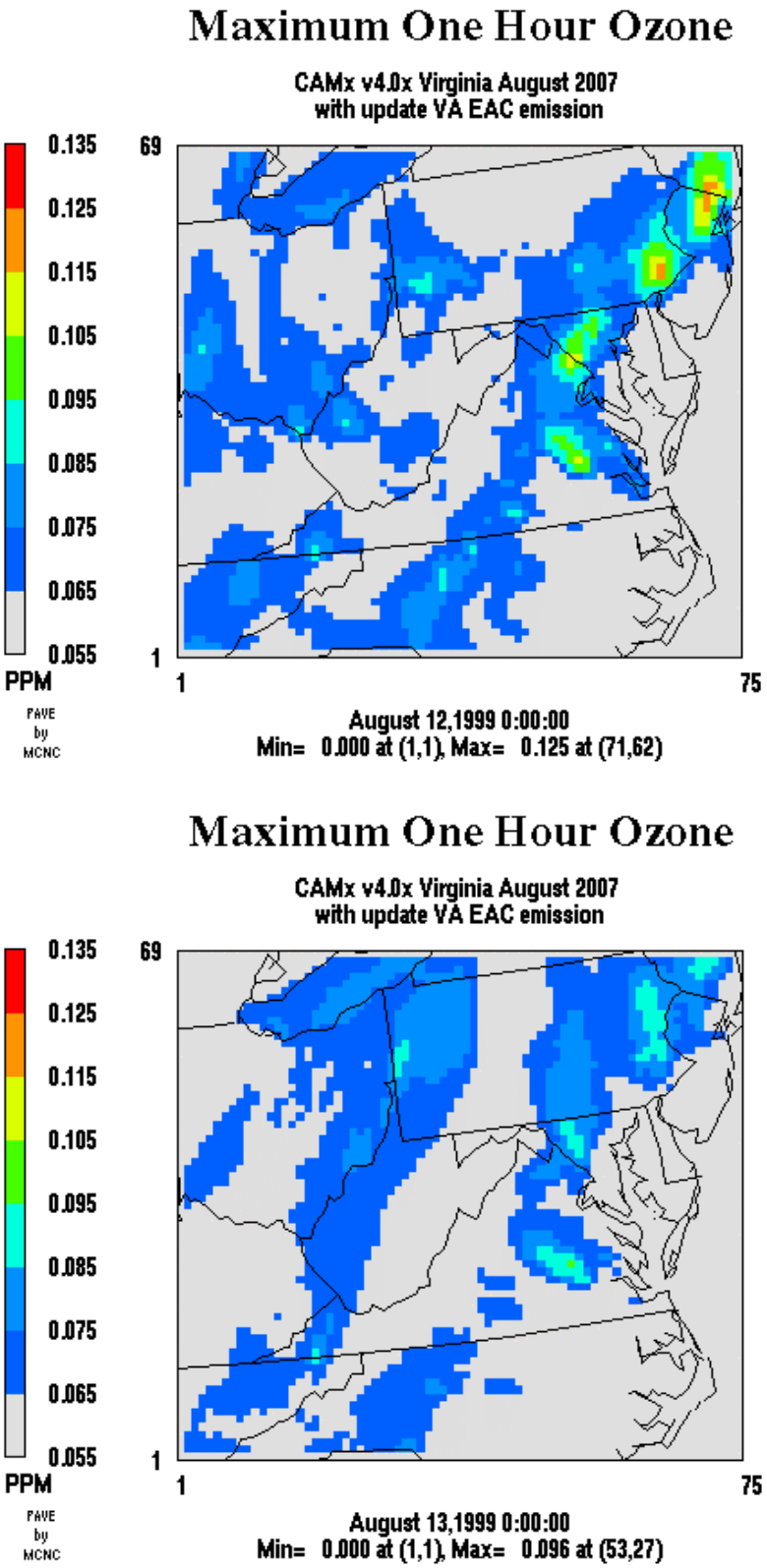
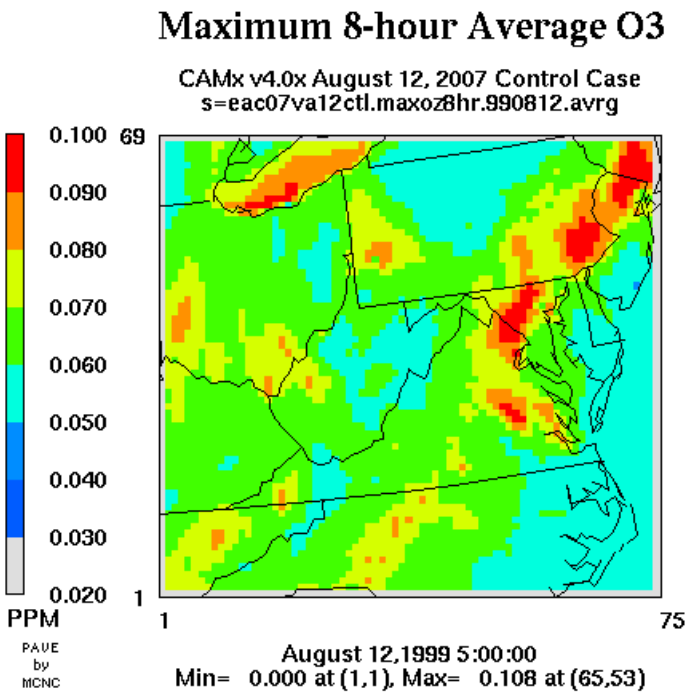


Figure 5-6. CAMx predicted future year 1-hour daily maximum ozone concentrations



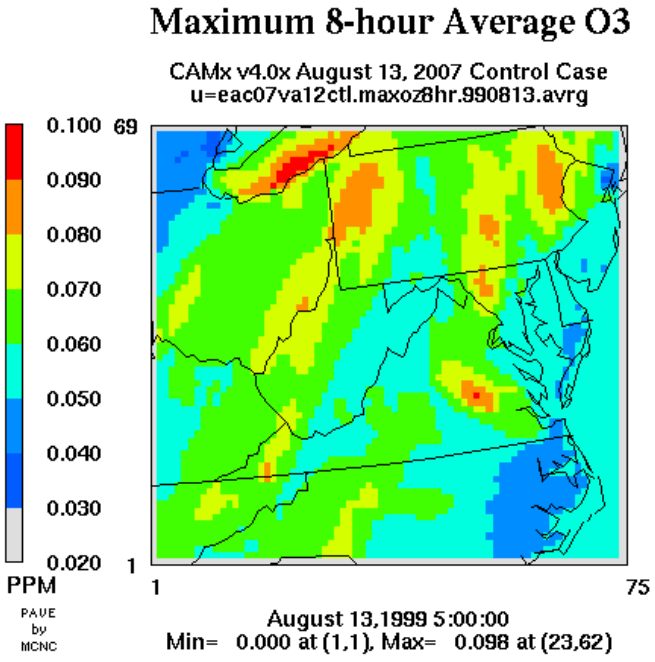


Figure 5-7. CAMx predicted future year 8-hour daily maximum ozone concentrations

6. Attainment Demonstration

Because EPA has not yet designated any region as non-attainment for 8-hour ozone, no formal requirement exists for an 8-hour attainment demonstration. However, EPA has developed draft procedures for using photochemical models to demonstrate attainment of the 8-hour ozone NAAQS. The critical elements in the demonstration of attainment under the 8-hour ozone NAAQS, established by the *Draft Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-Hour Ozone NAAQS, U.S. EPA Office of Air Quality Planning and Standards, EPA-454/R-99-004, May 1999*, are the calculation of relative reduction factors (RRFs) and future design values (DVs). The RRFs and base-year Design Values are the basis for projecting future-year Design Values (DVF).

All episode days with modeled base year daily maximum 8-hour ozone concentration greater than or equal to 70 ppb will be use to calculate the RRF for the all monitors representing the five EAC areas in this study. Table 6-1 lists the monitors and their corresponding EAC areas.

Table 6-1. Monitors for calculating RRFs

Monitors and AIRS ID	EAC Areas
51-161-1004 Roanoke	Roanoke MSA, Virginia
51-069-0010 Frederick	Frederick/Winchester City, Virginia
51-069-0010 Frederick	Berkley County/Martinsburg City, West Virginia
51-069-0010 Frederick	Jefferson County, West Virginia
24-043-0009 Hagerstown	Washington County, Maryland

Figure 6-1 shows the spatial locations of the monitors listed in the above table.

6.1 Calculation Methodology for RRFs and DVs

The methodology calls for scaling base-year design values using RRFs from a photochemical model to future year design values. The calculation is carried out for each monitor. The attainment test is passed if all the future year scaled DVs are 84 ppb or less.

For each monitor (i) and modeling day (j) the maximum 8-hour ozone near the monitor is selected for the current ($O3C_{ij}$) and future-year ($O3F_{ij}$):

$$RRF_i = [\sum O3F_{ij}] / [\sum O3C_{ij}]$$

Attainment demonstration is done using monitor specific relative reduction factor (RRFi) that is the ration of the future-year to current-year 8-hour ozone estimates near the monitor:

$$DVF_i = RRF_i \times DVC_i$$

These current EPA procedures for using models to demonstrate attainment of the 8-hour ozone NAAQS will be in this study. In this chapter, the relative differences in the modeled 8-hour ozone estimates between 1999 base case simulation and 2007 control case simulation will be developed to scale their measured Design Value for comparison with the 84 ppb 8-hour ozone NAAQS. The attainment demonstration will be done using the above mentioned procedures for two EAC areas in Virginia, two EAC areas in West Virginia and one EAC area in Maryland.

Table 6-2. 8-Hour Ozone Design Values for Virginia and West Virginia EAC Areas

Virginia DEQ 1998-2000 4th Highest 8-hour Ozone Averages					
AIRS ID	County/City	1998	1999	2000	3 yr. Avg.
51-161-1004	Roanoke	99	89	81	**90**
51-069-0010	Frederick	98	85	79	**87**

Table 6-3. 8-Hour Ozone Design Values for Maryland EAC Areas

Virginia DEQ 1997-2000 4th Highest 8-hour Ozone Averages					
AIRS ID	County/City	1998	1999	2000	3 yr. Avg.
24-043-0009	Hagerstown	-	94	94	**94**

The following procedures are carried out in monitor design value scaling:

1. For each monitor, identify the corresponding cell and eight surrounding cells.
2. For each cell, find daily maximum 8-hour ozone values greater or equal to 70 ppb for the entire episode for both the base case and future case.
3.Average the daily maximum 8-hour ozone values across days with daily maximum 8-hour ozone greater or equal to 70 ppb for the base case and future case.
4. Calculate the average Relative Reduction Factors for these cells, and
5. Calculate the average future year Design Values for these cells.

Figure 6-1 shows the geophysical locations of the three monitors participating in RRF calculation and attainment test

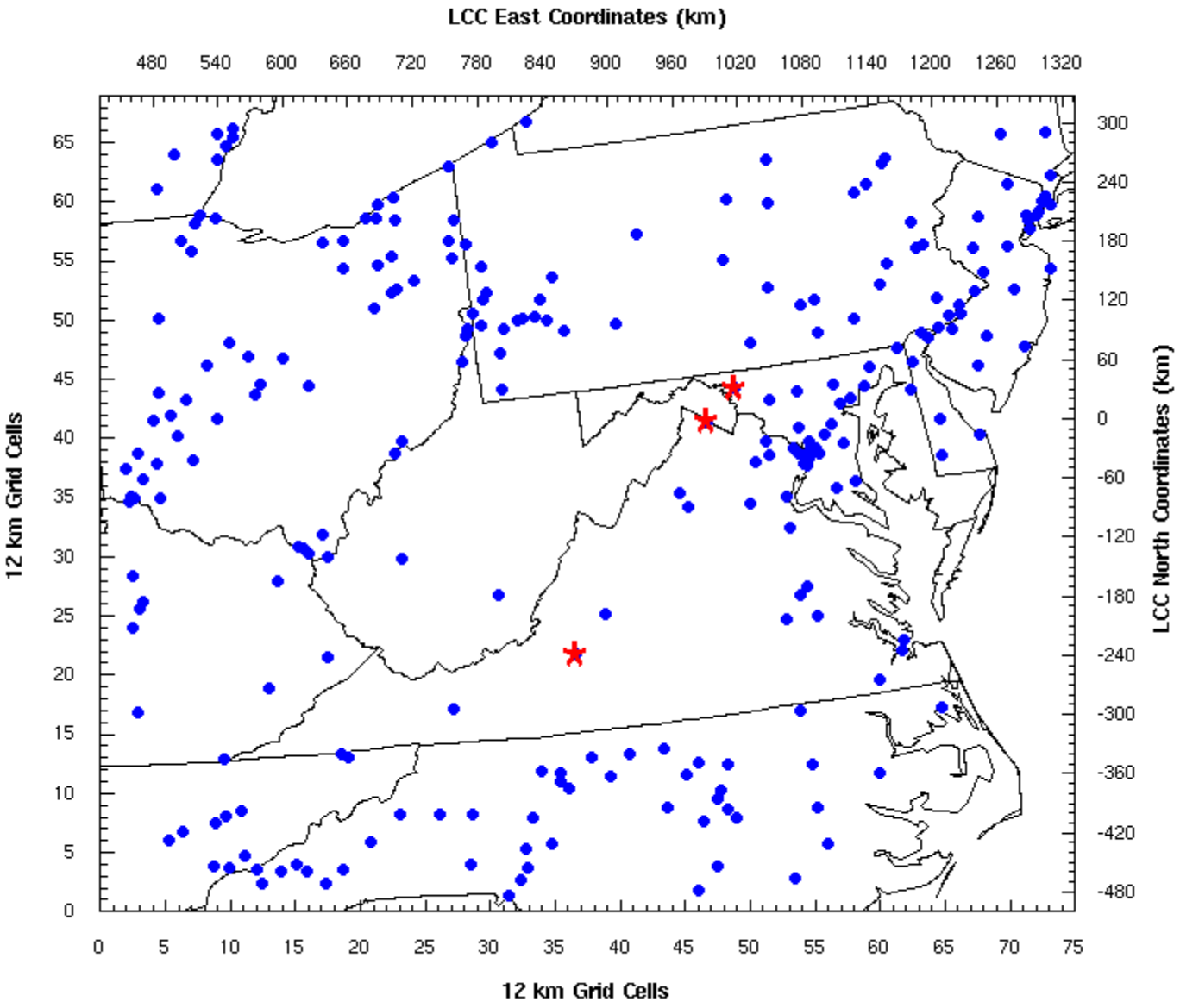


Figure 6-1. Spatial Locations of Monitors for RRFs Calculations and Attainment Demonstration of Virginia, West Virginia and Maryland EAC Areas.

6.1. 8-Hour Ozone Attainment Demonstration of Virginia and West Virginia EAC Areas

County/City	AIRS ID	1998-2000 Design Value, ppb	2001-2003 Design Value, ppb	Current Design Value
Roanoke Co.	510410004	90	85	90
Frederick Co.	510870014	87	85	87

Attainment Test Results for Monitors in the Virginia EAC Areas (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	Number of Analysis Days	Pass/Fail Status
Roanoke	82.93	65.72	0.793	90	71.4	5	PASS
Frederick	77.45	64.85	0.837	87	72.8	4	PASS

Nonattainment **Attainment**

6.2. 8-Hour Ozone Attainment Demonstration of Maryland EAC Area

Attainment Test Results for Monitors in the Maryland EAC Area

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	Number of Analysis Days	Pass/Fail Status
Washington	86.88	69.70	0.802	94	75.4	5	PASS

6.3. Summary

Table 6-4 and Table 6-5 has demonstrated that all concerned EAC areas in this study will attain the 8-hour ozone standard by 2007.

COMMONWEALTH OF VIRGINIA
PROPOSED STATE IMPLEMENTATION PLAN REVISION

PUBLIC HEARING ADDITIONAL STATEMENT

December 20, 2004
Roanoke, Virginia

In addition to the opening statement, I would like to make the following statement concerning a specific modification to the proposal under consideration today.

As part of the early action process, a regional photochemical modeling analysis must be performed to support the conclusion that the area involved will come into compliance with the ozone standard. A modeling analysis and report is included as part of the early action plan for the Roanoke area.

As a result of discussions with the U. S. Environmental Protection Agency concerning this modeling analysis, a review of the emissions inventories used in the modeling analysis has been performed. This review has resulted in adjustments to these inventories. In addition, the modeling analysis has been performed again using the adjusted emissions inventory data. This updated modeling analysis shows that the Roanoke area is predicted to come into compliance with the ozone standard by the year 2007 which is a requirement of the early action compact program. These updated results will be included in the final plan that will be submitted to the U. S. EPA.