MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard • Baltimore MD 21230
410-537-3000 • 1-800-633-6101 • www.mde.state.md.us

Baltimore Serious Nonattainment Area 0.08 ppm 8-Hour Ozone State Implementation Plan

Demonstrating Rate of Progress for 2008, 2011 and 2012
Revision to 2002 Base Year Emissions; and
Serious Area Attainment Demonstration

SIP Number: 13-07

June 17, 2013

Prepared for:

U.S. Environmental Protection Agency

Prepared by:

Maryland Department of the Environment

This Page Left Intentionally Blank

PLAN TO IMPROVE AIR QUALITY IN THE BALTIMORE MD REGION

State Implementation Plan (SIP)
"Serious Area SIP"

For the 0.08 ppm National Ambient Air Quality Standard for Ozone

Demonstrating Rate of Progress for 2008, 2011 and 2012;
Revision to 2002 Base Year Emissions; and
Serious Area Attainment Demonstration
for the

BALTIMORE MD
NONATTAINMENT AREA

Prepared by:

Maryland Department of the Environment

June 17, 2013

THIS PAGE LEFT INTENTIONALLY BLANK

Table of Contents

Appendices

List of Tables

List of Figures

1.0 EXECUTIVE SUMMARY

This document, the *Baltimore Serious Nonattainment Area 0.08 ppm 8-Hour Ozone State Implementation Plan* ("Serious Area Attainment Plan"), is a plan to improve air quality in the Baltimore region to meet the 1997, 0.08 ppm, national ambient air quality standard (NAAQS) for ozone (8-hour ozone standard). The Plan consists of two Rate of Progress demonstrations, for the periods 2002-2008 and 2008-2011; and an attainment demonstration for 2012.

Additionally, the plan includes commitments by the state to meet requirements for serious nonattainment areas; it also includes commitments by the state to meet additional U.S. Environmental Protection Agency (EPA) requirements for the Baltimore region, including a contingency plan for 2008 rate of progress, contingency plans for the 2012 rates of progress, and an analysis of reasonably available control measures (RACM). The plan presents revised emissions inventories for 2002, 2008, 2011, and 2012 based on the MOVES2010a model for estimating on-road vehicle emissions. The analysis methodology is consistent with past statewide inventory efforts.

The Serious Area Attainment Plan is intended to show the progress being made to improve air quality in the Baltimore Nonattainment Area and the efforts underway to assure that all necessary steps are taken to reach the federal health standard for ground-level ozone by 2012. The plan has been prepared by the Maryland Department of the Environment Air and Radiation Management Administration to comply with the Clean Air Act Amendments of 1990 (CAAA) and with EPA requirements for the Baltimore region as stated in EPA's reclassification of the Baltimore region (77 Fed. Reg. 4901, February 1, 2012).

1.1 INTRODUCTION

Ground level ozone is considered a significant health based pollutant and the EPA has set a specific national ambient air quality standard for ozone to best protect public health. This standard, known as the 8-hour ozone standard, is implemented by the federal Clean Air Act ("CAA" or "the Act"). Areas of the county that monitor air pollution above the federal standard are designated "nonattainment" and are therefore required to develop and implement air quality plans called State Implementation Plans, or SIPs, that show how a particular region will reduce pollution to the point where the region will meet the federal standards.

The Baltimore region, which comprises Baltimore City and the surrounding counties of Baltimore, Carroll, Anne Arundel, Howard and Harford, has been designated nonattainment under the 8-Hour Ozone standard. The following document explains the process by which the region will reduce pollution and meet the federal ozone standard by 2013 which is the designated attainment date for the Baltimore region.

1.2 EMISSIONS

A significant portion of this document is related to emissions. Nitrogen oxide (NOx) and volatile organic compound (VOC) emissions create ozone under heat and sunlight. Reductions in these ozone precursor emissions are a necessity to reduce ozone pollution. The MDE is responsible for creating a NOx and VOC emissions inventory that estimates the actual emissions created by all the emission sources in our state. Emissions come from a variety of sources including mobile sources such as cars and trucks, point sources such as power plants, area sources such as lawnmowers, and non-road sources such as construction equipment and all terrain vehicles.

This document details the current emissions inventory for NOx and VOC and predicted future emissions. It is important to project emissions in the future in order to track progress achieved from emissions-reducing programs. Also, projected emissions are incorporated into the attainment analysis work that actually predicts whether or not a region will meet the air quality standard.

The good news exhibited by this document is that NOx and VOC emissions are decreasing in the Baltimore region. Control programs aimed at reducing emissions have been developed and implemented and the reductions required by these programs are significant. Population growth, economic growth, and public needs have a tendency, though, to reduce the impact of the emission reductions that come from control programs. Despite these obstacles, the overall trend in NOx and VOC emissions is downward, and MDE predicts that with additional reductions cleaner air will come.

1.3 CONTROL PROGRAMS

Over the past several decades the MDE has adopted and implemented numerous control programs (laws, regulations, and voluntary measures) that reduce NOx and VOC emissions in Maryland. In addition, several new control measures are being adopted specifically to help Maryland attain the federal ozone standard. The new programs, in addition to the existing control programs that continue to be implemented and enforced, allow Maryland to develop an attainment demonstration that shows how Maryland will meet the federal ozone standard.

The most significant new control program is the Maryland Healthy Air Act (HAA), which substantially reduces NOx from Maryland's older coal burning power plants. The HAA is more stringent than the parallel federal rule called the Clean Air Interstate Rule and is the most substantial emission control program ever adopted in Maryland. Overall, the HAA reduced Maryland power plant NOx emissions by 70% (compared to 2002 levels) in 2009 and by 75% by 2012. The 2009 and 2012 reductions are a significant part of the attainment scheme developed by the MDE to meet the federal ozone standard.

Addition control programs being implemented to help Maryland meet the federal ozone standard include several VOC rules targeted at adhesives and sealants, lower VOC portable fuel containers, and lower VOC consumer products. Other non-traditional measures include an aggressive telework (also called "telecommuting") program and a tree canopy program.

The following is a brief summary of new control measures being implemented to assist Maryland with attaining the 8-hour ozone standard.

Table 1-1: Control Measure Summary

Control Measure	2008 VOC	2008 NOx	2011 VOC	2011 NOx	2012 VOC	2012 NOx
On-road Mobile Measures	52.86	158.43	61.94	181.42	66.59	192.33
Consumer Products Phase 1	3.70	0.00	3.77	0.00	3.79	0.00
Consumer Products Phase 2	0.00	0.00	0.46	0.00	0.46	0.00
Low VOC Paints (Architectural and Maintenance Coatings - AIM)	6.03	0.00	6.19	0.00	6.19	0.00
Portable Fuel Containers Phase 1	6.71	0.00	8.31	0.00	8.35	0.00
Portable Fuel Containers Phase 2	0.00	0.00	0.60	0.00	0.60	0.00
Industrial Adhesives Rule	0.00	0.00	2.63	0.00	2.64	0.00
Nonroad Measures	17.85	8.12	26.33	14.55	29.83	17.30
Railroads (Tier 2)	0.00	1.18	0.00	1.19	0.00	1.20
Healthy Air Act (HAA)	0.00	0.00	0.00	31.86	0.00	37.18
Total	**87.14**	**167.73**	**110.51**	**229.35**	**118.45**	**248.48**

** All control levels are in tons per day (tpd) and all totals are rounded.*

1.4 MODELING

A significant part of the attainment demonstration for Maryland consists of air quality modeling analysis. Required by the Act, air quality models are run to examine future air quality conditions and whether or not a region will attain the standard by its designated attainment date. The models are not relied upon as the only attainment test but are an important part of the attainment demonstration for Maryland.

The air quality modeling analysis completed for this SIP shows the Baltimore Nonattainment Area attaining the 8-hour ozone standard. All of the air quality monitors located in the nonattainment area are predicted to be at levels consistent with attainment.

1.5 WEIGHT OF EVIDENCE

As mentioned above, air quality models are not the only tool available to predict attainment of the federal ozone standard. A weight of evidence approach can be used to further analyze air quality data, trends, and meteorology and complete supplemental modeling. The MDE has completed supplemental data analyzes to show that the Baltimore NAA will indeed meet the federal ozone standard by 2013.

Some of the weight of evidence analysis utilized for the Baltimore NAA includes:

- an analysis of ozone trends;
- an analysis of ozone precursor trends; and
- supplemental modeling.

Based on the above analyses and air quality modeling performed for the Baltimore NAA, the weight of evidence shows that the region will meet the 8-hour ozone standard by the end of the 2012 ozone season.

2.0 INTRODUCTION AND BACKGROUND

This document, entitled *Baltimore Serious Nonattainment Area 0.08 ppm 8-Hour Ozone State Implementation Plan,* presents the Maryland Department of the Environment's (MDE) progress in adopting and implementing air pollution control programs needed to attain the 8-hour ozone standard by 2014 in the Baltimore metropolitan area. Based on the control measures being implemented, the related air quality modeling results, and the weight of evidence demonstration prepared, there is significant evidence that the Baltimore Nonattainment Area will attain the 8-hour ozone standard by June 15, 2013.

2.1 STATE IMPLEMENTATION PLANS

The State Implementation Plan (SIP) is a detailed document required for states or regions that do not meet air quality levels set by the federal government. The SIP identifies how that State will attain and/or maintain the primary and secondary National Ambient Air Quality Standards (NAAQS) set forth in section 109 of the Clean Air Act ("CAA" or "the Act") and 40 Code of Federal Regulations 50.4 through 50.12 and which includes federally-enforceable requirements. Each State is required to have a SIP that contains control measures and strategies that demonstrate how each area will attain and maintain the NAAQS. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee to EPA. The Clean Air Act requires EPA to review each plan and any plan revisions and to approve the plan or plan revisions if consistent with the Act.

SIP requirements applicable to all areas are provided in section 110 of the Act. Part D of Title I of the Act specifies additional requirements applicable to nonattainment areas. Section 110 and part D describe the elements of a SIP and include, among other components, emission inventories, a monitoring network, an air quality analysis, modeling, attainment demonstrations, enforcement mechanisms, and regulations which have been adopted by the State to attain or maintain NAAQS. EPA has adopted regulatory requirements which detail the procedures for preparing, adopting and submitting SIPs and SIP revisions. These regulatory requirements are codified in 40 CFR part 51. EPA's action on each State's SIP is promulgated in 40 CFR part 52.

The contents of a typical SIP fall into several categories: (1) State-adopted control measures which consist of either rules/regulations or source-specific requirements (e.g., orders and consent decrees); (2) State-submitted comprehensive air quality plans, such as attainment plans, maintenance plans rate of progress plans, and transportation control plans demonstrating how these state regulatory and source-specific controls, in conjunction with federal programs, will bring and/or keep air quality in compliance with federal air quality standards; (3) State-submitted "non-regulatory" requirements, such as emission inventories, small business compliance assistance programs, statutes demonstrating legal authority, and monitoring networks; and (4) additional requirements promulgated by EPA, in the absence of a commensurate State provision, to satisfy a mandatory section 110 or part D (CAA) requirement.

Once the Administrator of the EPA approves a state plan, the plan is enforceable as a state law and as federal law under Section 113 of the CAA. If the SIP is found to be inadequate in EPA's judgment to attain the NAAQS in all or any region of the state, and if the state fails to make the requisite amendments, under Section110(c)(1), the EPA Administrator may issue amendments to the SIP that are binding. EPA is required to impose severe sanctions on the state under three circumstances: the state's failure to submit a SIP revision; the finding of the inadequacy of the SIP to meet prescribed air quality requirements; and the state's failure to enforce the control strategies that are contained in the SIP. Sanctions include withholding federal funds for highway projects other than those for safety, mass transit, or transportation improvement projects related to air quality improvement or maintenance; and the imposition of 2:1 offset sanctions; these sanctions begin 24 months after the EPA announcement. No federal agency or department will be able to award a grant or fund, license, or permit any transportation activity that does not conform to the most recently approved SIP.

2.2 CLEAN AIR ACT

The Clean Air Act was passed in 1970 to protect public health and welfare. Congress amended the Act in 1990 to establish requirements for areas not meeting the National Ambient Air Quality Standards. The Clean Air Act Amendments of 1990 (CAAA) established a process for evaluating air quality in each region and identifying and classifying nonattainment areas according to the severity of their air pollution problem. The CAAA defines ground-level ozone as a criteria pollutant. In 1979 EPA promulgated the 0.12 parts per million (ppm) 1-hour ozone standard. In 1997, EPA issued a revised and stricter ozone standard of 0.08 ppm[1] measured over an eight-hour period. The one-hour ozone standard was consequently revoked in June 2005. The Clean Air Act also sets National Ambient Air Quality Standards for five other criteria pollutants; carbon monoxide, particulate matter, lead, sulfur dioxide and nitrogen dioxide.

In April 2004, EPA designated the Baltimore metropolitan area as a “moderate” nonattainment area for the 0.08 ppm eight-hour ozone standard under Subpart 2 of part D, Title I. The boundaries of the Baltimore Nonattainment Area are defined in the *Federal Register, (Vol:69, no.84, 4/30/04).* The Baltimore Nonattainment Area includes Baltimore City and Anne Arundel, Baltimore, Carroll, Harford, and Howard counties. A map of the nonattainment area is shown in Figure 2-1.

[1] Note that the 0.08 ppm ozone standard is often referred to as “80 ppb,” “84 ppb,” or “85 ppb” due to issues of how 0.08 ppm is rounded when converted to units of parts per billion (ppb).

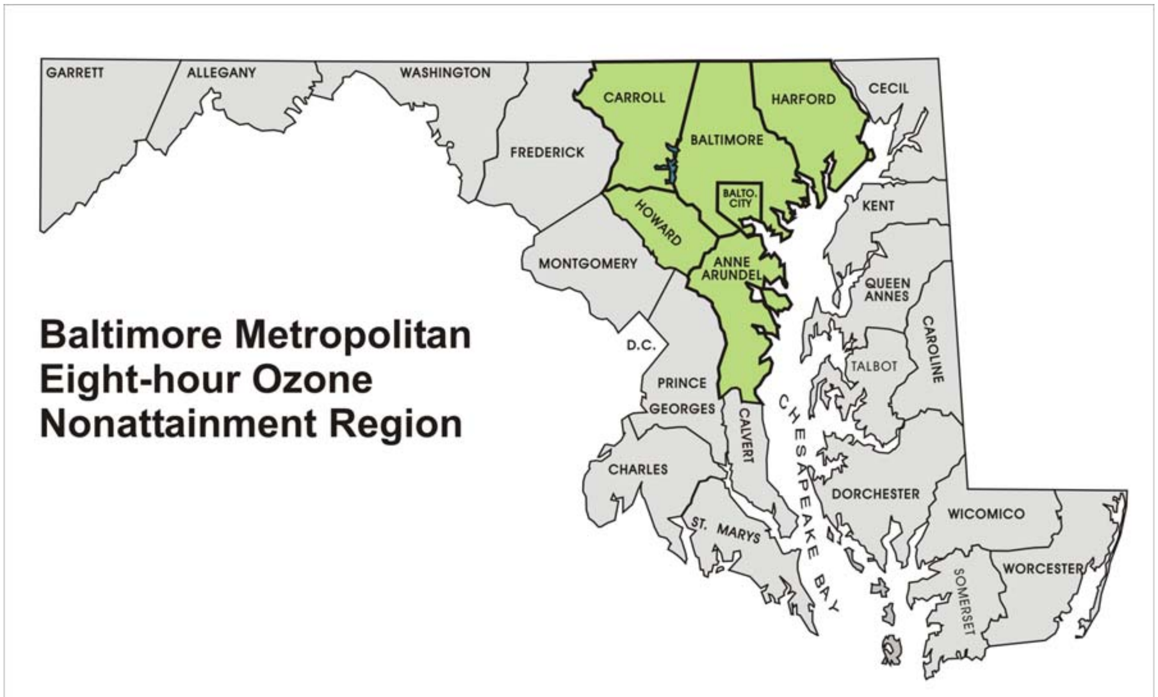


Figure 2-1: Map of the Baltimore Metropolitan Eight-hour Ozone Nonattainment Region

To meet the federal 0.08 ppm 8-hour standard for ozone, nonattainment areas are required to develop their SIP documents to reduce ozone-forming emissions by at least 15 percent between 2002-2008, and to reduce all ozone precursor emissions to a level sufficient to attain the federal eight-hour standard by June 15, 2010. However, the region is required to demonstrate attainment of the standard by the end of the last ozone season before that date, which is September 2009.

The region did not meet the Clean Air Act Amendments deadline of June 2010. Analysis suggests this was due to transported pollution from outside the region. This analysis was based on ozone concentrations measured at high elevation monitors located to the west of the Baltimore NAA. The results demonstrated the effect of transported pollution, which contributed potentially up to 50% of the pollution on the worst days of summer.

2.3 EIGHT-HOUR OZONE STANDARD

In 1997, EPA issued a revised ozone health standard based on an 8-hour measurement to protect human health against longer exposure periods. Since the late 1980's, more than 3,000 published health studies have indicated that health effects occur at levels lower than the previous 1-hour standard and that exposure times longer than one hour are of concern. EPA established an 8-hour standard at 0.08 ppm and defined the new standard as a "concentration-based" form, specifically the 3-year average of the annual 4th highest daily maximum 8-hour ozone concentration.

EPA changed the form of the standard to a concentration-based form because it more accurately reflects actual human exposure and related health effects. Even at relatively low levels, ozone may cause inflammation and irritation of the respiratory tract, particularly during physical activity. The resulting symptoms can include breathing difficulty, coughing, and throat irritation. Breathing ozone can affect lung function and worsen asthma attacks. Ozone can increase the susceptibility of the lungs to infections, allergens, and other air pollutants. Medical studies have shown that ozone damages lung tissue and complete recovery may take several days after exposure has ended.

2.4 SIP REQUIREMENTS FOR MODERATE NONATTAINMENT AREAS

The Clean Air Act Section 182 (b) requires moderate nonattainment areas to submit state implementation plan revisions that meet the following planning requirements:

- Reasonable Further Progress: 15% emission reduction from baseline within 6 years of enactment
- Attainment demonstration: Due 3 years after CAA Amendments enactment (7/15/07)
- New Source Review (NSR) and Reasonably Available Control Technology (RACT) major source applicability: 100 tons per year (TPY)
- NSR offsets: 1.15 to 1
- NSR permits: required for new or modified major stationary sources
- NOx control for RACT: requirement for major stationary VOC sources also applies to major NOx sources
- RACM/RACT: RACT required for all Control Technique Guideline (CTG) sources and all other major sources
- Inspection and Maintenance (I&M): Basic I&M
- Stage II vapor recovery: required for all gas stations
- Contingency measures: required for failure to meet Reasonable Further Progress (RFP) milestones or attain

Before designation as a moderate nonattainment area for the eight-hour standard, the Baltimore region was classified as a "severe" nonattainment area for the one-hour ozone standard. The Clean Air Act Section 182 (d) requirements for severe nonattainment areas include a number of planning requirements that are more stringent than those required for a moderate nonattainment area. Some of the more stringent requirements, such as lower permit thresholds, remain in force in the Baltimore region and throughout Maryland in order to prevent backsliding.

The more stringent regulations remaining in force in Maryland are the following:

- Lower permit threshold for point sources from 100 tons per year, to 25 tons per year;
- Lower threshold for definition of "Major" source to 25 tons per year for RACT control requirements;
- Require new or expanding sources to offset increased emissions by 1.3:1;
- Enhanced I&M

2.5 SIP REQUIREMENTS WHEN RECLASSIFYING FROM "MODERATE" TO "SERIOUS"

On February 1, 2012 (effective March 2, 2012) EPA reclassified the Baltimore, MD Nonattainment Area as a "serious" nonattainment area.[2] As a serious nonattainment area for 8-hour ozone National

[2] EPA 40 CFR Part 81, *Federal Register*, Vol. 77, No. 21, February 1, 2012, pp. 4901-4903.

Ambient Air Quality Standard (NAAQS), the Baltimore region is required to meet the requirements defined in the Clean Air Act, Section 182 (d) and to submit a revised serious area SIP by September 30, 2012. The “serious” nonattainment area requirements include:

- Meet all requirements for moderate nonattainment areas
- Adopt state regulations to meet CAA Section 182 (d)
- Adopt a contingency plan for 2008 Reasonable Further Progress (RFP)
- Require new or expanding sources to offset increased emissions by 1.3:1
- Revise and submit an updated attainment demonstration that reflects MOVES-based motor vehicle emissions budgets
- Demonstrate 3% per year reasonable further progress from 2008-2011 and from 2011-2012
- Adopt contingency measures for failure to make RFP in those periods and
- Submit an analysis of Reasonably Available Control Measures for the region.
- Submit a new attainment demonstration

2.6 GROUND LEVEL OZONE

Ground-level ozone is an extremely reactive gas comprised of three atoms of oxygen. Ozone, the primary constituent of smog, continues to be a pollution problem throughout many areas of the United States. Unlike many other pollutants, ground-level ozone is not directly emitted into the atmosphere from a specific source. Instead, ground-level ozone is formed when nitrogen oxides (NOx) chemically react with volatile organic compounds (VOCs) through a series of complicated chemical reactions in the presence of strong sunshine (ultraviolet light).

Because ozone formation is greatest when the sunlight is most intense, the peak ozone levels typically occur in Maryland during hot, dry, stagnant summertime conditions generally referred to as the ozone season (April 1 to October 31). Peak ozone concentrations exhibit a clear seasonal cycle, with concentrations rising with the onset of warmer weather in the spring and declining again as the autumn approaches. Changing weather patterns can significantly contribute to yearly differences in ozone concentrations. Years with summertime weather conditions that are hot and dry will generally result in many more days of poor air quality than cool and wet summers.

Figure 2-2: Formation of Ground Level Ozone

The formation of ozone is not an instantaneous process, nor is it limited in geographical scope. While many urban areas tend to have high levels of ozone, even rural areas are subject to increased ozone levels because wind carries ozone, and the pollutants that form it, hundreds of miles from their original sources. Numerous studies and modeling data show compelling evidence that weather patterns often result in the transport of ozone and the pollutants responsible for ozone formation, well beyond the locality that produced the emissions. In many cases, unhealthy days of air pollution experienced in Maryland are exacerbated by pollutants transported into Maryland from neighboring states.

Ground-level ozone can have significant impacts on human health, particularly people with existing respiratory disease, the elderly, and children. Ozone also impacts the environment and ecosystem health. Scientific evidence suggests that air pollution weakens the immune systems of many types of vegetation and can cause significant crop damage. In addition, rain and snow wash air pollution deposited on vegetation and architectural surfaces into the streams and rivers of the region and finally into the Chesapeake Bay.

2.7 AIR POLLUTION AND THE CHESAPEAKE BAY

Typically, air pollution is thought of as smog that affects people's health and reduces visibility. However, air pollution also contributes to land and water pollution that affects the health of the Chesapeake Bay's resources - its fish, shellfish, and other animals. Over the last thirty years, research has provided us with increased knowledge of how air pollution can directly affect the Bay.

Pollutants released into the air will eventually make their way back down to the earth's surface. Some of the factors that determine how far pollutants can travel through the air include the following: the chemical makeup of the pollutant, weather conditions (wind, temperature, humidity), type and height of the emission source (smokestack, automobile tail pipe), and the presence of other chemicals in the air. Airborne pollutants fall to the earth's surface by wet deposition (precipitation), or dry deposition (settling or adsorption). Airborne pollutants that deposit on the landscape can be transported into streams, rivers, and the Bay by runoff or through groundwater flow.

Excess nitrogen and chemical contaminants from atmospheric deposition impact the Chesapeake Bay and its watershed. Too much nitrogen entering the Chesapeake Bay leads to eutrophication, a process that causes an accelerated growth of algae. Too much algae in the Bay blocks sunlight needed for submerged aquatic vegetation to grow. Also, when the algae die, they sink to the bottom of the Bay and decompose in a process that depletes the oxygen in the water.

The effects of nitrogen can also be seen in acid rain. Nitrogen oxides (NOx) are one of the key air pollutants causing acid deposition, which results in adverse effects in aquatic and terrestrial ecosystems. Acid deposition increases the acidity of water and soils. Increases in water acidity can impair the ability of certain fish and aquatic life to grow, reproduce, and survive. Increases in soil acidity can impair the ability of some types of trees to grow and resist disease.

2.8 HEALTH EFFECTS

Ozone is a highly reactive gas that reacts strongly with living tissues, as well as many synthetic substances. Since 90% of the ozone breathed into the lungs is never exhaled, ozone molecules react with lung tissue to cause several health consequences.[3] Too much ozone in the air can be harmful to people who work or exercise outdoors regularly, anyone with respiratory difficulties, and especially to children. The most common symptom that people have when exposed to ozone is pain when taking a deep breath. Exposure to ozone can result in both long-term and short-term effects in healthy individuals as well as those who are already sensitive to air pollution, such as children, asthmatics and the elderly.

Ozone's long-term effects may include reduced lung function, scarring of lung tissue, and even premature death.[4] Research suggests that repeated exposure to ozone may cause damage to lung tissue, thereby reducing lung function. According to EPA, "Long-term exposures to ozone can cause repeated inflammation of the lung, impairment of lung defense mechanisms, and irreversible changes in lung structure, which could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis."[5]

---

[3] Sources and Health effects of Ground-Level Ozone, downloaded from http://www.dnr.state.wi.us/eq/aie/ozone/b_effect.htm.

[4] Bell ML, Dominici F, and Samet JM. *A Meta-Anaysis of Time-Series Studies of Ozone and Mortality with Comparison to the National Morbidity, Mortality, and Air Pollution Study*. Epdidemiology 2005; 16:436 445.

[5] United States Environmental Protection Agecny. (17 July, 1997), Factsheet: EPA's Revised Ozone Standard. United State Environmental Protection Agency, Technology Transfer Network, OAR Policy and Guidance. Retrived on December 28, 2005 from the World Wide Web: http://www.epa.gov/ttn/oarpg/naaqsfin/03fact.html/

Children are at greater risk for ozone-related respiratory problems because their lungs are still developing, they breathe more rapidly, and they play outside during the afternoons when ozone is at its highest levels. Children also inhale more air; hence, they receive more pollution per pound of body weight than adults do.[6] Additionally, anyone suffering from lung disease has even more trouble breathing when air is polluted with high levels of ozone. Prolonged exposure, even to relatively low levels of ozone, can significantly reduce a healthy adult's lung function.[7]

Short-term effects of ozone exposure among healthy populations include impaired lung function and reduced ability to perform physical exercise. For example, healthy young people developed a significant reduction of lung function, additional coughing and breathing pains, and enhanced airway reactivity to irritants when exposed to ozone at concentrations of 80-120 parts per billion (ppb) for 6.6 to 7.0 hours while exercising moderately.[8] Among people who are especially sensitive to ozone pollution, short-term effects include increased hospital admissions and emergency room visits for respiratory diseases such as asthma.

In summary, health effects from exposure to ozone can include the following:

- Increased susceptibility to respiratory infection
- Impaired lung function and reduced ability to perform physical exercise
- Severe lung swelling and death, due to short-term exposures greater than 300 ppb
- Increased hospital admissions and emergency room visits for respiratory diseases

2.9 MARYLAND-SPECIFIC AIR POLLUTION HEALTH EFFECTS

According to the U.S. Census Bureau, Census 2000 data, there are 5,296,486 people living in Maryland, of whom 1,136,846 were under 15 years of age, and of whom 599,307 were 65 or over[9]. This means that the total number of children and elderly in Maryland was 1,736,153. Approximately one third of Maryland's population is more likely to suffer the adverse effects of air pollution simply as a result of their age.

---

[6] Ambient Air Pollution: Respiratory Hazards to Children Committee on Environmental Health Pediatrics 1993 91: 1210-1213.

[7] Galizia, A. and Kinney, P.L. Long-Term Residence in Areas of High Ozone: Associations with Respiratory Health in Nationalwide Sample of Nonsmoking Young Adults. August 1999. Environ Health Perspect, Vol. 107, No. 8, pp. 675-679

[8] Foinsbee et al., 1990; Horstman et al., 1990; McDonnell et al., 1991. Out of Breath: A Report on the Health Consequences of Ozone and Acidic Air Pollution in Metropolitan Chicago. American Lung Association of Metropolitan Chicago, October 19, 1994

[9] United States Census Bureau. Census 2000 Demographic Profile highlights: Maryland. (Online, follow link to Maryland). United Stated Census Bureau, American FactFinder, 2000. Retrieved on March 28, 2005 from the World Wide Web: http://factfinder.census.gov/

According to an April 2006[10] report from the American Lung Association, the group of people with respiratory disease in the state of Maryland includes:

- 274,967 adult asthmatics and 100,370 child asthmatics;
- 147,226 residents with chronic bronchitis; and
- 57,310 residents with emphysema.

2.10 THE IMPACT OF OZONE UPON AGRICULTURE

Because ozone formation requires sunlight, periods of high ozone concentration coincide with the agriculture growing season in Maryland. Ozone damage to plants can occur with or without any visible signs. Consequently, many farmers are unaware that ozone is reducing their yields. Ozone enters the plant's leaves through its gas exchange pores (stomata), just as other atmospheric gases do in normal gas exchange. The ozone then dissolves in the water within the plant and reacts with other chemicals, causing a variety of problems.

Ozone damage in the plant causes photosynthesis to slow, resulting in slower plant growth. Such ozone induced problems also decrease the numbers of flowers and fruits a plant will produce, and impair water use efficiency and other functions. Plants weakened by ozone may be more susceptible to pests, disease, and drought.

Most studies of the economic impact of air pollution on agriculture have found that a 25 percent reduction in ambient ozone would provide benefits of at least $1-2 billion annually in the United States. Studies of soybean yields at the University of Maryland found a 10 percent loss of the soybean crop due to current levels of ozone in the state. The same study showed that ozone exposure causes the loss of 6-8 percent of winter wheat and 5 percent of the corn crop yields to Maryland farmers.

2.11 THE AIR QUALITY INDEX (AQI)

The AQI is an index used for reporting forecasted and daily air quality. The AQI uses both a color-coded and numerical scale to report how clean or polluted the air is and what associated health effects might be of concern. The AQI focuses on health effects people may experience within a few hours or days after breathing polluted air. The AQI is calculated for five major pollutants regulated by the Clean Air Act: particulate matter, ozone, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

[10] America Lung Association State of the Air, April 2006, pp. 1-207

Air Quality Numerical Value	Action Steps To Protect Your Health and Our Environment
GOOD 0-50	No pollution. Enjoy outdoor activities. ◆ Keep engines tuned. ◆ Use environmentally friendly products. ◆ Conserve electricity, set air conditioning to 78 degrees.
MODERATE 51-100	Air quality may pose a moderate risk, especially for those who are unusually sensitive to air pollution. ◆ Carpool, use public transit, bike, or walk. ◆ Limit driving, consolidate trips. ◆ Reduce car idling.
UNHEALTHY for Sensitive Groups 101-150	**Sensitive Groups**—children and active adults, people with respiratory disease, such as asthma and emphysema and heart ailments should limit prolonged outdoor physical activity. Follow all of the action steps listed previously AND: ◆ Refuel after dusk, use fuel-efficient vehicles. ◆ Avoid driving, use transit, telework. ◆ Avoid using aerosol products.
UNHEALTHY 151-200	**Unhealthy for Everyone** Sensitive Groups in particular should avoid outdoor physical activities. Everyone else, especially children, should limit prolonged outdoor exertion. Follow all of the action steps listed previously AND: ◆ Avoid lawn mowing or use electric mowers. ◆ Avoid using any gas powered lawn equipment. ◆ Put off painting until air quality improves.
VERY UNHEALTHY 201-300	**Very Unhealthy for Everyone** When air quality reaches very unhealthy levels everyone is strongly urged to follow all of the actions steps listed previously AND avoid outdoor physical activities.

Figure 2-3: The Air Quality Index and Action Guide

Using the Air Quality Index, the Maryland Department of the Environment and the Metropolitan Washington Council of Governments (COG) issue daily air quality forecasts for the Baltimore metropolitan area, Washington metropolitan area, Western Maryland, and the Eastern Shore. Extended range forecasts provide a three-day forecast so people can better plan their week and take the opportunity to arrange car pools, take mass transit, or take other actions to limit pollution when air quality is predicted to be unhealthful.

MDE and COG issue the air quality forecasts to local media and hundreds of businesses and individuals throughout the region. Anyone can sign up to receive the free, daily email by visiting the Clean Air Partners web site at http://www.cleanairpartners.net/. The Clean Air Partners web site provides the public with easy-access local and national air quality information. Clean Air Partners offers daily AQI forecasts and real-time AQI conditions throughout most of Maryland, the District of Columbia, and Northern Virginia. Users of Clean Air Partners may also sign-up for AirAlerts to receive real-time email notifications when air quality reaches unhealthy levels in the region.

Figure 2-4: Air-Watch.net Real-time Air Quality Data and Forecasts

2.12 SOURCES OF OZONE POLLUTION IN THE BALTIMORE REGION

There are a number of diverse sources that discharge VOCs and NOx, the two primary pollutants responsible for ozone formation. Human made sources, called anthropogenic sources, are divided into four categories: point, area, on-road mobile and non-road mobile sources. A fifth category, "biogenic" emissions, includes all naturally occurring sources of VOC emissions from trees, crops and other forms of vegetation.

Point sources are primarily manufacturing businesses that produce emissions equal to or greater than 25 tons per year (tpy) of VOCs or NOx. Large industrial plants such as power plants and chemical manufacturers are examples of point sources.

Area sources are smaller sources of air pollution whose emissions are too small to be measured individually. Examples of area sources include commercial and consumer products (such as paints and hairspray), bakeries, dry cleaners, gasoline refueling stations, printing facilities, and autobody refinishing shops.

Sources of air pollution that are not stationary are referred to as mobile sources and are split into two categories: on-road mobile sources and non-road mobile sources. The former include cars, vans, trucks and buses (i.e. vehicles that operate on highways). Non-road mobile sources include boats, lawn and garden equipment, construction equipment and locomotives.

Table 2-1:
Top Ten Sources of Human Made Volatile Organic Compound (VOCs) in the Baltimore Area in 2002, 2008, 2011 and 2012

			VOC (Tons/Day)			
Rank	***Source Category***	***Source***	***2002***	***2008***	***2011***	***2012***
1	On-Road Mobile	Cars, Buses, Trucks	72.48	50.12	44.54	40.23
2	Nonroad	Lawn and Garden Total	34.52	22.36	19.37	18.01
3	Area	Commercial & Consumer Solvents	24.75	22.33	22.33	22.43
4	Area	Portable Fuel Containers	18.68	13.00	11.23	11.29
5	Area	Architectural Surface Coatings	18.28	13.43	13.78	13.85
6	Area	Industrial Surface Coating	16.97	18.44	19.09	19.23
7	Point	Utilities and Other Stationary Sources	12.74	14.31	15.13	15.48
8	Nonroad	Pleasure Craft Total	8.68	6.68	5.40	4.94
9	Area	Surface Cleaning/Degreasing	8.09	8.81	9.12	9.19
10	Area	Gasoline Marketing	6.67	7.50	7.93	8.07
			221.85	176.97	167.92	162.73

****The emissions estimates above are rounded to the nearest whole number. The figures are MDE's best estimates. Total VOC emissions in the Baltimore area were 382 tons per day in 2002 and 285.7 tons per day in 2008. Biogenic emissions account for 314.7 tons/day of VOC emissions in the Baltimore region.***

Table 2-2:
Top Ten Sources of Nitrogen Oxides (NOx) in the Baltimore Area in 2002, 2008, 2011 and 2012

			NOx (Tons/Day)			
Rank	***Source Category***	***Source***	***2002***	***2008***	***2011***	***2012***
1	On-Road Mobile	Cars, Buses, Trucks	202.22	125.69	104.62	93.47
2	Point	Utilities and Other Stationary Sources	102.19	111.64	82.26	81.44
3	Nonroad	Construction and Mining Total	21.52	18.66	16.52	15.55
4	Nonroad	Industrial Total	7.40	5.32	3.75	3.25
5	Nonroad	Railroad Total	6.26	5.61	5.43	5.38
6	Nonroad	Lawn and Garden Total	5.86	5.17	4.70	4.35
7	Area	Incineration	3.84	3.84	3.84	3.84
8	Nonroad	Commercial Total	3.27	3.07	2.88	2.76
9	Area	Residential Fuel Combustion	2.66	2.78	2.83	2.84
10	Nonroad	Pleasure Craft Total	0.76	0.96	1.01	1.01
			355.99	282.75	227.85	213.90

The emissions estimates above are rounded to the nearest whole number. The figures are MDE's best estimates. The total emission of NOx in the Baltimore area was 541 tons per day in 2002 and 320 tons per day in 2008.

2.13 FREQUENCY OF VIOLATION OF FEDERAL HEALTH STANDARD FOR OZONE

Since the Clean Air Act Amendments of 1990, Maryland has made significant improvements in the quality of air. National, state, and local programs have all contributed to dramatically limiting the amount of pollution that is generated, which has reduced the number of days that unhealthful air is experienced throughout the region. Mandated reductions in emissions from businesses and industries and technological improvements in automobiles have brought about a steady progress in air quality.

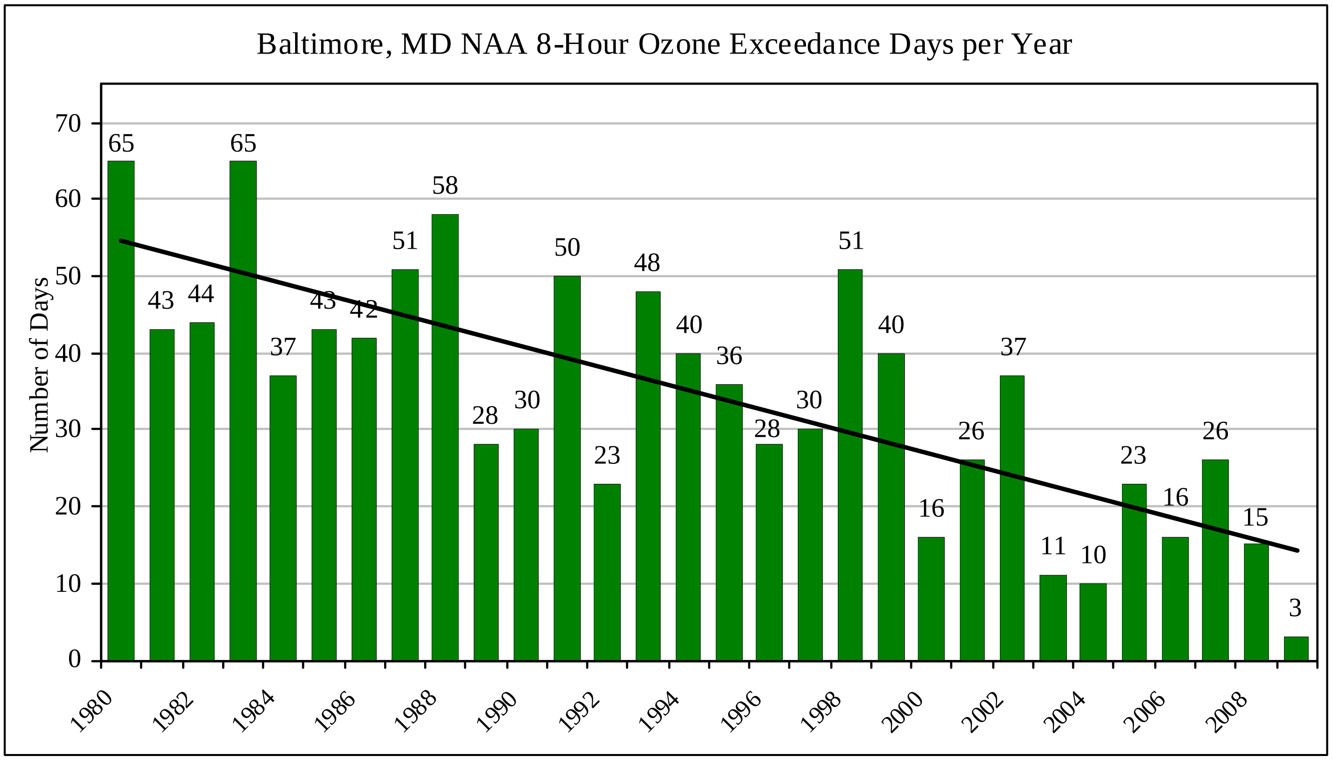


Figure 2-5: 8-Hour Ozone Exceedance Days for the Baltimore Nonattainment Area

The federal 8-hour ozone standard is set at 0.08 parts per million of ozone averaged over an eight-hour period. Figure 2-5 applies the eight-hour standard to historic data and shows the number of days that would have exceeded levels under the new standard. The figure also clearly shows an improving trend in the Baltimore regions air quality since 1980. While annual fluctuations can be attributed to weather (hot, stagnant summers are favorable for ozone formation), the downward trend is indicative of controls on sources of air pollution and the resulting levels of ozone precursors present in the ambient air.

2.14 REQUIRED SIP PRINCIPLES

Section 110 of the 1990 CAAA specifies the conditions under which EPA approves SIP submissions. These requirements are being followed by the Maryland Department of the Environment in developing this air quality plan (SIP). In order to develop effective control strategies, EPA has identified four fundamental principles that SIP control strategies must adhere to in order to achieve the desired emissions reductions. These four fundamental principles are outlined in the General Preamble to Title I of the Clean Air Act Amendments of 1990 at *Federal Register* 13567 (EPA, 1992a). The four fundamental principles are as follows:

1. Emissions reductions ascribed to the control measure must be quantifiable and measurable;

2. The control measures must be enforceable, in that the state must show that they have adopted legal means for ensuring that sources are in compliance with the control measure;

3. Measures are replicable; and

4. The control strategy must be accountable in that the SIP must contain provisions to track emissions changes at sources and to provide for corrective actions if the emissions reductions are not achieved according to the plan.

2.15 SANCTIONS

EPA must impose various sanctions if the State does not submit a plan, submits a plan that the EPA does not approve, or fails to implement the plan. These sanctions include withholding federal highway funding, withholding air quality planning grants, and imposing a federal plan ("federal implementation plan."). Failure to submit or implement a plan will have significant consequences for compliance with conformity requirements and the imposition of 2:1 offset requirements.

2.16 REASONABLE FURTHER PROGRESS

As a serious area, EPA requires the two Reasonable Further Progress demonstrations for the Baltimore Nonattainment Area; one for the period 2002 – 2008 and the second for 2008 – 2011.[11] EPA's implementation guidance requires that a serious ozone nonattainment area, such as the Metropolitan Baltimore region, with an approved 15% VOC reduction plan for the period 1990-1996 (required for former 1-hour ozone non-attainment areas) demonstrate a 15% Reasonable Further Progress by 2008 and 3% per year Reasonable Further Progress by 2011. Chapter 5 contains the Baltimore region's reasonable further progress demonstration for the years 2002-2008, and Chapter 6 provides the RFP demonstration for 2008-2011. The region needs to fulfill the 2008-2011 reasonable further progress requirements by January 1, 2012.

In order to demonstrate reasonable further progress, a region must show that its expected emissions, termed "controlled inventories," of NOx and VOC will be less than or equal to the target levels set for the end of the reasonable further progress period, or "milestone year". For the RFP period 2002-2008, the "target inventories" of emissions are the maximum quantity of anthropogenic emissions permissible during the 2008 milestone year. For the RFP period 2008-2011, the "target inventories" of emissions are the maximum quantity of anthropogenic emissions permissible during the 2011 milestone year.

2.17 ANALYSIS OF REASONABLY AVAILABLE CONTROL MEASURES (RACM)

An extensive list of potential control measures was analyzed and evaluated against criteria used for potential RACM measures. Individual measures must meet the following criteria: reduce emissions by the beginning of the Baltimore region's 2008 ozone season (April 1, 2008); are enforceable; are technically feasible; are economically feasible, defined as a cost of $3,500 to $5,000 per ton or less;

[11] Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard, Federal Register, Vol 70, No. 228, Nov.29, 2005, pp. 71612-71705.

would not create substantial or widespread adverse impacts within the region; and the emissions from the source being controlled must exceed a *de minimis* threshold, defined as 0.1 tons per day. Based on the analysis completed for the Baltimore Nonattainment Area which relied heavily upon a very formal RACM analysis completed for the Washington DC Nonattainment Area (where MDE actively participated in a significant RACM workgroup) there were no identified RACM measures that if implemented would advance attainment in the Baltimore Nonattainment Area.

2.18 CONTINGENCY MEASURES

In the event that the reductions anticipated in the 2011 Reasonable Further Progress demonstrations or the 2012 attainment demonstration are not realized within the timeframes specified, there must be contingency measures ready for implementation. EPA issued guidance that says that contingency measures must provide for a 3% reduction in adjusted 2002 base year inventory for both Reasonable Further Progress and attainment. A minimum of 0.3 percent VOC must be included. The total required reductions for RFP contingency equate to approximately 7.76 TPD of VOC, which Maryland meets. The measures proposed as contingency measures are listed in Chapter 12, which contains detail on these measures, how they would be implemented and enforced, and the level of emission reduction benefits expected.

3.0 THE 2002 BASE-YEAR INVENTORY AND REASONABLE FURTHER PROGRESS REVISIONS

3.1 BACKGROUND AND REQUIREMENTS

The 2002 Base-Year Inventory is published in a separate document, "2002 Base Year Emissions Inventory & QA/QC Plan Maryland," June 15, 2006. This document was submitted to the U.S. Environmental Protection Agency (EPA) Region III. MDE prepared the document, and the document remains intact to fulfill the State Implementation Plan (SIP) inventory requirement of the CAA. It is available for inspection at the Maryland Department of the Environment, Air and Radiation Management Administration, 1800 Washington Boulevard, Suite 730, Baltimore, Maryland 21230.

The emissions inventory covers the Baltimore nonattainment area, shown in Figure 2-1, which is classified as a moderate nonattainment area for ozone by the EPA. The 2002 emissions inventory is the starting point for calculating the emissions reductions required to meet the goal of a 15% reduction in VOC/NOx emissions, from anthropogenic sources, by 2008. Meeting this 2008 goal means meeting reasonable further progress requirements prescribed for moderate nonattainment areas by the Clean Air Act Amendments (CAAA) and EPA.

This separately published document, which was previously submitted to EPA, addresses emissions of volatile organic compounds (VOCs), nitrogen oxides (NOx), and carbon monoxide (CO) on a typical summer ozone season day and annual basis. Included in the inventory are anthropogenic (human-made) stationary, non-road and on-road mobile sources; and biogenic (naturally occurring) sources of ozone precursors.

When updating or revising a SIP, EPA requires that the latest models and inventory methodologies be used when calculating Reasonable Further Progress (RFP) goals and target levels. As such, updates to the RFP inventories are documented in Appendix A-1.

3.2 TOTAL EMISSIONS BY SOURCE

3.2.1 Point Sources

For emissions inventory purposes, point sources are defined as stationary, commercial, or industrial operations that emit more than 10 tons per year (tons/year) of VOCs or 25 tons/year or more of NOx or CO. The point source inventory consists of actual emissions for the base-year 2002 and includes sources within the geographical area of the Baltimore Nonattainment Area.

3.2.1.1 Reasonable Further Progress Revisions

No revisions to the point source emissions inventory were necessary for Reasonable Further Progress purposes.

3.2.2 Quasi-Point Sources

The Maryland Department of the Environment Air and Radiation Management has identified several facilities that due to size and/or function are not considered point sources. These establishments contain a wide variety of air emission sources, including traditional point sources, on-road mobile sources, off-road mobile sources and area sources. For each particular establishment, the emissions from these sources are totaled under a single point source and summary documents include these “quasi-point” sources as point sources.

Quasi-point sources will include all emissions at the facility regardless of whether they are classified as point, area, nonroad, or mobile source emissions. These emissions are actual emissions reported for the facilities. The Baltimore Nonattainment Area has the following quasi-point sources:

- Baltimore Washington International Airport (BWI)
- Aberdeen Proving Grounds

These emissions have been included as “point source” in summary documents.

3.2.2.1 Reasonable Further Progress Revisions

No revisions to the quasi-point source emissions inventory were necessary for Reasonable Further Progress purposes.

3.2.3 Area Sources

Area sources are sources of emissions too small to be inventoried individually and which collectively contribute significant emissions. Area sources include smaller stationary point sources not included in the states' point source inventories; for example, printing establishments, dry cleaners, and auto refinishing companies, as well as non-stationary sources.

Area source emissions typically are estimated by multiplying an emission factor by some known indicator of collective activity for each source category at the county or county-equivalent level. An activity level is any parameter associated with the activity of a source, such as production rate or fuel consumption that may be correlated with the air pollutant emissions from that source. For example, the total amount of VOC emissions emitted by commercial aircraft can be calculated by multiplying the number of landing and takeoff cycles (LTOs) by an EPA-approved emission factor per LTO cycle for each specific aircraft type.

Several approaches are available for estimating area source activity levels and emissions. These include apportioning statewide activity totals to the local inventory area and using emissions per employee or other unit factors. For example, solvent evaporation from consumer and commercial products such as waxes, aerosol products, and window cleaners cannot be routinely determined for many local sources. The per capita emission factor assumes that emissions in a given area can be reasonably associated with population. This assumption is valid over broad areas for certain activities such as dry cleaning and small degreasing operations. For some other sources an employment based factor is more appropriate as an activity surrogate.

3.2.3.1 Reasonable Further Progress Revisions

No revisions to the area source emissions inventory were necessary for Reasonable Further Progress purposes.

3.2.4 Mobile Sources

On-road mobile sources include all vehicles registered to use the public roadways. The predominant emissions source in this category is the automobiles, although trucks and buses are also significant sources of emissions.

The computation of highway vehicle emissions required two primary entities: a) vehicle emission factors and b) vehicle activity.

The emission factors are generated by using MOBILE6.2, which is the latest version of U.S. EPA's emission factor model as far as the base year inventory. Vehicle activity (vehicle miles traveled, or "VMT") is usually obtained from two sources: a) the Maryland State Highway Administration (SHA), and b) Baltimore Metropolitan Council (BMC) staff. VMT data from SHA, based on vehicle traffic counts on the roadway system, is mainly used for the rural counties. The Baltimore Region Transportation Board-provided transportation modeled link-based data is used in the emission modeling of the Baltimore Ozone Nonattainment Area.

In a simple modeling scenario, the product of the emission factor and vehicle miles traveled should yield emission levels. Proper units and conversions are used to arrive at reasonable emission estimates.

In a complex modeling scenario, many emissions types, such as exhaust, evaporative, diurnal, crankcase, and refueling emissions, are computed separately and treated with the appropriate activity levels.

MOBILE6 expects enormous amount of local data input, such as the fleet characteristics, fleet mileage accrual rates, speed, fuel parameters, inspection and maintenance (I/M) program in place, and weather data.

In MOBILE6 emission factor model, the total highway vehicle population is characterized by the following 16 composite vehicle type categories:

LDV - Light-Duty Vehicles (Passenger Cars)
LDT1 - Light-Duty Trucks 1
LDT2 - Light-Duty Trucks 2
LDT3 - Light-Duty Trucks 3
LDT4 - Light-Duty Trucks 4
HDV2B- Class 2b Heavy Duty Vehicles
HDV3 - Class 3 Heavy Duty Vehicles
HDV4 - Class 4 Heavy Duty Vehicles
HDV5 - Class 5 Heavy Duty Vehicles
HDV6 - Class 6 Heavy Duty Vehicles
HDV7 - Class 7 Heavy Duty Vehicles
HDV8A- Class 8a Heavy Duty Vehicles

HDV8B- Class 8b Heavy Duty Vehicles
HDBT - Transit and Urban Buses
HDBS - School Buses
MC - Motorcycles

These composite vehicle types are further classified into 28 vehicle types, depending on whether they use gasoline or diesel fuel. For example, all motorcycles are gasoline based and transit and urban buses are diesels. School buses can be either gasoline-driven or diesel-driven vehicles.

MOBILE6 also allows for the modeling of other fuel type vehicles such as hybrids and alternate fuel vehicles (AFV) as a special case in a complex modeling initiative.

The MOBILE6 model produces emission factors for each of the 28 vehicle types and one composite factor for all vehicle types.

A post-processing system takes care of all emission computations of the modeling domain by aggregating the emissions from roads/links appropriate to the area. It also produces meaningful reports by area, by vehicle type and by roadway type.

3.2.4.1 Reasonable Further Progress Revisions

EPA replaced the previous model for estimating on-road mobile source emissions, MOBILE6.2, with a new model, MOVES (**MO**tor **V**ehicle **E**mission **S**imulator). MOVES2010 is the state-of-the-art upgrade to EPA's modeling tools for estimating emissions from highway vehicles, based on analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions.

This SIP presents revised emissions inventories for 2002, 2008, 2011, and 2012 based on the MOVES2010a model for estimating on-road vehicle emissions. The analysis methodology is consistent with past statewide inventory efforts including the 2008 National Emissions Inventory (NEI) submission. Also, the methodology includes the use of statewide traffic roadway data obtained from the State Highway Administration and custom post-processing software (PPSuite) to calculate hourly speeds and prepare key traffic input files to the MOVES2010a emission model. MOVES2010a is built in to the PPSuite software package.

MDE used MOVES2010a to estimate volatile organic compounds (VOCs), nitrogen oxides (NOx), and carbon monoxide (CO) emissions for this SIP revision.

3.2.5 Nonroad Sources

Emissions for all nonroad vehicles and engines except for those at BWI airport (aircraft, ground support equipment (GSE) and, auxiliary power units (APU)), locomotives, and diesel marine vessels were calculated using EPA's NONROAD2005.0.0 (dt. 12/02/2005) model. Since the time it was first issued on 12/02/2005, this model version has undergone several corrections. The base year nonroad inventory was created using what was the version current as of 3/21/2006.

Emissions from the "nonroad vehicles and engines" category result from the use of fuel in a diverse collection of vehicles and equipment, including those in the following categories:

- Recreational vehicles, such as all-terrain vehicles and off-road motorcycles;
- Logging equipment, such as chain saws;
- Agricultural equipment, such as tractors;
- Construction equipment, such as graders and back hoes;
- Industrial equipment, such as fork lifts and sweepers;
- Residential and commercial lawn and garden equipment, such as leaf and snow blowers; and
- Aircraft ground support equipment.

The nonroad model estimates emissions for each specific type of nonroad equipment by multiplying the following input data estimates:

- Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
- Average load factor, expressed as average fraction of available power;
- Available power, in horsepower;
- Activity, in hours of use per year; and
- Emission factor with deterioration and/or new standards.

The emissions are then temporally and geographically allocated using appropriate allocation factors.

3.2.5.1 Reasonable Further Progress Revisions

EPA replaced the previous model for estimating off-road mobile source emissions, NONROAD2005, with a new version, NONROAD2008. The main change for NONROAD2008 is the inclusion of emission reductions associated with two rules finalized in 2008:

- Diesel (CI) recreational marine standards in the Locomotive/Marine final rule (Federal Register Vol 73, No. 88, page 25098, May 6, 2008).
- Small Spark Ignition (SI) and SI Recreational Marine final rule (Federal Register Vol 73, No. 196, page 59034, October 8, 2008).

NONROAD2008 predicts substantially lower hydrocarbons (HC) and CO and somewhat lower NOx and PM emissions than NONROAD2005 while using comparable scenario inputs.

Aircraft (military, commercial, general aviation, and air taxi) and auxiliary power units (APU) operated at airports, along with locomotives and diesel marine vessels, are also considered nonroad sources and are included in the nonroad category.

Baltimore Washington International Airport (BWI) and the Maryland Aviation Administration (MAA) provided all types of airport emissions for BWI airport. Aircraft and APU emissions for other counties were calculated by MDE through landing and take-off data surveys. Emissions from locomotives and commercial diesel marine vessels were also produced by the MDE.

3.2.6 Biogenic Emissions

An important component of the inventory is biogenic emissions. Biogenic emissions are those resulting from natural sources. Biogenic emissions are primarily VOCs that are released from vegetation; they are emitted throughout the day. Biogenic emissions of NOx include lightning and forest fires. EPA used a biogenic computer model (BEIS3.12) to estimate biogenic emissions for each county in the country for all twelve months of the year 2002.

Emissions data for the Baltimore Nonattainment Area was acquired from the EPA website (ftp://ftp.epa.gov/EmisInventory/2002finalnei/biogenic_sector_data/). EPA has recommended that states use these emissions in case they do not have their own estimated biogenic emissions. The Baltimore, Maryland ozone non-attainment area decided to use the inventories provided by the EPA.

4.0 REASONABLE FURTHER PROGRESS PROJECTED 2008, 2011 AND 2012 INVENTORIES

Part II of EPA's rule to implement the 8-hour NAAQS required the Baltimore, MD as a moderate ozone nonattainment area to achieve, by 2008, a 15 percent emissions reduction, including either VOC or NOx emissions or any combination of the two.[12] By re-classifying as a "serious" ozone nonattainment area, the Baltimore, MD region is further required to reduce VOC and NOx emissions by 3 percent per year by 2011. An inventory for the attainment year 2012 is also required for the region.

The reductions must be calculated from the anthropogenic emissions levels reported in the 2002 Base-Year Inventory after those levels have been adjusted to reflect the expected growth in emissions between 2002 and 2008/2011/2012. The 2002 Base-Year Inventory was described in Chapter 3. This chapter presents the 2008, 2011 and 2012 Projection Inventories, that is, the estimation of the levels of emissions to be expected in those years before the consideration of emission controls.

The 2008, 2011 and 2012 projected inventories are derived by applying the appropriate growth factors to the 2002 Base-Year Emissions Inventory. EPA guidance describes four typical indicators of growth. In order of priority, these are as follows: (1) product output, or the amount of product being produced; (2) value added, or "the value of a product sold by a firm less the value of the goods purchased and used by the firm to produce the product";[13] (3) earnings, and (4) employment. Surrogate indicators of activity, for example population growth, are also acceptable methods.

Round 6B Cooperative Forecasting results (population, household and employment projections), prepared and officially adopted by the Baltimore Metropolitan Council (BMC) were used to project emissions from area sources. Projections for onroad emissions were developed using MOVES model (please see Appendix E for information on mobile source emissions).

EPA's nonroad model, NONROAD2008, was used for developing the 2008, 2011 and 2012 nonroad model inventories. BMC's Round 6B Cooperative Forecasting results and the Economic Growth Analysis System (EGAS) model were used to project growth in the additional nonroad source categories such as railroad locomotives, marine vessels and airports. The EGAS model was also used to project growth in point source emissions.

4.1 GROWTH PROJECTION METHODOLOGY

The following sections describe the method followed to determine the projected inventories for 2008, 2011 and 2012.

---

[12] EPA 40 CFR Parts 51, 52 & 90, *Federal Register.* Vol.70, No. 228, Nov. 29, 2005, pp.71612-71705.
[13] STAPPA-ALAPCO-EPA Emission Inventory Improvement Program, *Emission Projections*, prepared by The Pechan-Avanti Group, Springfield, VA, December 1999.

4.1.1 Growth Projection Methodology for Point Sources: EGAS

The growth in point source emissions is projected using EGAS version 5.0. Point source emissions for 2002 are provided from the state data sources. The model is run with the 2002 emissions data grouped by Source Classification Code (SCC). Growth factors generated from the Bureau of Labor Statistics national economic forecast and the baseline regional economic forecast are applied to each SCC grouping.

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators, please refer to Appendix A-1.

Point source emission projection data is contained in Appendix A-2.

4.1.2 Growth Projection Methodology for Quasi-Point Sources

Quasi-point sources will include all emissions at the facility regardless of whether they are classified as point, area, nonroad, or mobile source emissions. These emissions are actual emissions reported for the facilities. Actual emissions will be forecast to the projection years using surrogates specific to each quasi-point source. The growth factor indicators and their sources are listed below by facility (names are in italics):

Quasi-Point Source	Surrogate Growth Indicator
Baltimore Washington International Airport (BWI):	
Aircraft LTOs	FAA Aircraft Operations Forecasts
Mobile Source Emissions	FAA Enplanement Forecasts
Aberdeen Proving Grounds	BRAC Population Estimates

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators please refer to Appendix A-1.

Quasi-point source emission projection data is contained in Appendix A-3.

4.1.3 Growth Projection Methodology: Area Sources

Base-year area source surrogate growth factors for 2002 were calculated using 2002 population, household, and employment data. Linearly interpolating between 2000 and 2005 data produced the 2002 data. Dividing Round 6B population, household, and employment forecasts for the analysis year by the derived 2002 values for the region produced the growth factors for the periods of 2002 to 2008, 2002 to 2011 and 2002 to 2012. Categories related to the transportation and storage of gasoline were grown using projected vehicle miles traveled (VMT) for analysis years. Area projection inventories are contained in Appendix B. The growth factors used for the 2002-2008, 2002-2011, and 2002-2012 projection years are presented in Tables 4-1, 4-2 and 4-3. The growth factors were applied to emissions categories by specific jurisdictions.

Table 4-1: 2002-2008 Growth Factors[14]

Jurisdiction	Employment	Population	Household	VMT
Anne Arundel County	1.0742	1.0447	1.0734	1.1346
Baltimore City	1.0533	1.0070	1.0196	1.1101
Baltimore County	1.1343	1.0510	1.0591	1.1223
Carroll County	1.0909	1.1091	1.1204	1.1358
Harford County	1.1429	1.0963	1.1191	1.1408
Howard County	1.0238	1.1002	1.1126	1.1105

Table 4-2: 2002-2011 Growth Factors[15]

Jurisdiction	Employment	Population	Household	VMT
Anne Arundel County	1.1119	1.0622	1.1065	1.1776
Baltimore City	1.0783	1.0146	1.0390	1.1557
Baltimore County	1.1860	1.0696	1.0808	1.2099
Carroll County	1.1238	1.1441	1.1620	1.2096
Harford County	1.2083	1.1438	1.1778	1.1991
Howard County	1.0382	1.1434	1.1680	1.1776

Table 4-3: 2002-2012 Growth Factors[16]

Jurisdiction	Employment	Population	Household	VMT
Anne Arundel County	1.1266	1.0676	1.1168	1.1960
Baltimore City	1.0822	1.0144	1.0432	1.1709
Baltimore County	1.1930	1.0730	1.0853	1.2346
Carroll County	1.1327	1.1534	1.1739	1.2325
Harford County	1.2262	1.1558	1.1949	1.2287
Howard County	1.0426	1.1547	1.1866	1.1960

[14] Employment, population, and household growth factors are based on BMC Final Round 6B Cooperative Forecasts. VMT growth factors are based on VMT estimates provided by the MDE Mobile Sources Control Program.
[15] *Ibid*.
[16] *Ibid*.

The 2008, 2011 and 2012 emissions for area sources are calculated by multiplying the 2002 base-year area emissions by the above growth factors for the appropriate year for each jurisdiction. Each area source category was matched to an appropriate growth surrogate based on the activity used to generate the base-year emission estimates. Surrogates were chosen as follows:

Surface Coating – depending on whether emission factors were based on employment or population, surrogate chosen varied with individual subcategories. For example, automobile refinishing category was grown using employment, as the emission factor was based on it, but population was chosen for growing traffic markings as its emission factor was based on population.

Commercial/Consumer Solvent Use - population was chosen as the growth surrogate since 2002 emissions are based on per capita emission factors.

Residential Fuel Combustion – households was chosen as the growth surrogate.

Industrial/Commercial/Institutional Fuel Combustion - employment was chosen as the growth surrogate except for the commercial/institutional coal combustion category, where no growth was assumed.

Vehicle Fueling (Stage II) and Underground Tank Breathing - all gasoline marketing categories were based on vehicle miles traveled (VMT) data since VMT is an appropriate surrogate for gasoline sales. Emission factors for these categories are based on gasoline sales.

Open Burning - population was chosen as the growth surrogate as yard wastes, land debris, and the like increase with population.

Structural Fires, Motor Vehicle Fires – population was chosen as the growth surrogate.

Publicly Owned Treatment Works (POTW) – households was chosen as the growth surrogate.

Dry Cleaning - population was chosen as the surrogate.

Graphic Arts - population was used to estimate growth since emissions are based on per capita emission factors.

Surface Cleaning - employment growth was used as the surrogate.

Tank Truck Unloading –growth in VMT was applied to this category since base-year emissions are calculated using gasoline sales.

Municipal Landfills - Base-year emissions are estimated using data on total refuse deposited. Population was chosen as a surrogate since deposited waste is from the general population rather than industrial facilities.

Asphalt Paving - population was chosen as the surrogate since base-year emissions are calculated using per capita emission factors.

Bakeries, Breweries - population was chosen as the surrogate.

Soil/Groundwater Remediation - zero growth was applied to this category. The number of remediations during the ozone season, used to generate base-year emissions, does not directly correlate to population, households, or employment growth.

General Aviation and Air Taxi Emissions - Emissions from small airports were projected using the EGAS 5.0 model. The Maryland Aviation Administration (MAA) provided commercial aircraft operations information at Baltimore Washington International (BWI) Airport. Emissions were calculated using FAA-approved activity data and the Emissions Dispersion Modeling system (EDMS) model. Emissions were grown by FAA Terminal Area Forecasts (TAFs).

Aircraft Refueling Emissions - emissions from refueling of aircrafts was projected based on employment.

Portable Fuel Container Emissions - emissions from portable fuel containers were grown based on population.

Railroad Locomotives - employment growth was used as the surrogate.

Forest Fires, Slash Burning, Prescribed Burning – zero growth was applied to this category.

Accidental Oil Spills - zero growth was applied to this category.

Incineration– zero growth was applied to this category.

Pesticide Application - zero growth was applied to this category.

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators, please refer to Appendix A-1.

Area source emission projection data is contained in Appendix A-4.

4.1.4 Growth Projection Methodology: Nonroad Sources

The 2008, 2011 and 2012 nonroad source inventories were created through the use of EPA's NONROAD2008 model. Locomotives, marine diesel vessels, and aircraft are not included. The base year 2002 nonroad source inventory was revised for Reasonable Further Progress using NONROAD2008 model.

Nonroad model runs were made for the metropolitan Baltimore region for a typical summer weekday.

Methodology to prepare inputs for the ozone season day is provided below.

Temperature:

Temperature data were acquired from the National Climatic Data Center (NCDC). Hourly average temperature data were collected for Baltimore Washington International (BWI) station for the top ten 8-hour maximum ozone days between 2002 and 2004. Then minimum, maximum, and average temperatures were computed from this hourly temperature dataset.

Fuel inputs:

Month-specific data for fuel Reid Vapor Pressure (RVP) and oxygen weight percent were collected from the Baltimore Regional Transportation Board (BRTB), the Baltimore Metropolitan Council (BMC), and the MDE Mobile Sources Control Program. The data was averaged for the period May through September to obtain ozone season average inputs. Model defaults were used for gas, diesel, marine diesel, and CNG/LPG sulfur percent. Stage II controls were not assumed and were set at zero for the model runs.

Model inputs (temperature, fuel, and other parameters) are listed below:

NONROAD Model Inputs (all NR Runs)

Options File

Fuel RVP for gas	6.6	**Minimum Temp (°F)**	65.55
Oxygen Weight %	2.44	**Maximum Temp (°F)**	87.60
Gas S %	0.0339	**Average Temp (°F)**	76.80
Diesel S %	0.2284	**State II Control %**	0
Marine Diesel S %	0.2318	**EtOH Blend Market %**	75.1
CNG/LPG Sulfur %	0.003	**EtOH Volume %**	9.3

Period

Episode	Inventory Year Requested (2002, 2008, 2011, 2012)
Period	Seasonal
Season	Summer
Type	Typical Day
Day	Weekday

Region

Region	County	
Selected	Anne Arundel County MD	Harford County MD
	Baltimore County MD	Howard County MD
	Carroll County MD	Baltimore City MD

Sources Active	**All Sources**

Since the nonroad model does not generate emissions for aircraft, auxiliary power units (APU), locomotives, and commercial diesel marine vessels, these were either projected from the base year emissions using the BMC Round 6B Cooperative Forecast or the EGAS model. Below are the details for projecting emissions for the above mentioned individual nonroad categories.

Aircraft emissions (military, commercial, general aviation, air taxi)

As previously noted, Maryland Aviation Administration (MAA) provided all types of airport activity data and emissions for Baltimore Washington International (BWI) airport. Aviation emissions from BWI were grown by FAA Terminal Area Forecasts (TAFs). Emissions were calculated using FAA-approved activity data and the Emissions Dispersion Modeling system (EDMS) model.

General aviation and air taxi emissions from small airports were projected using the EGAS 5.0 model.

Auxiliary power units emissions

These emissions were only available for BWI airport. Emissions were calculated using FAA-approved activity data and the EDMS model.

Ground support equipment emissions

The NONROAD2005.1.0 model generated these emissions for small airports. BWI ground support equipment (GSE) emissions were generated using the EDMS model, which calculated emissions based on actual aircraft operations. The NONROAD model calculates emissions based on GSE population only and therefore emissions generated this way are considered less accurate than the ones generated by the EDMS model.

Commercial Diesel Marine Vessels

Base year emissions from commercial diesel marine vessels were grown to future years using employment as the surrogate.

Railroad

Railroad or locomotive emissions were grown using employment as the surrogate.

For source category listings and descriptions, projection methods and data sources, and surrogate growth indicators please refer to Appendix A-1.

Nonroad mobile source emission projection data is contained in Appendix A-6.

4.1.5 Growth Projection Methodology: Onroad Sources

The 2008, 2011 and 2012 mobile source inventories were created through the MOVES model. A full description of this mobile emission estimating process can be found in Appendix E of this report.

4.1.6 Biogenic Emission Projections

Biogenic emission inventories are the same as those used for the 2002 base year for Baltimore, MD ozone nonattainment region. Year-specific biogenic inventories were not estimated. Base year emissions for 2002 were estimated by EPA using BEIS3.12 model. No 2008 biogenic inventories were prepared as these inventories are not used to determine rate of progress.

4.2 OFFSET PROVISIONS, EMISSION REDUCTION CREDITS AND POINT SOURCE GROWTH

The Clean Air Act (CAA or "the Act") requires that emissions growth from major stationary sources in nonattainment areas be offset by emissions reductions that would not otherwise be achieved by other mandated controls. The offset requirement applies to all new major stationary sources, and to existing major stationary sources that have undergone major modifications. At the same time, existing sources' emissions increases resulting specifically from increases in capacity utilization are not subject to the offset requirement.

For the purposes of the offset requirement, major stationary sources include all stationary sources exceeding an applicable size cutoff. The NSR thresholds for the Baltimore Nonattainment Area are 25 tpy VOC and 25 tpy NOx.

EPA has issued guidance on the inclusion of emission reduction credits in the projected emissions inventory. The guidance states:

> The base year inventory includes actual emissions from existing sources and would not normally reflect emissions from units that were shutdown or curtailed before the base year, as these emissions are not 'in the air.' To the extent that these emission reduction credits are to be considered available for use as offsets and are thus 'in the air' for purposes of demonstrating attainment, they must be specifically included in the projected emissions inventory used in the attainment demonstration along with other growth in emissions over the base year inventory. This step assures that emissions from shutdown and curtailed units are accounted for in attainment planning.[17]

MDE has included emission reduction credits in the attainment demonstration projected inventory. A list of these emission reduction credits and associated facilities is shown in Table 4-4.

Table 4-4: Emission Reduction Credits

Facility Name	*State Facility Identifier*	*Pollutant Code*	*Emission Reduction Credits (TPY)*
Alltrista Metal Services	510-0508	NOX	2
Andrews Air Force Base	033-0655	NOX	15
Armco Stainless/	510-0340	NOX	16
Bausch & Lomb	023-0019	NOX	1

[17] Federal Register, Vol. 71, No. 243, page 75910, December 19, 2006.

Facility Name	*State Facility Identifier*	*Pollutant Code*	*Emission Reduction Credits (TPY)*
Bethlehem Steel	005-0147	NOX	701
Chevron Asphalt	510-0072	NOX	49
Coca Cola	510-0242	NOX	5
Crown Cork & Seal - Duncanwood	510-0320	NOX	10
G. Heileman Brewing (Strohs)	005-0129	NOX	24
General Electric	027-0020	NOX	82
General Motors - Truck & Bus	510-0354	NOX	119
Giant - Bakery (930 King St)	031-0224	NOX	2
Gordon D. Garratt	510-0360	NOX	1
Grief Brothers Corp.	005-0134	NOX	1
Millenium Inorganic Chemicals	510-0109	NOX	30
Proctor & Gamble	510-0185	NOX	12
Pulaski Incinerator	510-0498	NOX	302
Quebecor Printing	003-0274	NOX	2
Rohr Industries	043-0104	NOX	6
Schluderberg-Kurdle	510-0283	NOX	19
Showell Farms	047-0036	NOX	8
Simpkins Industries - River Rd	027-0005	NOX	87
TPS Technologies, Inc. -Todd's La.	005-2131	NOX	16
Trigen (Leadenhall St)	510-2796	NOX	33
U.S.Can - Sparrows Pt. (Amer Nat)	005-0183	NOX	7
Westport 510-0006 & Riverside 005-0078	510-0006	NOX	1480
WR Grace	510-0076	NOX	17
3M Commercial Graphics	013-0052	VOC	30
Alltrista Metal Services	510-00508	VOC	11
American Mouldings	043-0191	VOC	69
Armco/Balto. Specialty Steel	510-0340	VOC	11
BARCO – Fairlawn	510-2854	VOC	5
Bata Shoe	025-0003	VOC	18
Bausch & Lomb	023-0019	VOC	16
Baycraft Fiberglass Engineering	025-0231	VOC	10
Bethlehem Steel	005-0147	VOC	0
BGE - SNG Plant	005-1054	VOC	7
Blue Chip Products	015-0058	VOC	35
Carpenter Insulation	043-0189	VOC	146
CE Stevens Packaging (printer)	510-2900	VOC	10
Cello Professional Products	025-0145	VOC	0
Cherokee Sanford	033-0565	VOC	0
Chevron Asphalt	510-0072	VOC	2
Conoco Sun Gasoline Terminal	510-0676	VOC	27

Facility Name	State Facility Identifier	Pollutant Code	Emission Reduction Credits (TPY)
Constellation - Westport 510-0006 & Riverside 005-0078	510-0006	VOC	23
Crown Central Petroleum	003-0234	VOC	21
Crown Cork & Seal - Duncanwood	510-0320	VOC	13
Crown Cork & Seal - Hurlock	019-0073	VOC	96
CSX Minerals	043-0110	VOC	10
Ecko-Glaco Ltd.	005-0310	VOC	27
G. Heileman Brewing Co. (Strohs)	005-0129	VOC	48
General Motors - Electromotive	005-0692	VOC	15
General Motors - Truck & Bus	510-0354	VOC	0
Giant - Bakery - 930 King St	031-0224	VOC	0
Grief Brothers Corporation	005-0134	VOC	0
LeSaffre Yeast	510-0191	VOC	179
Mail-Weil Graphics	019-0097	VOC	8
Maryland Paper Box	005-2220	VOC	15
Metalfab - Grove Road	021-0317	VOC	11
PPG Industries	001-0005	VOC	28
Pulaski Incinerator	510-0498	VOC	11
Quebecor Printing	003-0274	VOC	322
Rohr Industries	043-0104	VOC	4
Schlumberger Malco, Inc.	005-1614	VOC	12
Simpkins Industries (River Rd)	027-0005	VOC	7
Thomas Mfg.	005-0240	VOC	22
Tidewater Industrial Corp.	011-0039	VOC	11
TPS Technologies (Todd's La.)	005-2131	VOC	4
U.S.Can-Sparrows Pt. (Amer Nat)	005-0183	VOC	90

4.3 ACTUAL VS. ALLOWABLE EMISSIONS IN DEVELOPMENT OF THE 2008, 2011 AND 2012 PROJECTED EMISSIONS INVENTORIES

For the purposes of calculating the projection emissions inventories, EPA guidance specifically outlines the circumstances under which emissions projections are to be based on actual or allowable emissions. For sources or source categories that are subject to a pre-1990 regulation and that the state does not anticipate subjecting to additional regulation, emissions projections should be based on actual emissions levels. Actual emissions levels should also be used for emissions projections for sources or source categories that were unregulated as of 1990. For sources that are expected to be subject to post-1990 regulations, projections should be based on new allowable emissions.

To simplify comparisons between the base-year and the projected year, EPA guidance states that comparisons should be made only between like emissions: actual to actual, or allowable to allowable, not actual to allowable. As a result, all base-year and all projection-year emissions estimates are based on actual emissions.

Maryland regulation defines "actual emissions" and "allowable emissions" as follows:[18]

> "Actual emissions" means the average rate, in tons per year, at which a source discharged a pollutant during a 2-year period which precedes the date of a completed application for an NSR source or other specified date, and which is representative of normal source operation... Actual emissions shall be calculated using the source's operating hours, production rates, and types of materials processed, stored, or combusted during the selected time period.
>
> "Allowable emissions" means the maximum emissions a source or installation is capable of discharging after consideration of any physical, operational, or emissions limitations required by [state regulations] or by federally enforceable conditions which restrict operations and which are included in an applicable air quality permit to construct, permit to operate, secretarial order, plan for compliance, consent agreement, court order, or applicable federal requirement.

4.4 PROJECTION INVENTORY RESULTS

Chapter 8 of this SIP describes the control measures that have been implemented or will be implemented from 2008 through 2012 that will reduce emissions. Most control measures are required by federal or state regulations. Projected controlled inventories for 2008, 2011 and 2012 assume a number of control measures, as identified in Chapter 8, to be in place by these years.

Tables 4-5, 4-6, and 4-7 present the projected controlled emissions for the 2008 reasonable further progress, 2011 reasonable further progress, and 2012 attainment years resulting from implementation of the control measures.

4.5 2008 CONTROLLED EMISSIONS FOR REASONABLE FURTHER PROGRESS

The projection of 2008 controlled emissions is simply the 2008 uncontrolled emissions minus the emission reductions achieved from the federal control measures and the reasonable further progress control measures implemented by states for the 8-hour ozone SIP. This information is presented in Table 4-5. Controlled inventories are contained in Appendix A. Details on mobile source controlled inventories can be found in Appendix E.

[18] See Code of Maryland Regulations (COMAR) 26.11.01.01.

Table 4-5:
2008 Projected Controlled VOC & NOx Emissions (tons/day)
Baltimore Nonattainment Area

Emission Source Category	***Baltimore NAA*** **VOC Emissions***	***Baltimore NAA*** **NOx Emissions***
Point	15.63	122.65
Area	108.17	8.43
Non-road	44.04	42.85
Mobile	50.12	125.69
Total	**217.96**	**299.62**

*Small discrepancies may result due to rounding.

4.6 2011 CONTROLLED EMISSIONS FOR REASONABLE FURTHER PROGRESS

The projection of 2011 controlled emissions is simply the 2011 uncontrolled emissions minus the emission reductions achieved from the federal control measures and the reasonable further progress control measures implemented by states for the 8-hour ozone SIP. This information is presented in Table 4-6. Controlled inventories are contained in Appendix A. Details on mobile source controlled inventories can be found in Appendix E.

Table 4-6:
2011 Projected Controlled VOC & NOx Emissions (tons/day)
Baltimore Nonattainment Area

Emission Source Category	***Baltimore NAA*** **VOC Emissions***	***Baltimore NAA*** **NOx Emissions***
Point	16.79	95.21
Area	106.07	8.54
Non-road	38.26	38.12
Mobile	44.54	104.62
Total	**205.65**	**246.48**

*Small discrepancies may result due to rounding.

4.7 2012 CONTROLLED EMISSIONS FOR ATTAINMENT

The projection of 2012 controlled emissions is simply the 2012 uncontrolled emissions minus the emission reductions achieved from the federal control measures and the reasonable further progress control measures implemented by states for the 8-hour ozone SIP. This information is presented in Table 4-7.

Table 4-7:
2012 Projected Controlled VOC & NOx Emissions (tons/day)
Baltimore Nonattainment Area

Emission Source Category	***Baltimore NAA*** **VOC Emissions***	***Baltimore NAA*** **NOx Emissions***
Point	17.19	94.79
Area	106.79	8.56
Non-road	35.69	36.05
Mobile	40.23	93.47
Total	**199.90**	**232.88**

*Small discrepancies may result due to rounding.

5.0 2008 REASONABLE FURTHER PROGRESS REQUIREMENTS

5.1 INTRODUCTION

In June 2005 EPA revoked the one-hour ozone standard and published implementation guidance for the 8-hour ozone standard. EPA classified the metropolitan Baltimore region as being in moderate nonattainment of the 8-hour ozone standard; EPA made this classification under the Clean Air Act (CAA or "the Act") Subpart 2, Section 182(b).

As a moderate nonattainment area, the metropolitan Baltimore region is required to demonstrate reasonable further progress towards attainment by 2008.[19] EPA's implementation guidance requires that a moderate area, such as Baltimore, with an approved 15% VOC reduction plan for the period 1990-1996 (required for former 1-hour ozone non-attainment areas) demonstrate a 15% RFP by 2008. This chapter contains the Baltimore region's reasonable further progress demonstration for the years 2002-2008. The region needs to fulfill the 2002-2008 reasonable further progress requirements by January 1, 2009.

In order to demonstrate reasonable further progress, a region must show that its expected emissions, termed "controlled inventories," of NOx and VOC will be less than or equal to the target levels, or "target inventories" set for the end of the reasonable further progress period, or "milestone year". For the RFP period 2002-2008, the target inventories of emissions are the maximum quantity of anthropogenic emissions permissible during the 2008 milestone year.

This section describes the methodology used to establish the regional target inventories and controlled inventories for 2008. Because the expected NOx and VOC emissions are less than or equal to the target levels in the analysis, the Baltimore region meets the RFP requirements for 2008.

The reasonable further progress emission inventories utilize the latest EPA models (MOVES and NONROAD2008) providing revised up-to-date emission estimates.

5.1.1 Reasonable Further Progress Demonstrated in Previous State Implementation Plans

Since 1990, the Clean Air Act has required ozone nonattainment areas to demonstrate progress towards attaining the ozone standard. This requirement is referred to as the reasonable further progress requirement, or RFP. During the period 1990-1996, areas in nonattainment of the one-hour ozone standard were required to reduce VOC emissions by 15%. Since 1996, regions have been required to demonstrate a 9% rate of progress every three years until the region's attainment date.

---

[19] Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard—Phase 2; Final Rule To Implement Certain Aspects of the 1990 Amendments Relating to New Source Review and Prevention of Significant Deterioration as They Apply in Carbon Monoxide, Particulate Matter and Ozone NAAQS; Final Rule for Reformulated Gasoline, Federal Register, Vol 70, No. 228, Nov.29, 2005, pp. 71612-71705.

The CAA included restrictions on the use of control measures to meet the 15% requirements. Reductions in ozone precursors resulting from four types of federal and state regulations could not be used to meet rate of progress. These four types of programs are as follows:

(1) Federal Motor Vehicle Control Program (FMVCP) tailpipe and evaporative standards issued in January 1, 1990;
(2) Federal regulations (55 Fed Reg. 23666, June 11, 1990) limit the Reid Vapor Pressure (RVP) of gasoline in ozone nonattainment areas;
(3) State regulations correcting deficiencies in reasonably available control technology rules
(4) State regulations establishing or correcting inspection and maintenance (I/M) programs for on-road vehicles.

The basic procedures of developing target levels for the 15% Plan are describe in EPA's guidance, *Adjusted Base Year Emissions Inventory and the 1996 Target for the 15% Rate of Progress Plans*.

5.2 GUIDANCE FOR CALCULATING REASONABLE FURTHER PROGRESS (RFP) EMISSION TARGET LEVELS

The Clean Air Act Amendments (CAAA) of 1990 provide the primary guidance for calculating the VOC and NOx target levels used in a region's RFP plans. In November 2005 as part of its final implementation rule for the 8-hour ozone standard, EPA issued guidance to assist the states in RFP development.

The guidance that applies to the metropolitan Baltimore area is guidance for previously severe 1-hour ozone nonattainment areas with an approved 15% RFP plan for the period 1990-1996. Since the Baltimore region is a former severe 1-hour ozone nonattainment area and has an approved 15% RFP plan for the above period, "Method 2" of the guidance applies to the region.[20] The region is required to reduce emissions by 15% from 2002-2008 to demonstrate RFP, according to Method 2.

EPA's guidance (Method 2) states that the target level of VOC and NOx emissions in 2008 needed to meet the 2008 RFP requirement is any combination of VOC and NOx reductions from the adjusted base year 2002 inventories (base year 2002 emissions minus non-creditable emissions reduction occurring between 2002 and 2008) that total 15 percent. For example, the target level of VOC emissions in 2008 could be a 10 percent reduction from the adjusted base year 2002 VOC inventory and a 5 percent reduction from the adjusted NOx inventory. The actual projected 2008 VOC and NOx inventories for all sources with all control measures in place and including projected 2008 growth in activity must be at or lower than the target levels of VOC and NOx emissions.

This section briefly summarizes the requirements and procedures for calculating the target emission levels required for a RFP demonstration. RFP demonstrations build upon each other, starting from the base year of 2002.

[20] "Appendix A to Preamble—Methods to Account for Non-Creditable Reductions When Calculating ROP Targets for the 2008 and Later ROP Milestone Years," in Final Rule to Implement the 8-Hour Ozone National Ambient Air Quality Standard, Federal Register, Vol 70, No. 228, Nov.29, 2005.

5.2.1 2008 VOC and NOx Target Levels

EPA's *Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard* – Phase II mandates that to meet the reasonable further progress requirement, the Baltimore, MD ozone nonattainment area needs to reduce its emissions by 15% between 2002 and 2008 using either reductions in VOC or NOx or any combination of the two. The Baltimore region is able to demonstrate reasonable further progress for the period 2002-2008.

The target levels for 2008 reasonable further progress plans are calculated according to the EPA's final rule mentioned above. The general formula for calculation of 2008 target levels is as follows:

Equation 5-1

$$\text{Target Level}_{2008} = \text{RFP base year emissions} - \text{reductions required to meet the reasonable further progress requirement} - \text{non-creditable emissions reduction between 2002 and 2008}$$

Calculation of 2008 Target Levels

Equation 5-2 gives the general formula for calculating post-1996 target levels. Since the region has chosen to demonstrate the 2008 reasonable further progress using 8% VOC reduction, the 2008 VOC target level becomes:

Equation 5-2

$$\text{2008 VOC Target Level} = \left[\text{2002 RFP Base-Year emissions}\right] - \left[\text{8.0\% VOC Reduction}\right] - \left[\text{non-creditable emissions reduction between 2002 and 2008}\right]$$

Equation 5-3

$$\text{2008 NOx Target Level} = \left[\text{2002 RFP Base-Year emissions}\right] - \left[\text{7.0\% NOx Reduction}\right] - \left[\text{non-creditable emissions reduction between 2002 and 2008}\right]$$

Step 1: Develop 2002 Base Year Inventories and 2002 Reasonable Further Progress Base Year Inventories

The 2002 Base-Year Inventory is published in a separate document, "2002 Base Year Emissions Inventory & QA/QC Plan Maryland," (June 15, 2006). This document was submitted to EPA Region III. The document was prepared by the Maryland Department of the Environment and remains intact to fulfill the SIP inventory requirement of the CAA. It is available for inspection at the Maryland Department of the Environment, Air and Radiation Management Administration, 1800 Washington Boulevard, Suite 730, Baltimore, Maryland 21230.

The RFP base-year inventory includes only anthropogenic emissions generated within the Metropolitan Baltimore Nonattainment Area and is required to utilize the most recent EPA models and methods when estimating emissions. As such, the 2002 RFP inventory uses the MOVES model to estimate on-road mobile emissions and the NONROAD model (version 2008) to estimate the non-road mobile emissions. The reasonable further progress base year VOC and NOx emissions are presented in Table 5-1.

Table 5-1:
2002 Reasonable Further Progress Base-Year Inventory
(Ozone Season tons per day)

Source	VOC	NOx
Point	13.88	111.89
Area	116.81	8.18
Non-Road	59.61	49.18
On-Road	72.48	202.22
TOTAL	262.77	371.47

Note: Small discrepancies may result due to rounding

Step 2: Develop 2002 and 2008 Reasonable Further Progress Adjusted Year Inventories

According to the 1990 CAAA, reductions necessary to meet the reasonable further progress requirement must be calculated from an emissions baseline that excludes the effects of the non-creditable Federal Motor Vehicle Control Program (FMVCP) and Reid Vapor Pressure (RVP) programs described in Section 5.1.1. Therefore the 2002 baseline must be adjusted by subtracting the VOC and NOx reductions that result from these two programs between 2002 and 2008. The resulting inventory is referred to as the 2002 Adjusted Base Year Inventory.

In order to calculate the non-creditable emissions reductions, which occur between 2002 and 2008, the following two mobile inventories are needed:

1) 2002 Reasonable Further Progress Adjusted-Year Inventory
2) 2008 Reasonable Further Progress Adjusted-Year Inventory

Both of these mobile inventories were created using the inputs, listed below, with the only difference between the two inventories being the model year. Inventory #1 and #2 were created for 2002 and 2008, respectively.

a) 1990 I/M Program
b) RVP = 7.8 psi (RVP required according to June 1990 fuel RVP regulations)[21]

[21] *The 1990 Phase II regulations specify 7.8 psi as the maximum RVP of gasoline being sold in the Baltimore, DC-MD-VA ozone nonattainment area in 1992.*

c) No Post-1990 Clean Air Act Measures
d) 2002 Vehicle Activity Inputs
e) 2002 Vehicle Miles Traveled (VMT)

The on-road mobile input files are included in Appendix E. Tables 5-2 & 5-3 show RFP adjusted-year inventories for 2002 and 2008, respectively.

Table 5-2:
2002 Reasonable Further Progress Adjusted-Year Inventory
(Ozone Season tons per day)

Source	VOC	NOx
Point	13.88	111.88
Area	116.81	8.18
Non-Road	70.22	40.96
On-Road	111.14	287.69
TOTAL	312.05	448.71

Note: Small discrepancies may result due to rounding

Table 5-3:
2008 Reasonable Further Progress Adjusted-Year Inventory
(Ozone Season tons per day)

Source	VOC	NOx
Point	13.88	111.88
Area	116.81	8.18
Non-Road	70.22	40.96
On-Road	107.05	285.91
TOTAL	307.96	446.93

Note: Small discrepancies may result due to rounding

Step 3: Non-creditable Emissions Reductions

The non-creditable emissions reductions that occur in the absence of any post-1990 CAA measures during a reasonable further progress period can be determined by taking the difference between the RFP adjusted-year inventories for the relevant milestone years. For VOC and NOx, the relevant milestone years are 2002 and 2008.

Equation 5-4

$$\text{Non-creditable Emissions Reductions} = \left[\text{2002 RFP Adjusted Year Inventory}\right] - \left[\text{2008 RFP Adjusted Year Inventory}\right]$$

Table 5-4:
Calculation of Non-creditable Emissions Reductions
(Ozone Season tons per day)

Description	VOC	NOx
2002 Adjusted Year Inventory (a)	111.14	287.69
2008 Adjusted Year Inventory (b)	107.05	285.91
Non-creditable Emissions Reduction (a-b)	4.09	1.78

Step 4: Calculation of 2008 Target Levels

The VOC and NOx target levels for 2008 are calculated in Table 5-5 below:

Table 5-5:
Calculation of VOC and NOx Target Levels for 2008
(Ozone Season tons per day)

	Description	Formula	VOC	NOx
A	2002 Base Year Inventory		485.97	371.47
B	Biogenic Emissions		223.20	0.00
C	2002 Rate-of Progress Base Year Inventory	A - B	262.77	371.47
D	FMVCP/RVP Reductions Between 2002 and 2008		4.08	1.78
E	2002 Adjusted Base Year Inventory Calculated Relative to 2008	C - D	258.69	369.69
F	Reduction Ratio		0.0800	0.0700
G	Emissions Reductions Required Between 2002 and 2008	E * F	20.70	25.88
H	Target Level for 2008 [$TL_{(2008)}$]	C - D - G	238.00	343.81

5.3 COMPLIANCE WITH 2008 REASONABLE FURTHER PROGRESS REQUIREMENTS

In order to demonstrate reasonable further progress for the period 2002-2008, the Baltimore region must show that expected emissions in 2008 are equal to or less than the 2008 target levels presented in Table 5-5.

The 2008 controlled inventories are inventories of all anthropogenic VOC and NOx emissions expected to occur in the Baltimore Nonattainment Area during 2008. The 2008 inventories were developed as described in Chapter 4 and are displayed in Table 4-5. As summarized in Table 5-6, the 2008 controlled VOC and NOx inventories are less than the 2008 target inventories. Table 5-6 demonstrates that the Baltimore region fulfills the 2002-2008 reasonable further progress requirements.

Table 5-6:
Baltimore Nonattainment Area
Comparison of 2008 Controlled and Target Inventories
Ozone Season Daily Emissions (tons per day)

Description	VOC	NOx
2008 Target Levels	238.00	343.81
2008 Controlled Emissions	217.96	299.62

References

U.S. EPA, "Guidance on the Adjusted Base Year Emissions Inventory and the 1996 Target for the 15% Rate of Progress Plans"

U.S. EPA, "Guidance on the Post-1996 Reasonable Further Progress Plan and the Attainment Demonstration," February 18, 1994.

U.S. EPA, "NOx Substitution Guidance," December 1993.

6.0 2011 REASONABLE FURTHER PROGRESS REQUIREMENTS

6.1 INTRODUCTION

In addition to the 2002-2008 reasonable further progress (RFP) demonstration contained in Chapter 5, the Baltimore region must also demonstrate RFP for the period 2008-2011. In order to demonstrate RFP, a region must show that its expected emissions, termed "controlled inventories," of NOx and VOC will be less than or equal to the target levels set for the end of the RFP period, or "milestone year". By re-classifying as a "serious" ozone nonattainment area, the Baltimore region is required to establish target levels that reduce VOC and NOx emissions by 3 percent per year (or 9% total) over the 2008 to 2011 period. For the RFP period 2008-2011, the target levels of emissions are the maximum quantity of anthropogenic emissions permissible during the 2011 milestone year. This section describes the methodology used to establish the regional target inventories and controlled inventories for 2011. Because the expected NOx and VOC emissions will be less than the target levels, the Baltimore region will meet the RFP requirements by the January 1, 2012 deadline.

6.2 GUIDANCE FOR CALCULATING REASONABLE FURTHER PROGRESS (RFP) EMISSION TARGET LEVELS

The guidance and methods used to calculate the 2011 target levels are the same as for the 2008 target levels; however, the starting point is the 2008 target levels instead of the 2002 Base Year Inventory.

6.2.1 2011 VOC and NOx Target Levels

EPA's *Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard* – Phase II mandates that to meet the reasonable further progress requirement, the Baltimore ozone nonattainment area needs to reduce its emissions by 9% between 2008 and 2011 using either reduction in VOC or NOx or any combination of the two. The Baltimore region is able to demonstrate reasonable further progress for the period 2008-2011.

The target levels for 2011 reasonable further progress plans are calculated according to the EPA's final rule mentioned above. The general formula for calculation of 2011 target levels is as follows:

Equation 6-1

$$\text{Target Level}_{2011} = \left[\text{Target Level}_{2008}\right] - \left[\text{Reductions Required to meet the RFP (2008 – 2011)}\right] - \left[\text{non-creditable emissions reduction between 2008 and 2011}\right]$$

Equation 6-1, above, gives the general formula for calculating 2011 target levels. Since the region has chosen to demonstrate the 2008 reasonable further progress using a 6% VOC reduction, the 2011 VOC target level is as shown in Equation 6-2:

Equation 6-2

$$\text{2011 VOC Target Level} = \left[\text{2008 VOC Target Level}\right] - \left[\text{6.0\% VOC Reduction}\right] - \left[\text{non-creditable emissions reduction between 2008 and 2011}\right]$$

Equation 6-3

$$\text{2011 NOx Target Level} = \left[\text{2008 NOX Target Level}\right] - \left[\text{3.0\% NOx Reduction}\right] - \left[\text{non-creditable emissions reduction between 2008 and 2011}\right]$$

Step 1: Develop 2008 Target Levels for VOC and NOx

The 2008 target levels were developed in accordance with EPA protocols and the methods were presented in Chapter 5.

Step 2: Non-creditable Emissions Reductions

The non-creditable emissions reductions that occur in the absence of any post-1990 CAA measures during a reasonable further progress period can be determined by taking the difference between the RFP adjusted-year inventories for the relevant milestone years. For VOC and NOx, the relevant milestone years are 2008 and 2011. Note: The non-creditable emissions reductions between two RFP years cannot be negative.

Equation 6-4

$$\text{Non-creditable Emissions Reductions} = \left[\text{2008 RFP Adjusted Year Inventory}\right] - \left[\text{2011 RFP Adjusted Year Inventory}\right]$$

Table 6-1:
Calculation of Non-creditable Emissions Reductions
(Ozone Season tons per day)

Description	VOC	NOx
Non-creditable Emissions Reduction (2008 – 2011)	0.29	0.00

Step 3: Calculation of 2011 Target Levels

Following Equations 6-2, 6-3 and 6-4, the VOC and NOx target levels for 2011 are calculated in Table 6-2 below:

Table 6-2:
Calculation of VOC and NOx Target Levels for 2011
(Ozone Season tons per day)

	Description	Formula	VOC	NOx
A	2008 Target Level		238.00	343.81
B	FMVCP/RVP Reductions Between 2008 and 2011		0.29	0.00
C	2002 Adjusted Base Year Inventory Calculated Relative to 2011	A - B	237.71	343.81
D	Reduction Ratio		0.0600	0.0300
E	Emissions Reductions Required Between 2008 and 2011	C * D	14.28	10.31
F	Target Level for 2011 [$TL_{(2011)}$]	A - B - E	223.72	333.49

6.3 COMPLIANCE WITH 2011 REASONABLE FURTHER PROGRESS REQUIREMENTS

In order to demonstrate reasonable further progress for the period 2008-2011, the Baltimore region must show that expected emissions in 2011 are equal to or less than the 2011 target levels presented in Table 6-2.

The 2011 controlled inventories are inventories of all anthropogenic VOC and NOx emissions expected to occur in the Baltimore Nonattainment Area during 2011. The inventories were developed as described in Chapter 4 and are displayed in Table 4-6. As summarized in Table 6-3, the 2011 controlled VOC and NOx inventories are less than the 2011 target inventories. Table 6-3 demonstrates that the Baltimore region fulfills the 2008-2011 reasonable further progress requirements.

Table 6-3:
Baltimore Nonattainment Area
Comparison of 2011 Controlled and Target Inventories
Ozone Season Daily Emissions (tons per day)

Description	VOC	NOx
2011 Target Levels	223.72	333.49
2011 Controlled Emissions	205.65	246.48

7.0 2012 REASONABLE FURTHER PROGRESS REQUIREMENTS

7.1 INTRODUCTION

In addition to the 2008-2011 reasonable further progress (RFP) demonstration contained in Chapter 6, the Baltimore region must also demonstrate reasonable further progress for the period 2011-2012. In order to demonstrate reasonable further progress, a region must show that its expected emissions, termed "controlled inventories," of NOx and VOC will be less than or equal to the target levels set for the end of the reasonable further progress period, or "milestone year". By re-classifying as a "serious" ozone nonattainment area, the Baltimore region is required to establish target levels that reduce VOC and NOx emissions by 3 percent per year (or 3% total) over the 2011 to 2012 period. For the reasonable further progress period 2011-2012, the target levels of emissions are the maximum quantity of anthropogenic emissions permissible during the 2012 milestone year. This section describes the methodology used to establish the regional target inventories and controlled inventories for 2012. Because the expected NOx and VOC emissions will be less than the target levels, the Baltimore region will meet the reasonable further progress requirements by the January 1, 2013 deadline.

7.2 GUIDANCE FOR CALCULATING REASONABLE FURTHER PROGRESS (RFP) EMISSION TARGET LEVELS

The guidance and methods used to calculate the 2012 target levels are the same as the 2008 and 2011 target levels, however the starting point is the 2011 target level.

7.2.1 2012 VOC and NOx Target Levels

EPA's *Final Rule To Implement the 8-Hour Ozone National Ambient Air Quality Standard* – Phase II mandates that to meet the reasonable further progress requirement, the Baltimore ozone nonattainment area needs to reduce its emissions by 3 between 2011 and 2012 using reductions in either VOC or NOx or any combination of the two. The Baltimore region is able to demonstrate reasonable further progress for the period 2011-2012.

The target levels for 2012 reasonable further progress plans are calculated according to the EPA's final rule mentioned above. The general formula for calculation of 2012 target levels is as shown in Equation 7-1:

Equation 7-1

$$\text{Target Level}_{2012} = \left[\text{Target Level}_{2011}\right] - \left[\text{Reductions Required to meet the RFP (2011 – 2012)}\right] - \left[\text{non-creditable emissions reduction between 2011 and 2012}\right]$$

Equation 7-1, above, gives the general formula for calculating 2012 target levels. Since the region has chosen to demonstrate the 2012 reasonable further progress using a 1.5% VOC reduction, the 2012 VOC target level is as shown in Equation 7-2.

Equation 7-2

$$\text{2012 VOC Target Level} = \left[\text{2011 VOC Target Level}\right] - \left[\text{1.5\% VOC Reduction}\right] - \left[\text{non-creditable emissions reduction between 2011 and 2012}\right]$$

Equation 7-3

$$\text{2012 NOx Target Level} = \left[\text{2011 NOX Target Level}\right] - \left[\text{1.5\% NOx Reduction}\right] - \left[\text{non-creditable emissions reduction between 2011 and 2012}\right]$$

Step 1: Develop 2011 Target Levels for VOC and NOx

The 2011 target levels were developed in accordance with EPA protocols and the methods were presented in Chapter 6.

Step 2: Non-creditable Emissions Reductions

The non-creditable emissions reductions that occur in absence of any post-1990 CAA measures during a reasonable further progress period can be determined by taking the difference between the RFP adjusted-year inventories for the relevant milestone years. For VOC and NOx, the relevant milestone years are 2011 and 2012. The non-creditable emissions reductions between two RFP years cannot be negative.

Equation 7-4

$$\text{Non-creditable Emissions Reductions} = \left[\text{2011 RFP Adjusted Year Inventory}\right] - \left[\text{2012 RFP Adjusted Year Inventory}\right]$$

Table 7-1:
Calculation of Non-creditable Emissions Reductions
(Ozone Season tons per day)

Description	**VOC**	**NOx**
Non-creditable Emissions Reduction (2008 – 2011)	0.00	0.18

Step 3: Calculation of 2012 Target Levels

Following Equations 7-2, 7-3 and 7-4, the VOC and NOx target levels for 2012 are calculated in Table 7-2 below:

Table 7-2:
Calculation of VOC and NOx Target Levels for 2012
(Ozone Season tons per day)

	Description	Formula	VOC	NOx
A	2011 Target Level		223.73	333.49
B	FMVCP/RVP Reductions Between 2011 and 2012		0.00	0.18
C	2002 Adjusted Base Year Inventory Calculated Relative to 2012	B - A	223.73	333.32
D	Reduction Ratio		0.0150	0.0150
E	Emissions Reductions Required Between 2011 and 2012	C * D	3.36	5.00
F	Target Level for 2012 [$TL_{(2012)}$]	A - B - E	220.38	328.49

7.3 COMPLIANCE WITH 2012 REASONABLE FURTHER PROGRESS REQUIREMENTS

In order to demonstrate reasonable further progress for the period 2011-2012, the Baltimore region must show that expected emissions in 2012 are equal to or less than the 2012 target levels presented in Table 7-2.

The 2012 controlled inventories are inventories of all anthropogenic VOC and NOx emissions expected to occur in the Baltimore Nonattainment Area during 2012. The inventories were developed as described in Chapter 4 and are displayed in Table 4-7. As summarized in Table 7-3, the 2012 controlled VOC and NOx inventories are less than the 2012 target inventories. Table 7-3 demonstrates that the Baltimore region fulfills the 2011-2012 reasonable further progress requirements.

Table 7-3:
Baltimore Nonattainment Area
Comparison of 2012 Controlled and Target Inventories
Ozone Season Daily Emissions (tons per day)

Description	VOC	NOx
2012 Target Levels	220.38	328.49
2012 Controlled Emissions	199.90	232.88

8.0 CONTROL MEASURES

This chapter is divided into three sections. Section 8.1 identifies the control measures that were part of the 1-Hour Ozone SIP for the Baltimore Nonattainment Area. These regulations/control measures continue to be in existence and continue to reduce emissions in the region. All of the emission reductions from the measures identified in Section 8.1 were part of the baseline emissions inventory for the Baltimore Nonattainment Area.

Section 8.2 of this chapter identifies measures implemented after 2002 that were not part of the baseline inventory and are giving specific emission reductions to the region's 8-hour Ozone reasonable further progress demonstration.

Section 8.3 identified voluntary/innovative measures that the Maryland is not taking formal credit for in the SIP. These measures are not commitments to programs but present information on programs that are directionally correct and could provide ozone benefits.

8.1 1-HOUR OZONE CONTROL MEASURES

8.1.1 On-Road Mobile Measures

Enhanced Vehicle Inspection and Maintenance (Enhanced I/M)

The Clean Air Act (CAA or "the Act") requires enhanced motor vehicle inspection and maintenance (I/M) programs in serious, severe, and extreme ozone nonattainment areas and Metropolitan Statistical Area (MSA)/Consolidated Metropolitan Statistical Area (CMSA) portions of the OTR with urbanized populations over 200,000. In Maryland, this required an enhanced I/M program in the eight jurisdictions operating a basic I/M program as well as six new jurisdictions, for a total of 14 of the 23 jurisdictions in the state.   Tailpipe emissions are measured over a transient driving cycle conducted on a dynamometer, which provides a much better indication of actual on-road vehicle performance than the existing idle test.

Tier I Vehicle Emission Standards and New Federal Evaporative Test Procedures

The Act requires a new and cleaner set of federal motor vehicle emissions standards (Tier I standards) beginning with model year 1994. The Act also requires a uniform level of evaporative emission controls which are more stringent than most evaporative controls used in existing vehicles. These federally implemented programs affect light duty vehicles and trucks.

Reformulated Gasoline in On-road Vehicles

All gasoline-powered vehicles are affected by this control measure. Vehicle refueling emissions at service stations are also reduced. In addition, emissions from gasoline powered nonroad vehicles and equipment are reduced by this control strategy. Since January 1995, only gasoline that the EPA has certified as reformulated may be sold to consumers in the nine worst ozone nonattainment areas with populations exceeding 250,000.

Tier 2 Vehicle Emission Standards

On December 21, 1999, the EPA announced new regulations affecting tailpipe emissions standards for the production of new cars and light trucks weighing up to 8,500 pounds. Commonly referred to as "Tier 2," these standards take effect beginning in 2004. The emissions reduction benefits of this Tier 2 program for the Maryland region are be significant, including passenger cars that are 77 percent cleaner than those on the road today. Light-duty trucks, such as Sport Utility Vehicles (SUVs), which are subject to standards that are less protective than those for cars, would be as much as 95 percent cleaner under the new standards. In effect, the rule forces SUVs and light trucks to meet the same tailpipe emission standards as cars.

As part of the new tailpipe standard, the EPA also announced standards for lower sulfur in gasoline. The lower sulfur standards are necessary to enable passenger vehicles to meet Tier 2 emission standards.

National Low Emission Vehicle Program

The National Low Emission Vehicle Program (National LEV) program is a vehicle technology program resulting in the production of light duty vehicles and light-duty trucks with significantly lower tailpipe emissions. The National LEV program is applicable to 1999 and later model-year vehicles sold in the Ozone Transport Region (OTR) and 2001 and later model-year vehicles sold throughout the United States. The National LEV program was developed through an unprecedented, cooperative, voluntary effort by the northeastern states, auto manufacturers, environmentalists, fuel providers, U.S. EPA and other interested parties. National LEV vehicles are 70 percent cleaner than 1998 models. The National LEV program results in substantial reductions in volatile organic compounds (VOCs) and oxides of nitrogen (NOx), which contribute to unhealthy levels of smog in many areas across the country.

Federal Heavy-Duty Diesel Engine Rule

EPA's heavy-duty diesel engine (HDDE) rule addresses diesel vehicles weighing more than 8,500 pounds. These standards take effect in 2007 and reduce emissions from new HDDEs by 95%. In order to achieve the new standards, ultra-low sulfur diesel fuel will also be needed.

Stage II and New Vehicle On-Board Vapor Recovery Systems

These measures required the following: (1) installation of Stage II vapor recovery nozzles at gasoline pumps and (2) the installation of onboard refueling emissions (onboard refueling vapor recovery, or "ORVR") controls for new passenger cars and light trucks beginning in the 1998 model year. Maryland adopted Stage II vapor recovery regulations for the Baltimore and Washington nonattainment areas and Cecil County in January of 1993, earlier than required of the Ozone Transport Region (OTR). The Stage II vapor recovery regulation requires that the gasoline dispensing system be equipped with nozzles that are designed to return the vapors, through a vapor line, into the gasoline tank.

8.1.2 Area Source Measures

VOC Controls in Maryland[22]

- Automotive and Light-Duty Truck Coating
- Can Coating
- Coil Coating
- Large Appliance Coating
- Paper, Fabric, Vinyl, and Other Plastic Parts Coating
- Control of VOC Emissions from Solid Resin Decorative Surface Manufacturing
- Metal Furniture Coating
- Control of VOC Emissions from Cold and Vapor Degreasing
- Flexographic and Rotogravure Printing
- Lithographic Printing
- Dry Cleaning Installations
- Miscellaneous Metal Coating
- Aerospace Coating Operations
- Brake Shoe Coating Operations
- Control of Volatile Organic Compounds from Structural Steel Coating Operations
- Manufacture of Synthesized Pharmaceutical Products
- Paint, Resin and Adhesive Manufacturing and Adhesive Application
- Control of VOC Equipment Leaks
- Control of Volatile Organic Compound (VOC) Emissions from Yeast Manufacturing
- Control of Volatile Organic Compound Emissions from Screen Printing and Digital Imaging

[22] See the Code of Maryland Regulations (COMAR) 26.11.10, 26.11.14, and 26.11.19.

- Control of Volatile Organic Compounds (VOC) Emissions from Expandable Polystyrene Operations
- Control of Landfill Gas Emissions from Municipal Solid Waste Landfills
- Control of Volatile Organic Compounds (VOC) Emissions from Commercial Bakery Ovens
- Control of Volatile Organic Compounds (VOC) from Vinegar Generators
- Control of VOC Emissions from Vehicle Refinishing
- Control of VOC Emissions from Leather Coating
- Control of Volatile Organic Compounds from Explosives and Propellant Manufacturing
- Control of Volatile Organic Compound Emissions from Reinforced Plastic Manufacturing
- Control of Volatile Organic Compounds from Marine Vessel Coating Operations
- Control of Volatile Organic Compounds from Bread and Snack Food Drying Operations
- Control of Volatile Organic Compounds from Distilled Facilities
- Control of Volatile Organic Compounds from Organic Chemical Production
- Iron and Steel Production Installations
- Control of Kraft Pulp Mill Emissions

Municipal Landfills

A municipal solid waste landfill is a disposal facility where household waste is placed and periodically covered with inert material. Landfill gases are produced from the decomposition and chemical reactions of the refuse in the landfill. They consist primarily of methane and carbon dioxide, with volatile organic compounds making up less than one percent of the total emissions. The control strategy for this source category is based upon federal rules.

Burning Ban

Open burning is primarily used for the disposal of brush, trees, and yard waste and as a method of land clearing by both developers and individual citizens. Emissions from open burning include oxides of nitrogen, hydrocarbons, carbon dioxide (CO_2), carbon monoxide (CO) and other toxic compounds. Emissions levels from open burning are high due to the inefficient and uncontrolled manner in which the material is burned. The Department adopted a regulation that prohibits open burning during the peak ozone period (June to August). There are exemptions for agricultural burning, fire training and recreational activities.

Surface Cleaning/Degreasing

Cold degreasing is an operation that uses solvents and other materials to remove oils and grease from metal parts including automotive parts, machined products and fabricated metal components. MDE adopted regulations in 1995 to require small degreasing operations such as gasoline stations, autobody paint shops and machine shops to use less polluting degreasing solvents in serious and severe ozone nonattainment areas. Also, solvent baths and rags soaked with solvents must be covered under this regulation.

Architectural and Industrial Maintenance Coatings

Architectural and industrial maintenance coatings are field-applied coatings used by industry, contractors, and homeowners to coat houses, buildings, highway surfaces, and industrial equipment for decorative or protective purposes. VOC emissions result from the evaporation of solvents from the coatings during application and drying. A federal measure requires reformulation of architectural and industrial maintenance coatings. The users of these coatings are small and widespread, making the use of add-on control devices technically and economically infeasible.

Commercial and Consumer Products

Consumer and commercial products are items sold to retail customers for household, personal or automotive use, along with the products marketed by wholesale distributors for use in institutional or commercial settings such as beauty shops, schools, and hospitals. VOC emissions result from the evaporation of solvent contents in the products or solvents used as propellants. This measure requires the reformulation of certain consumer products to reduce their VOC content. Product reformulation can be accomplished by substituting water, other non-VOC ingredients, or low-VOC solvents for VOCs in the product.

Automobile Refinishing

Automobile refinishing is the repainting of worn or damaged automobiles, light trucks and other vehicles. Volatile organic compound emissions result from the evaporation of solvents from the coatings during application, drying and clean up techniques. This measure, based in state regulation, requires large and small autobody refinishing operations to use low VOC content materials in the refinishing process and cleanup, and to use efficient spray guns to control application. The Department adopted regulations in 1995 requiring the use of reformulated coatings.

Screen Printing

A screen-printing process is used to apply printing or an image to virtually any substrate. In the screen-printing operation, ink is distributed through a porous screen mesh to which a stencil may have been applied to define an image to be printed on a substrate. VOC emissions result from the evaporation of ink solvents and from the use of solvents for cleaning. The major source of VOC emissions is the printing process. This measure requires smaller printers to use water based and/or low VOC materials to reduce VOC emissions. Because the users of these coatings are relatively small, requiring the use of add-on control devices is technically and economically infeasible. Reductions in VOC emissions were obtained through the use of ink reformulation, process printing modification, and material substitution for cleaning operations. This regulation became effective on June 5, 1995.

Graphic Arts – Lithographic Printing

This source category consists of numerous small sheet-fed printers that perform non-continuous printing, and web printers that print on a continuous web or roll. Heat-set web printers use drying ovens to force dry the printed matter. Web printing sources perform high volume printing on paper or paperboard. VOC emissions are caused by evaporation of the ink solvents, alcohol in the fountain or dampening solution, and equipment wash solvents. These VOC discharges may also cause visible emissions and nuisance odors. MDE adopted a regulation in 1995 to require printers to use control devices and/or low VOC materials to reduce VOC emissions.

Graphic Arts – Flexographic and Rotogravure Printing

This source category consists of numerous small flexographic or rotogravure printers that perform non-continuous sheet fed printing and continuous web or roll printing. MDE adopted a printing regulation in 1987 that requires smaller printers to use control devices and/or low VOC materials to reduce VOC emissions. VOC emissions are caused almost entirely by evaporation of the ink solvents. Although several control devices were evaluated over the years for rotogravure and flexographic web printers, a catalytic oxidizer has proven to be most successful. A typical oxidizer yields 96-98 percent destruction of VOC. Most sources were in compliance with all requirements by early 1992.

8.1.3 Non-Road Measures

Nonroad Small Gasoline Engines

This measure requires small gasoline-powered engine equipment, such as lawn and garden equipment, manufactured after August 1, 1996 to meet federal emissions standards. Small gasoline-powered engine equipment includes, for example, lawn mowers, trimmers, generators, and compressors. These measures apply to equipment with engines of less than 25 horsepower. VOC emissions result from combustion and evaporation of gasoline used to power this equipment.

Non-Road Diesel Engines Tier I and Tier II

This measure takes credit for NOx emissions reductions from emissions standards promulgated by the EPA for non-road, compression-ignition (i.e., diesel-powered) utility engines. The measure affects diesel-powered (or other compression-ignition) heavy-duty farm, construction equipment, industrial equipment, etc., rated at or above 37 kilowatts (37 kilowatts is approximately equal to 50 horsepower). Heavy-duty farm and construction equipment includes asphalt pavers, rollers, scrapers, rubber-tired dozers, agricultural tractors, combines, balers, and harvesters. This measure applies to all compression-ignition engines except engines used in aircraft, marine vessels, locomotives and underground mining activity. NOx emissions result from combustion of diesel fuel used to power this equipment.

Marine Engine Standards

Of the nonroad sources studied by EPA, gasoline marine engines were found to be one of the largest contributors of hydrocarbon (HC) emissions, 30% of the nationwide nonroad total. This measure controls exhaust emissions from new spark-ignition (SI) gasoline marine engines, including outboard engines, personal watercraft engines, and jet boat engines.

Emissions standards for large spark ignition engines

This EPA measure controls VOC and NOx emissions from several groups of previously unregulated nonroad engines, including large industrial spark-ignition engines, recreational vehicles, and diesel marine engines. The emission standards apply to all new engines sold in the United States and any imported engines manufactured after these standards begin. Controls on the category of large industrial spark-ignition engines are first required in 2004. Large industrial spark-ignition engines are those rated over 19 kW used in a variety of commercial applications; most use liquefied petroleum gas, with others operating on gasoline or natural gas. Controls on the other engine categories are required beginning in years after 2005.

Reformulated gasoline use in non-road motor vehicles and equipment

This federally mandated measure requires the use of lower polluting "reformulated" gasoline in the Baltimore Nonattainment Area. The measure involves taking credit for emissions reductions resulting from the use of the federally reformulated gasoline in non-road mobile sources. Nonattainment areas classified as severe were required to opt in on the delivery of reformulated gasoline. This measure affects the various non-road mobile sources that burn gasoline, such as small gasoline-powered engine equipment including lawn mowers, trimmers, generators, and compressors. VOC emissions result from combustion and evaporation of gasoline used to power this equipment.

Railroad Engine Standards

This measure establishes emission standards for oxides of nitrogen, hydrocarbons, carbon monoxide, particulate matter, and smoke for newly manufactured and remanufactured diesel-powered locomotives and locomotive engines, which were previously unregulated. This regulation took effect in 2000 and affects railroad manufacturers and locomotive re-manufacturers. It involves adoption of three separate sets of emission standards with the applicability dependent on the date a locomotive is first manufactured.

8.1.4 Point Source Measures

Expandable Polystyrene Products

These sources use expandable polystyrene beads that contain pentane, a VOC, to manufacture foam products such as foam cups, board insulation, and custom shapes. VOC emissions typically occur during storage and pre-expansion of the beads, during manufacturing, and during "aging" when the blowing agent (pentane) slowly diffuses from the foam before shipping. This control measure requires Reasonably Available Control Technologies (RACT) to be installed at operations that manufacture foam cups, foam insulation and other foam products. The regulation became effective in July 1995.

Yeast Manufacturing

Yeast is produced using an aerated fermentation process under controlled conditions. In June 1995, MDE required RACT to be installed at two yeast-manufacturing operations in the Baltimore Nonattainment Area. The regulation results in an overall emission reduction of approximately 60 to 70 percent from the 1990 baseline by requiring affected sources to meet specific VOC emission standards.

Commercial Bakery Ovens

This measure requires commercial bakeries using yeast to leaven bread and bread products to install RACT. Commercial bakeries generate VOC emissions from the fermentation and baking processes used to produce yeast-raised baked goods. These emissions are primarily ethanol. The regulation requires control equipment dependent upon thresholds that are based on cost effectiveness criteria.

Federal Air Toxics

This measure covers sources that are required to comply with federal air toxics requirements. The Department has delegation to implement federal air toxics rules that will achieve VOC emissions reductions. Federal rules that may achieve such reductions include the following: federal NESHAPs for vinyl chloride production plants, benzene emissions from equipment leaks, benzene storage vessels, coke by-product recovery plants, benzene transfer operations, and benzene waste operations; and the EPA Maximum Achievable Control Technology (MACT) program.

Enhanced Rule Compliance

Enhanced Rule Compliance or rule effectiveness (RE) improvement refers to an improvement in the implementation of and compliance with a regulation. These RE improvements may take several forms, ranging from more frequent and in-depth training of inspectors to larger fines for sources that do not comply with a given rule.

State Air Toxics

This measure addresses stationary sources that are covered by Maryland's air toxics regulations that have achieved VOC reductions above and beyond current federally enforceable limits. In general, Maryland's air toxics regulations cover any source required to obtain a permit to construct or annually renewed state permit to operate. The Department adopted the air toxics regulations in 1988.

NOx RACT -- Reasonably Available Control Technology

This measure requires control of nitrogen oxides (NOx) emissions by installing RACT. NOx RACT will apply to utility, industrial and commercial fuel burning equipment and combustion installations. The regulation established cost-effective controls on all installations located at major NOx sources. This first phase of stationary source NOx reductions resulted in an approximate 22% reduction in NOx emissions.

NOx Phase II/Phase III Ozone Transport Commission (OTC)/NOx Budget Rule (Phase II) and NOx SIP Call (Phase III)

In 1994, the OTC member states signed a major agreement to reduce NOx emissions from power plants and other major stationary sources of pollution throughout the Northeast and Mid-Atlantic states. The agreement recognized that further reductions in NOx emissions are needed to enable the entire Ozone Transport Region (OTR) to meet the NAAQS. The Department adopted a “NOx Budget” rule to require a second phase of stationary source NOx reductions as part of this regulatory initiative. This regulation requires large stationary sources to reduce summertime NOx emissions by approximately 65% from 1990 levels. The regulation also includes provisions allowing sources to comply by trading “allowances.” This regulation requires affected sources to have met these requirements by May 2000.

In late 1998, the U.S. EPA adopted its “NOx SIP Call” to reduce ozone transport in the Eastern United States. This regional NOx reduction program requires 22 states, including Maryland, to submit regulations and a revision to State Implementation Plans (SIPs) to further reduce NOx emissions. Maryland’s Phase III regulations achieve approximately 23% additional reductions from large stationary sources such as power plants, cement kilns and large industrial boilers. The regulations require affected sources to add specific control equipment, reduce emissions, or trade to meet the allowable amount ("cap") of seasonal NOx emissions by 2003.

8.2 8-HOUR OZONE CONTROL MEASURES

The following measures have been implemented in Maryland since 2002, the baseline emissions inventory year for 8-Hour Ozone. These measures were not part of the baseline emissions inventory for the 8-Hour Ozone SIP, and emission reductions from these measures were forecasted for 2008, 2011, and 2012 (reasonable further progress calculation) and 2012 (attainment inventory) for use in the reasonable further progress calculations for the Baltimore Nonattainment Area as well as the attainment modeling for the region. A summary of the control measures and their benefits is presented in Table 8-1 below. The benefits below summarize the emission credits available from the listed measures based on the difference between a controlled and uncontrolled inventory, each year, for each pollutant.

Table 8-1: Summary of Emissions Credits Available from Control Measures

	2008		2011		2012	
Control Measure	**VOC**	**NOx**	**VOC**	**NOx**	**VOC**	**NOx**
Total Mobile (Includes Enhanced I/M, Tier I, Reform Gas, LEV, and HDDE)	52.86	158.43	62.23	181.35	66.59	192.33
Stage II/Refuel	0.00	0.00	0.00	0.00	0.00	0.00
OTC - Consumer Products Phase 1	3.70	0.00	3.77	0.00	3.79	0.00
OTC - Consumer Products Phase 2	0.00	0.00	0.46	0.00	0.46	0.00
OTC – AIM	6.03	0.00	6.19	0.00	6.19	0.00
OTC - PFC Phase 1	6.71	0.00	8.31	0.00	8.35	0.00
OTC - PFC Phase 2	0.00	0.00	0.60	0.00	0.60	0.00
OTC - Industrial Adhesives	0.00	0.00	2.63	0.00	2.64	0.00
Open Burning	0.00	0.00	0.00	0.00	0.00	0.00
Nonroad Model	17.85	8.12	26.33	14.55	29.83	17.30
Railroads (Tier 2)	0.00	1.18	0.00	1.58	0.00	1.67
Healthy Air Act (HAA)	0.00	0.00	0.00	31.86	0.00	37.18
Total	**87.14**	**167.73**	**110.51**	**229.35**	**118.45**	**248.48**

8.2.1 The Maryland Healthy Air Act (HAA)

In April of 2006, the Maryland General Assembly enacted the Maryland Healthy Air Act. The Maryland General Assembly record related to the HAA and the final version of the Act itself can be found at:

http://mlis.state.md.us/2006rs/billfile/SB0154.htm

The MDE Regulations (Code of Maryland Regulations) can be found at:

http://www.mde.state.md.us/assets/document/CPR_12-26-06_Emergency_and_Permanent_HAA_Regs_for_AELR.pdf

The HAA requires reductions in nitrogen oxides (NO_x), sulfur dioxide (SO_2) and mercury emissions from large coal burning power plants. The Healthy Air Act also requires that Maryland become involved in the Regional Greenhouse Gas Initiative (RGGI) which is aimed at reducing greenhouse gas emissions.

The Maryland Department of the Environment has been charged with implementing the HAA through regulations. As enacted, these regulations constitute the most sweeping air pollution emission reduction measure proposed in Maryland history.

Affected Sources

The Healthy Air Act NOx reduction requirements affect the fossil fuel fired electric generating units below. Note that only the Ravens Power Holdings, LLC plants are located in the Baltimore Nonattainment Area.

Ravens Power Holdings,
Brandon Shores 1 & 2, Anne Arundel County
H. A. Wagner 2 & 3, Anne Arundel County
C. P. Crane 1 & 2, Baltimore County

Mirant System
Chalk Point 1 & 2, Prince George's County
Dickerson 1, 2, & 3, Montgomery County
Morgantown 1 & 2, Charles County

Allegheny Energy Washington County
R. Paul Smith, 3 & 4

Overview of Expected Emission Reductions

Over ninety-five percent of the air pollution emitted from Maryland's power plants comes from the largest and oldest coal burning plants. The emission reductions from the Healthy Air Act come in two phases. The first phase requires reductions in the 2009/ 2010 timeframe, and compared to a 2002 emissions baseline, reduce NO_x emissions by almost 70%, SO_2 emissions by 80% and mercury emissions by 80%.

The second phase of emission control occurs in the 2012/2013 timeframe. At full implementation the HAA will reduce NO_x emissions by approximately 75 percent from 2002 levels, SO_2 emissions will be reduced by approximately 85 percent from 2002 levels, and mercury emissions will be reduced by 90 percent.

Table 8-2: Annual Maryland Healthy Air Act NOx Emissions Reductions (TPY):

Unit	2002 Emissions	Uncontrolled 2009 Emissions	2009 HAA Caps	**2009 HAA Emission Reductions**	2009 HAA Emission Reduction %	2012 HAA Caps	2009 Uncontrolled Emissions - 2012 HAA Cap	2012 HAA Emission Reduction %
Brandon Shores 1	6329	7558	2927	**4631**	61.27	2414	5144	68.06
Brandon Shores 2	6034	7206	3055	**4151**	57.60	2519	4687	65.04
Wagner 2	2232	2666	673	**1993**	74.76	555	2111	79.18
Wagner 3	1718	2052	1352	**700**	34.11	1115	937	45.66
Crane 1	6245	7458	832	**6626**	88.84	686	6772	90.80
Crane 2	4285	5117	894	**4223**	82.53	737	4380	85.60
TOTALS	**26843**	**32057**	**9733**	**22324**	**69.64**	**8026**	**24031**	**74.96**

Table 8-3: Ozone Season Maryland Healthy Air Act NOx Emissions Reductions*

Unit	(a) 2002 Emissions (Ozone Season Day)	(b) 2002 Emissions (Ozone Season = 153 Days)	(c) Uncontrolled 2009 Emissions (Ozone Season Day)	(d) Uncontrolled 2009 Emissions (Ozone Season = 153 Days)	(e) 2009 HAA Caps (Ozone Season = 153 Days)	**(f) 2009 HAA Emission Reductions (Ozone Season)**	**(g) 2009 HAA Reductions (Ozone Season Day)**	(h) 2012 HAA Caps (Ozone Season = 153 Days)	(i) 2009 Uncontrolled Emissions - 2012 HAA Cap (Ozone Season)	(j) 2009 Uncontrolled Emissions - 2012 HAA Cap (Tons Per Ozone Season day)
Brandon Shores 1	9.68	1481.04	11.56	1768.68	1363	**405.68**	**2.65**	1124	644.68	4.21
Brandon Shores 2	7.60	1162.80	9.08	1389.24	1449	**-59.76**	**-0.39**	1195	194.24	1.27
Wagner 2	6.88	1052.64	8.21	1256.13	278	**978.13**	**6.39**	229	1027.13	6.71
Wagner 3	3.28	501.84	3.91	598.23	583	**15.23**	**0.10**	481	117.23	0.77
Crane 1	11.86	1814.58	14.16	2166.48	345	**1821.48**	**11.91**	284	1882.48	12.30
Crane 2	10.56	1615.68	12.61	1929.33	385	**1544.33**	**10.09**	317	1612.33	10.54
TOTALS	**49.86**	**7628.58**	**59.53**	**9108.09**	**4403**	**4705**	**30.75**	**3630**	**5478**	**36**

***All emissions are measured in short tons.**

8.2.2 Portable Fuel Containers Rule: Phase I

This measure introduces performance standards for portable fuel containers and spouts. The standards are intended to reduce emissions from storage, transport and refueling activities. The rule also included administrative and labeling requirements. Compliant containers must have the following: only one opening for both pouring and filling, an automatic shut-off to prevent overfill, an automatic sealing mechanism when not dispensing fuel, specified fuel flow rates, and permeation rates and warranties.

Source Type Affected

This measures affects any person or entity selling, supplying or manufacturing portable fuel containers, except containers with a capacity of less than or equal to one quart, rapid refueling devices with capacities greater than or equal to four gallons, safety cans and portable marine fuel tanks operating with outboard motors, and products resulting in cumulative VOC emissions below those of a representative container or spout.

Control Strategy

Maryland adopted phase I of the Ozone Transport Commission (OTC) Model Rule for Portable Fuel Containers in January 2002. The rule applies to all counties in the nonattainment area. Reductions from this rule increase annually beginning with implementation in the State of Maryland on January 1, 2004.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 6.71
VOC Emission Reductions for 2011 (TPD): 8.31
VOC Emission Reductions for 2012 (TPD): 8.35

Emission Benefit Calculations

Projected reductions are based on an emission reduction factor of 75% after full implementation after 10 years. Implementation began in 2004.

References

E.H. Pechan, "Control Measure Development Support Analysis for the Ozone Transport Commission Model Rules", March 31, 2001.

8.2.3 Architectural and Industrial Maintenance Coatings Rule

This rule requires manufacturers to reformulate various types of coatings to meet VOC content limits. Affected products include architectural coatings, traffic markings, high-performance maintenance coatings and other special-purpose coatings. It uses more stringent VOC content limits than the existing federal consumer products rule.

Source Type Affected

The measure affects all manufacturers of affected coatings.

Control Strategy

Maryland adopted this rule on March 29, 2004. The rule applies to all counties in the nonattainment area. Compliance with this rule was required as of January 1, 2004.

The VOC content limits in this rule are based on a Suggested Control Measure (SCM) adopted by the California Air Resources Board (CARB) and a National Association of Clean Air Agencies (NACAA) model rule or OTC coatings. Manufacturers are expected to comply with this rule using primarily EPA Test Method 24.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 6.03

VOC Emission Reductions for 2011 (TPD): 6.19
VOC Emission Reductions for 2012 (TPD): 6.19

Emission Benefit Calculations

Projected reductions are based on an emission reduction factor of 31 percent, based on Pechan (2001).

References

E.H. Pechan, "Control Measure Development Support Analysis for the Ozone Transport Commission Model Rules", March 31, 2001.

8.2.4 Consumer Products Rule: Phase 1

Phase I of the Consumer Products Rule required reformulation of approximately 80 types of consumer products to reduce their VOC content. It uses more stringent VOC content limits than the existing federal consumer products rule. The rule also contains requirements for labeling and reporting.

Source Type Affected

Manufacturers of various specialty chemicals named in the rule, such as aerosol adhesives, floor wax strippers, dry cleaning fluids and general purpose cleaners

Control Strategy

Phase I of the Ozone Transport Commission Model Rule for Reformulated Consumer Products became effective in the State of Maryland on August 18, 2003.

Manufacturers are expected to demonstrate compliance with the rule primarily through a California Air Resources Board test method. If complying with the VOC contents becomes difficult, flexibility options are provided.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 3.70
VOC Emission Reductions for 2011 (TPD): 3.77
VOC Emission Reductions for 2012 (TPD): 3.79

Emission Benefit Calculations

Projected reductions are based on an emission reduction factor of 14.2 percent, based on Pechan (2001).

References

E.H. Pechan, "Control Measure Development Support Analysis for the Ozone Transport Commission Model Rules", March 31, 2001.

8.2.5 Industrial Adhesives and Sealants Rule

This rule establishes VOC content limitations for industrial and commercial application of solvent-based adhesives and sealants. Controls will cover adhesives, sealants, adhesive primers, sealer primers, adhesive application to substrates, and aerosol adhesives. VOC content limits are similar to those contained in the CARB Reasonably Available Control Technology (RACT) or Best Available Control Technology (BACT) document for adhesives and sealants (Dec. 1998).

Source Type Affected

Manufacturers and distributors of industrial adhesives and sealants

Control Strategy

The State of Maryland will adopt the Ozone Transport Commission (OTC) Model Rule for Industrial Adhesives and Sealants in time such that the effective date of emissions reductions occurs no later than May 1, 2009.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 0.00
VOC Emission Reductions for 2011 (TPD): 2.63
VOC Emission Reductions for 2012 (TPD): 2.64

Emission Benefit Calculations

Emission benefits are based on a 64 percent reduction in emissions of VOC from the baseline. Further details are available in OTC (2006).

References

OTC 2006. *Identification and Evaluation of Candidate Control Measures: Draft Technical Support Document.* Prepared by MACTEC Federal Programs, Inc., Herndon, Virginia for the Ozone Transport Commission. August 4, 2006.

8.2.6 Portable Fuel Containers Rule: Phase II

This measure expands existing performance standards for portable gasoline containers and spouts to kerosene containers. The standards are intended to reduce emissions from storage, transport and refueling activities. The rule also includes administrative and labeling requirements. Compliant containers must have the following: only one opening for both pouring and filling; an automatic shut-off to prevent overfill; an automatic sealing mechanism when not dispensing fuel; and specified fuel flow rates, permeation rates and warranties.

Source Type Affected

This measure affects any person or entity selling, supplying or manufacturing portable fuel containers, except containers with a capacity of less than or equal to one quart, rapid refueling devices with capacities greater than or equal to four gallons, safety cans and portable marine fuel tanks operating with outboard motors, and products resulting in cumulative VOC emissions below those of a representative container or spout.

Control Strategy

The State of Maryland has adopted the Ozone Transport Commission (OTC) Model Rule for Portable Fuel Containers Phase II in time such that the effective date of emissions reductions occurs no later than May 1, 2008.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 0.00
VOC Emission Reductions for 2011 (TPD): 0.60
VOC Emission Reductions for 2012 (TPD): 0.60

Emission Benefit Calculations

Projected reductions are based on an emission reduction factor of 58% after full implementation after 10 years. Implementation began in 2004. In 2008, the emission reduction factor is 0.00%. In 2009, the emission reduction factor is 5.8%. Further details are available in OTC Technical Support Document (2006).

References

[OTC 2006. *Identification and Evaluation of Candidate Control Measures: Draft Technical Support Document.* Prepared by MACTEC Federal Programs, Inc., Herndon, Virginia for the Ozone Transport Commission. August 4, 2006]

8.2.7 Consumer Products Rule: Phase II

Phase II of the Consumer Products Rule involves adopting the CARB 7/20/05 Amendments which set new or revise existing limits on 13 consumer product categories. It uses more stringent VOC content limits than the existing federal consumer products rule. The rule also contains requirements for labeling and reporting.

Source Type Affected

Manufacturers of various specialty chemicals named in the rule, such as aerosol adhesives, floor wax strippers, dry cleaning fluids and general purpose cleaners

Control Strategy

The State of Maryland will adopt the Ozone Transport Commission (OTC) Model Rule for Consumer Products Phase II in time such that the effective date of emissions reductions occurs no later than May 1, 2008.

Projected Reductions

VOC Emission Reductions for 2008 (TPD): 0.00
VOC Emission Reductions for 2011 (TPD): 0.46
VOC Emission Reductions for 2012 (TPD): 0.46

Emission Benefit Calculations

Emission reductions are based on an additional 2 percent reduction in emissions of VOC from the baseline. Further details are available in OTC Technical Support Document (2006).

References

[OTC 2006. *Identification and Evaluation of Candidate Control Measures: Draft Technical Support Document.* Prepared by MACTEC Federal Programs, Inc., Herndon, Virginia for the Ozone Transport Commission. August 4, 2006]

Rule Phase In

The following rules have a phase in period for the Baltimore Nonattainment Area and give the region phased-in emissions benefits:

Area Sources:
- Additional phase in of reductions from Federal Locomotives Rule
- Federal Rule related to On-Board Refueling/Vapor Recovery for LD Trucks (2004)

Nonroad Sources:
- Federal 2004 Nonroad Heavy Duty Diesel Rule (negligible benefits by 2009)

8.3 VOLUNTARY AND INNOVATIVE MEASURES

EPA's voluntary measures policy, "Guidance on Incorporating Voluntary Mobile Source Emission Reduction Programs in State Implementation Plans," establishes criteria under which emission reductions from voluntary programs are creditable in a SIP. This policy permits states to develop and implement innovative programs that partner with local jurisdictions, businesses and private citizens to implement emission-reducing behaviors at the local level.

Inclusion of the programs below in the "Control Measures" portion of this attainment plan is not intended to create an enforceable commitment by MDE or the State of Maryland to implement the programs or to achieve any specific emission reductions projected as a result of implementation of the programs, and neither MDE nor the State makes any such commitment. In addition, MDE does not rely on any emission reductions projected as a result of implementation of these programs to demonstrate attainment. While the emission reductions from these programs could be substantial and could lead to significant regional air quality benefits, actual air quality benefits are uncertain. Consequently, projected emission reductions from these programs are not included in the emission inventory, the attainment modeling, the reasonable further progress calculation or any other area of the SIP where specific projected emission reductions are identified.

8.3.1 Regional Forest Canopy Program: Conservation, Restoration, and Expansion

Expanded tree canopy cover is an innovative voluntary measure proposed to improve the air quality in the Baltimore region. Trees reduce ground-level ozone concentrations by the following means:

1) Reducing air temperatures and reducing energy used for cooling, and
2) Directly removing ozone and NOx from the air.

Modeling has clearly shown that trees reduce ozone levels. In addition, trees in an urban setting have far-reaching water quality habits (e.g. decreasing storm water runoff) and societal benefits. To achieve a reduction in ground-level ozone under a tree canopy program, it is necessary to preserve the current canopy and plant and maintain a significant number of new trees.

The current Baltimore region tree canopy is composed of mixed native hardwoods and urban plantings. On average these species require 30 years to mature, so the short-term benefits of a tree program are not substantial yet the long-term benefits are still significant. To achieve area-wide canopy expansion requires long-term commitment by the state and local agencies, volunteer organizations, and private landowners.

Achieving maximum benefits from this type of program requires the following types of commitments:

1) Initiate and/or enhance efforts to support, monitor, evaluate, and report preservation of existing urban tree canopy and canopy expansion efforts.

2) Implement urban forestry programs to affect air temperature, surface temperature, and wind speed and reduce VOC emissions. Programs include sustained tree planting, reduced mowing, and lawn maintenance. Also included are tree planting initiatives for streets, parking lots, and government-owned facilities.

3) Provide assistance and outreach to landowners and businesses to encourage tree conservation, planting and maintenance.

4) Initiate development of a comprehensive plan that establishes a detailed regional baseline and outline strategies to preserve, enhance, increase, protect, measure, and track overall forest canopy change in the region over the next 20 years.

5) Monitor these activities and report annually.

Current Programs

While Maryland has over 40 state programs that support, encourage or require the planting of trees, five of these tools are of special importance for implementation at the local level:

- Forest Conservation Act
- Critical Areas Act
- Mitigation Requirements
- Comprehensive Plans Requirements
- Urban and Community Forestry Programs

Special attention will be paid to how these programs can be coordinated with new local ordinances and initiatives to enhance their use in tree protection, canopy preservation and expansion to achieve regional air quality (SIP) goals.

Control Strategy

Coordination

This type of measure requires collaboration among the various state and local agencies that support, encourage, and require tree planting. Currently, numerous agencies bear responsibility for implementing and tracking tree planting related activities, but there is no centralized repository for this information. The state can be encouraged to commit to create a new program to coordinate tree-planting programs. This program would be housed within the Department of Natural Resources' Maryland Forest Service and would be charged with management of a tree planting database and promoting outreach efforts to landowners and stakeholder groups. This database would be used to compile baseline data, including maps and descriptive information about each nonattainment county in the planning area; information about tree plantings, including new and replacement trees; and canopy change.

Canopy Preservation

The state coordinating office will work with local governments to fully implement key programs. Particular attention will be given to those who set conservation, tree planting and canopy goals and reforestation standards for local authorities to track during the development process. Local authorities will be encouraged to do the following:

1) Track efforts aimed at preserving existing canopy,

2) Provide the resource agency with data regarding preservation efforts including new ordinances and development tools, and

3) Work with federal, state and private landowners to identify development mitigation areas.

The effectiveness of canopy preservation efforts could then be periodically evaluated.

Public Outreach

The region would need to commit to undertake a public outreach program designed to promote tree planting. This need could be addressed building upon the Chesapeake Bay Agreement Forestry Directive and local land use guidelines. Past initiatives under Maryland programs have included financial incentives to private landowners for planting trees. The Baltimore Metropolitan Council, state government agencies, and local governments could work with volunteer tree planting organizations, landowners, and stakeholder groups to support tree planting and conduct educational outreach regarding documenting and reporting voluntary planting and maintenance programs.

Canopy Goals

Each jurisdiction in the nonattainment area could be encouraged to adopt a tree canopy goal. Local and state governments could evaluate reforestation of public lands to meet canopy goals. Governments could collaborate with private citizens to address canopy goals.

Strategic Tree Planting

Biogenic volatile organic compounds (BVOCs), an ozone precursor, are emitted by some tree species as a natural process. Expanding the canopy primarily with trees whose BVOC emissions are lower will have a significant impact on overall emissions; planting lower BVOC trees is a key approach to reducing BVOCs. A right tree – right place strategy will need to be encouraged to garner the maximum benefits from this type of program.

8.3.2 Clean Air Teleworking Initiative

The State of Maryland, on occasion experiences unhealthful levels of the air pollutants, ground-level ozone and fine particles. When air quality elevates to unhealthful levels, it poses significant health and economic impacts on Maryland residents. Since 1990, when the modern-day Clean Air Act was passed, to address air pollution concerns and requirements Maryland has implemented over 100 pollution control programs affecting industries, small businesses, mobile sources, and the general public. These programs have prevented nearly 800 tons of ozone-forming pollutants from entering the air each day. In order to inform the public about daily air pollution levels, the Maryland Department of the Environment has been accurately forecasting and reporting air quality information since 1993.

Traffic congestion is a major problem in Maryland's metropolitan areas where individuals waste hundreds of hours every year stuck in traffic due to congested roadways. Numerous studies have demonstrated that telework (or "telecommuting") programs are advantageous in addressing major environmental, transportation, productivity, quality of life, and employment issues.

Reducing the number of road miles traveled by commuters decreases air polluting vehicle emissions, gasoline consumption, traffic congestion, and highway maintenance costs for Maryland residents. Telework provides economic and organizational benefits to employers, resulting in increased employee productivity, enhanced employee morale, improved employee recruitment and retention, reduced office space and parking needs, reduced stress, increased job satisfaction, decreased absenteeism costs, an expanded labor pool, and increased flexibility in meeting the needs of state residents. Maryland, as a major employer, has recognized its leadership role in developing substantive programs, such as teleworking, to reduce commuter road miles traveled by state employees and enhance productivity.

Objective

The objectives of the Clean Air Telework initiative are as follows: to 1) increase the number of employees who telework in the Baltimore/Washington metropolitan area and, 2) increase the frequency of employees who telework by linking teleworking with air quality; specifically, encouraging employees to telework on days when air quality is at its worst.

The decision to encourage teleworking on bad air days will be guided by the **Air Quality Index (AQI)**, a nationwide, color-coded scale used by the U.S. Environmental Protection Agency to communicate air quality to the public. "Code Orange" is considered ***unhealthy for sensitive groups*** (children, the elderly, and those with heart or lung conditions) and "Code Red" is considered

unhealthy for everyone. "Code Purple," which occurs very infrequently in the region, is considered ***very unhealthy for everyone***. Clean Air Partners, a nonprofit organization that encourages voluntary action to improve air quality, provides a three-day air quality forecast to local employers through its Air Quality Action Day (AQAD) program. A copy of Clean Air Partners' Air Quality Action Guide, which incorporated the AQI, is shown in Figure 8-1. Teleworking is encouraged at Code Orange and above.

CLEAN AIR PARTNERS™

Air Quality Action Guide (AQAG)

Your guide to cleaner, healthier air in the metropolitan Washington-Baltimore region.

Air Quality Numerical Value	**Action Steps To Protect Your Health and Our Environment**
GOOD 0-50	No pollution. Enjoy outdoor activities. ◆ Keep engines tuned. ◆ Use environmentally friendly products. ◆ Conserve electricity, set air conditioning to 78 degrees.
MODERATE 51-100	Air quality may pose a moderate risk, especially for those who are unusually sensitive to air pollution. ◆ Carpool, use public transit, bike, or walk. ◆ Limit driving, consolidate trips. ◆ Reduce car idling.
UNHEALTHY for Sensitive Groups 101-150	**Sensitive Groups**–children and active adults, people with respiratory disease, such as asthma and emphysema and heart ailments should limit prolonged outdoor physical activity. Follow all of the action steps listed previously AND: ◆ Refuel after dusk, use fuel-efficient vehicles. ◆ Avoid driving, use transit, telework. ◆ Avoid using aerosol products.
UNHEALTHY 151-200	**Unhealthy for Everyone** Sensitive Groups in particular should avoid outdoor physical activities. Everyone else, especially children, should limit prolonged outdoor exertion. Follow all of the action steps listed previously AND: ◆ Avoid lawn mowing or use electric mowers. ◆ Avoid using any gas powered lawn equipment. ◆ Put off painting until air quality improves.
VERY UNHEALTHY 201-300	**Very Unhealthy for Everyone** When air quality reaches very unhealthy levels everyone is strongly urged to follow all of the actions steps listed previously AND avoid outdoor physical activities.

For more information visit Clean Air Partners' website at **www.cleanairpartners.net**

Figure 8-1: Air Quality Action Guide

Approach

Encouraging employees to telework on poor air quality days may result in numerous employees and managers working at home for several consecutive days. This will require advanced preparation by employees, managers, and office coworkers to ensure transparency and a consistent level of productivity. While this may initially seem challenging from a management perspective, the added benefit is that employees and managers will become adept at teleworking concurrently, thereby increasing the organization's business continuity capabilities in the event of an actual emergency.

Implementation

The following steps are recommended to help businesses successfully launch their "Clean Air Teleworking" initiative:

Get Input from Managers **–** Businesses should get input from several managers to identify potential barriers and solutions to the "Clean Air Teleworking" initiative. This could be accomplished by conducting one-on-one interviews with 4-5 managers or a small discussion group. The input from the managers could then be used to shape the development and implementation of the program, starting with a small pilot involving a couple of managers supportive of teleworking ***and*** the "Clean Air Teleworking" initiative.

Become an AQAD Participant **–** Businesses should become Air Quality Action Days participants so they can receive the Clean Air Partners' three-day air quality forecast, which can then be distributed by email to employees when a poor air quality day (Code Orange, Code Red, or Code Purple) is forecasted.

Conduct Pilot **–** Businesses should select managers and employees who will be participating in the "Clean Air Teleworking" pilot and launch the program over the summer of 2007. Conduct an orientation/training session for participants prior to implementation and follow up with brief phone interviews after a multi-day episode to determine if there were any problems. Prepare a summary report at the end of the pilot and share with management and employees.

Implement Tracking System **–** Ask participants to track their participation using a Web-based system that tracks reductions in vehicle emissions, particularly NOx, VOC, CO, and CO_2, resulting from teleworking. An example is of such a Web-based system is TeleTrips (https://www.secure-teletrips.com/). The information collected can be reported at the individual, department/team, and organizational level and provides continuous feedback on how the program and participants are improving air quality. Furthermore, businesses should consider recognizing individuals or teams/departments with the highest level of participation and emissions reductions.

Communicate **–** Businesses should send out several email communications to all their employees; including, prior to the launch of the "Clean Air Teleworking" pilot, during implementation, and at the conclusion of the pilot. The emails should explain pilot program objectives and keep employees informed. Furthermore, employees not participating in the pilot should also receive the air quality forecast for Code Orange, Code Red, and Code Purple days and be encouraged to take other voluntary measures at work and at home (e.g., carpooling, eating in the cafeteria rather than going out for lunch, refueling after dusk, and postponing mowing lawns.)

Expand Program **–** Businesses should share the results of the pilot with all staff and encourage additional managers and employees to participate in the program in future years. Repeat orientation/training for new participants prior to implementation, conduct phone or on-line survey with participants during implementation, track participation and results for all participants, and recognize or reward individuals, teams, and departments with the highest level of participation and emissions reductions.

An initial pilot program will be initiated throughout the Maryland Department of the Environment (MDE). It will encourage telecommuting opportunities for qualified personnel when air quality is forecasted to be in the Code Orange (Unhealthy for Sensitive Groups) range or above. The MDE pilot program will launch in May 2007.

Additional strategies will be employed to encourage a wider participation in the Clean Air Teleworking Initiative. Examples include these:

- Promote participation among all Maryland State agencies;
- Collaborate with the Baltimore Metropolitan Council and the Metropolitan Washington Council of Governments to promote the initiative throughout the local jurisdictions; Clean Air Partners will serve as the work group to implement the program;
- Develop a strategic plan for local governments and federal agencies;
- Encourage participation within the private sector;
- Develop a merit-based recognition/award system for participation; and
- Promote program throughout the Ozone Transport Commission.

A timeline of the implementation steps is shown in Table 8-4.

Table 8-4: Clean Air Teleworking Time Line

	Task/Step	Apr-07	May-07	Jun-07	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07
1.0	**Telework Toolkit**									
1.1	Research materials	x								
1.2	Compile toolkit	X								
1.3	Integrate with Clean Air Partners web site		x							
2.0	**Clean Air Teleworking Pilot**									
2.1	Recruit organization(s)		x	x						
2.2	Develop/implement communications plan		x	x						
2.3	Conduct interviews/focus groups with managers		x	x						
2.4	Identify participants (e.g., specific units/departments)		x	x						
2.5	Conduct orientation			x						
2.6	Launch and conduct pilot			x	x	X	x			
2.6	Conduct "spot" phone interviews/email surveys			x	x	X	x			
2.7	Implement tracking system		x	x	x	X	x			
2.8	Track and report results		x	x	x	X	x	x	x	
2.9	Expand program								x	x

The Clean Air Teleworking Initiative will be developed in close coordination with other entities who have a role in telework implementation: Commuter Connections, Maryland Telework Partnership with Employers, Telework!Va, and the newly created Office of Telework Promotion and Broadband Assistance in VA.

Supporting Material

Clean Air Partners will compile and customize a telework tool kit that would be posted on the organization's Web site. The tool kit would provide on-line resources to help employers start or expand a telework program, including the use of "episodic" teleworking on poor air quality days.

University of Maryland Study of Air Quality Benefits of Teleworking

To simulate the effects of a very aggressive telework initiative, the University of Maryland modeled the air quality change that would result if 40% of all light duty vehicles were taken off the road in the nonattainment areas of Baltimore, Philadelphia, and Washington, D.C. on 38 high ozone days in the summer of 2002. Changes in emissions were implemented as a flat 40% reduction in vehicle miles traveled in each county of the three nonattainment areas. The effects of implementing such a program were modeled using version 4.4 of the CMAQ model. The model results showed that across the three nonattainment areas, an aggressive telework program has the potential for considerable benefit to air quality, with fairly uniform benefits across all three areas. The highest monitors in the Philadelphia and Washington, D.C. areas would see the largest benefits from this program, suggesting it is reaching the most troublesome monitors on the worst ozone days. Benefits in all three nonattainment areas averaged more than 2 ppbv ozone.

8.3.3 High Electricity Demand Day (HEDD) Initiative

Emissions from Electric Generating Units (EGUs) are higher on high electric demand days (HEDD), resulting in poorer air quality. High electrical demand day operation of EGUs generally has not been addressed under existing air quality control requirements, and the HEDD units are called into service on the very hot days of summer and on very cold days of winter when air pollution levels typically reach their peaks. HEDD units include gasoline and diesel combustion turbines as well as residual oil burning units.

The Ozone Transport Commission (OTC) has been meeting with state environmental and utility regulators, EPA staff, EGU owners and operators and the independent regional systems operators. The purpose of these meetings has been to assess emissions associated with HEDD during the ozone season and to address excess NOx emissions on HEDDs. The OTC has found that NOx emissions are much higher on a high electrical demand day than on a typical summer day. The potential exists to reduce HEDD emissions by approximately 25 percent in the short term through the application of known control technologies.

On March 2, 2007, the OTC states and the District of Columbia agreed to a Memorandum of Understanding (MOU) committing to reductions from the HEDD source sector. The MOU includes specific targets for a group of six states to achieve reductions in NOx emissions associated with HEDD units on high electrical demand days during the ozone season. These states agreed to achieve these reductions beginning with the 2009 ozone season or as soon as feasible thereafter, but no later than 2012. The OTC states not included in the MOU, including Virginia and the District of Columbia, agreed to continue to review the HEDD program and seek reductions where possible, but they do not have a formal emissions reduction target in the MOU. The OTC MOU is included in Appendix C.

8.3.4 Emission Reductions from Transportation Measures

Substantial funding commitments have come from State and local agencies and private employers for promotion of strategies to reduce mobile emissions. Examples of these measures include idling reduction, ridesharing, teleworking, transit use, vehicle replacement and retrofit measures, and bicycle and pedestrian programs. These funding commitments produce reductions in emissions, some of which are being reflected in transportation plans.

Although these programs are working to reduce emissions from mobile sources and play an important role in the transportation sector's contribution to cleaner air, neither MDE, nor the State intends their inclusion in this SIP to constitute enforceable commitments to implement these programs or to achieve any emission reductions projected as a result of implementing these programs, and neither MDE, nor the State makes any such commitment. These directionally correct programs will continue to be used outside of the SIP for transportation planning purposes as needed.

The following are descriptions of selected emission reduction strategies in the Baltimore region.

Clean and Efficient Strategies
With the support of both state and federal funds, MDE has worked with several local governments to introduce new technologies designed to reduce emissions of their in-use fleets. The MDE worked successfully with Baltimore City to retrofit 108 trash haulers, 23 dump trucks and 49 fire-trucks with diesel oxidation catalysts (DOCs) and closed crankcase ventilation filtration systems (CCVFSs). These systems help reduce PM emissions from both the exhaust systems and from the engine. MDE is also supporting the installation of two "Quick Charge" recharging units in Baltimore City. These chargers allow the city to recharge its fleet of electric vehicles in under an hour, compared with the previous time of 6 hours. This will encourage the City to purchase more electric vehicles for its downtown fleet. MDE is also working with Johns Hopkins University to retrofit its fleet of 10 diesel vehicles with DOCs and CCVFSs as well as install a "Quick Charger" unit at its main campus. MDE has worked with Howard County to successfully retrofit 25 of their transit buses with DOCs, CCVFSs, and International Clean diesel kits. This project is reducing both particulate matter and NOx emissions. MDE has also worked with Anne Arundel County Public Schools to retrofit their fleet of 51 diesel-powered school buses with DOCs and CCVFSs. Finally, MDE is in the process of retrofitting 10 fire trucks for the City of Annapolis. These vehicles will be retrofitted with DOCs and CCVFSs.

Traffic Flow Improvements (CHART)
The Coordinated Highways Action Response Team (CHART) program, operated by MDOT and Maryland State Police, focuses its operations on non-recurring congestion such as backups caused by accidents. The Statewide Operations Center, and the three satellite Operations Centers in the region, survey the state's roadways to quickly identify incidents through the use of Intelligent Transportation System (ITS) technology. CHART also includes traffic patrols, which have been operating during peak periods on many of the state highways in the region since the early 1990s.

Based on 2005 data, it has been estimated that CHART operations saved 37.3 million vehicle hours of delay statewide including 21.3 million in the Baltimore region; saved 6.3 million gallons of fuel; and reduced overall mobile source emissions.

Truck Stop Electrification (TSE)
Truck Stop Electrification allows truckers to shut down their engine and obtain electric power and “creature comforts” while resting. TSEs reduce diesel emissions and reduce noise and wear and tear on the truck engine. IdleAire truck stops provide electricity (110V AC), cab heating/cooling, television and movies, telephone and Internet access. IdleAire has over 100 locations nationally, including three in Maryland. The Maryland sites are located in Baltimore and Jessup, both in the Baltimore region. An additional TSE has been put in place in Cecil County at I-95 and MD 279.

Electronic Toll Collection
The Maryland Transportation Authority (MDTA) commenced operation of its electronic toll collection system, M-TAG, at the authority’s three harbor crossing facilities in 1999. By fall 2001, all toll facilities in the region were equipped with electronic toll collection equipment. As of January 2004, 45 percent of vehicles using MDTA facilities used electronic toll tags. MDTA is a member of the E-Z Pass InterAgency Group, a coalition of Northeast Toll Authorities. MDTA established reciprocity with the E-Z Pass system in 2001, enabling travelers in Maryland, as well as at most toll facilities in New York, New Jersey, Delaware, Pennsylvania, Massachusetts, Virginia, and West Virginia to pay tolls using one electronic device.

Traffic Signal System Retiming
SHA has instituted a program to review and retime its 1,200 traffic signals in the Baltimore region. The timing of each traffic signal system is reviewed and updated every three years. In addition, systems in high profile corridors or corridors subject to significant traffic pattern change are evaluated on a more frequent schedule. This program results in smoother traffic flow as well as reduced emissions resulting from idling vehicles. *Synchro* software is used to develop new timing plans and to calculate benefits from the new timing plans. This program has resulted in the following average annual benefits for the Baltimore region: 11.8 percent reduction in network delay; 8.5 percent reduction in arterial delay; 8.7 percent reduction in arterial stops; and 1.9 percent reduction in fuel consumption.

Ride Share
The Baltimore region’s original rideshare program began in 1974 as a joint effort of Baltimore City, the Regional Planning Council (now the Baltimore Metropolitan Council), and MDOT. Efforts to encourage ridesharing were expanded to cover the entire state in 1978 when the Maryland Ridesharing Office of the Maryland Transit Administration (MTA) was established. Since it was formed, the MTA has enhanced and expanded its activities to include both commuters and their employers. A continuing program administered by the MTA provides funding support to local rideshare coordinators in order to strengthen ride matching and rideshare-support services at the jurisdictional level. The BMC provides ridesharing coordination services for Baltimore and Carroll Counties. Local rideshare coordinators have provided ridesharing information that has helped in the development of more effective regional emission reduction strategies. They have also assisted employers and employees in identifying opportunities for other Emission Reduction Strategies (ERSs) such as transit, flexible work hours, and telecommuting.

Maryland Commuter Tax Credit

In January 2000, a tax credit went into effect statewide that allows employers to claim a 50% state tax credit, up to $52.50 per month, for providing transit benefits in the form of a subsidy to an employee. An employer may provide this benefit to an employee without tax consequences under the federal tax law. It is expected that the state tax credit will be even more attractive to employers as a benefit to offer employees than is the federal law; the state benefit is a direct tax credit as opposed to an allowable business expense, the case of the federal program. This feature of the Maryland law also has the potential to encourage increased transit use by low and moderate-income employees. Under provisions of both the 1999 and 2000 Maryland laws, private non-profit organizations will also be able to participate in the program. Employers will be able to claim tax credits for providing transit passes and vouchers, guaranteed ride home, and parking cash-out programs. Similar to the IRS benefits, the Maryland Commuter Tax Benefit program does not provide financial assistance to carpoolers. Information is also provided online and employers are able to register over the Internet to participate in the program.

Clean Commute Month

The Baltimore Regional Transportation Board (BRTB) has teamed with state transportation and air quality agencies as well as private organizations to promote Clean Commute Week. The program was expanded in 2003 and is now known as Clean Commute Month (CCM). During CCM, residents of the Baltimore region are asked to try an alternative to driving alone for at least one day during May. Clean Commute Month 2006 promotion began in late April, with a number of outreach events throughout the region. Events continued through May, and included a Bike to Work Day. Participation in Bike to Work Day has increased substantially in recent years, and many local businesses and organizations donate prizes for registered participants. Bike to Work Day, a true region-wide initiative, features rallies in Annapolis; Baltimore City; and Baltimore, Carroll, Harford and Howard Counties. With a grant from MDE, CCM 2006 also included Clean Car Clinics, where certified technicians provided free car inspections to the public.

Telework Partnership with Employers

BMC and MWCOG participate in a bi-regional program to assist large and small employers to establish home-based telecommuting programs for their employees. This program, known as the “Telework Partnership with Employers,” or “TPE,” is funded by MDOT. In addition to the traffic and emission reduction benefits of the TPE program, the TPE program assists in perfecting marketing, outreach procedures, and administrative methods that may be used in other alternate commute programs. Since its kickoff in October 1999, over 25 large and small private sector employers as well as two nonprofit organizations have been recruited to participate in the bi-regional TPE program. In the Baltimore region, eight employers have taken advantage of the TPE and several others are currently considering the program. Employers are recruited through outreach events. Employers that have signed up to participate in year-long pilot programs choose from a list of qualified regional and national telecommuting consultants whose services are paid for by MDOT.

Transit Oriented Development

The transit oriented development (TOD) in Owings Mills in Baltimore County is an example of long-range planning which has resulted in the location of high-density commercial and residential development within close proximity of the Baltimore subway system’s Owings Mills station and the transit bus stop. Similar developments are planned or underway in other parts of the Baltimore region.

Bicycle/Pedestrian Enhancements
Bicycle commuting can provide an alternate travel mode to shorter car trips which pollute more per mile than longer trips. Both bicycle and pedestrian modes of travel to work, when used alone or in combination with transit, can help to reduce traffic congestion by taking cars off the road. Bicycling and walking lend themselves to smart growth land uses such as transit oriented and mixed use developments. They also work well with travel demand management and "live near your work" programs. The physical activity involved in cycling and walking also provide health benefits of exercise which is important considering the current problem of obesity in the United States.

Through MDOT, the Maryland State Highway Administration (SHA) has worked to engineer and implement new and improved bicycle and pedestrian facilities, and SHA has implemented programs to encourage walking. SHA has a stated goal of providing 200 miles of marked bicycle lanes throughout Maryland by December 31, 2006. In addition, SHA has developed the *Maryland SHA Bicycle and Pedestrian Guidelines* to provide general guidance on design. The state has a policy of considering sidewalks to reinforce pedestrian safety and promote pedestrian access adjacent to roadways under construction or reconstruction. Special efforts are made to facilitate pedestrian travel near schools.

In addition, bicycle safety and bicycle travel in general are being improved through the construction of wider shoulders and/or curb lanes to separate motor vehicles from the cyclists. In regard to bicycle or pedestrian travel in controlled access roadway corridors, a separation almost always exists between the bike or pedestrian travel and the motor vehicles. It is only along roadways where the vehicle speeds or mix of the travel modes could result in serious accidents that sidewalks and bicycle travel not promoted.

Beginning in 2005 improvements to existing sidewalks or new sidewalk construction has taken place along many roadways in the Baltimore region. These roads include MD 2, MD 435, MD 26, MD 134, MD 140, MD 7, MD 150, MD 542 and MD 648. In addition, since 2005, separate bike or pedestrian paths have been constructed to facilitate recreation, pedestrian shopping, or school-related travel. In the Baltimore region these include the Maryland and Pennsylvania Heritage trail extension, Broken Land Parkway Pathway, Centennial Access Trail, Wakefield Community Trail, Broadneck Peninsula Trail and the South Shore Trail.

Other recent bike/pedestrian enhancements include the following:

- Bike to Work Day expansion in the Baltimore region
- Quantification of benefits of bicycling as far as reductions in air pollutants (per Appendix G: "Recreation and Reduced Auto Use Benefits," of the National Cooperative Highway Research Program (NCHRP) report *Guidelines for Analysis of Investments in Bicycle Facilities*)
- Status of regional efforts such as BMC's Action Plan 2001 and statewide efforts such as MDOT's *Twenty Year Bicycle and Pedestrian Access Master Plan*.
- Street Smart campaign- MDOT
- Safe Routes to School- MD SHA
- MDOT's "Safe Bicycling in Maryland"
- Complete Streets program
- Free water taxi service around Baltimore Harbor
- BMC's "Bicycle Commuter Resource Guide for the Baltimore Region"

MARC Station Parking Enhancements
MARC commuter rail services have been enhanced through construction of additional parking at stations throughout the Baltimore region. A feasibility study is underway for structured parking (garage or parking deck) at Odenton Station for 2,500 spaces on the MTA owned property. In addition the Odenton MARC parking facilities were expanded by over 700 spaces; the facilities were opened in 2006. There are a total of 2,000 spaces at the location. Expansion of the Halethorpe MARC Station park-and-ride lot Phase I, is complete with 428 parking spaces added. The scope of the work includes high level platforms, new shelters, improved accessibility for persons with disabilities, lighting, and streetscaping. Phase II, which includes a pedestrian bridge and high level platforms is in the project initiation stage. In September 2005, construction began on a parking lot expansion at the Martin State Airport MARC station, located on the Penn Line. It was completed in 2006. This expansion increased the number of parking spaces from 171 to 321.

Refurbishing MARC and other rail vehicles
In order to insure the reliability, safety and comfort of MARC equipment, the rolling stock is periodically overhauled. These include 26 MARC cars that have been or are scheduled to be refurbished between FY2005 and FY 2008. In addition, 23 locomotives are in the process of being overhauled and retrofitted to meet cleaner, federally required TIER standards. This is an ongoing effort that started in FY 2005 and is not expected to be completed until at least 2012.

MTA Bus Purchases
The Maryland Transit Administration (MTA) makes annual purchases of buses to replace, expand or upgrade the fleet. Buses over 12 years old are replaced. This purchase is made to prevent high out-of-service rates and reduce break down and repair problems. Bus replacements include new clean diesel as well as hybrid electric vehicles. The newer buses are much cleaner than the buses being replaced. In 2005, 125 buses were replaced; in 2006, 105 buses were replaced; and in 2007, 100 buses were replaced.

Locally Operated Transit Systems (LOTS)
MTA provides funding to small jurisdictions and rural area systems including Anne Arundel, Baltimore, Carroll, Harford and Howard Counties. Regular small system buses and handicapped/senior ride vehicles are replaced, repaired, or expanded. The ridesharing program provides citizens with commute options. Funds are also used for outreach to companies in the counties to provide them with information on commuting options.

Smart Card Implementation
Implementation of Smart Card technology and fare collection equipment for the Baltimore Metro, bus, light rail, commuter bus and lots is being pursued by MTA. Smart card allows for quicker and seamless travel between different transit systems. Passengers are able to pay for travel throughout the state with the swipe of a card. This makes transit and high occupancy vehicle (HOV) travel more convenient for the traveler.

Light Rail double tracking
Installation of the double track was opened between North Avenue and Hunt Valley in 2006. The double track will enhance operational flexibility by eliminating delays and improve headways and service. The double track will make the service more attractive and thus increase HOV ridership.

Port of Baltimore Initiatives
In 2006, the Maryland Port Authority (MPA) partnered with Port stakeholders to oversee various physical and operational improvements to terminal gates. The purpose of the improvements was to expedite inbound and outbound vehicle traffic. A net benefit of these projects was overall reductions in idling time for heavy-duty diesel trucks and other vehicles visiting the terminals, resulting in reduced emissions. Since November 2006, MPA uses Ultra Low Sulfur Diesel Fuel blended with bio-diesel in all of its on-road as well as off-road diesel engines. This includes vehicles such as its cranes, fleet vehicles, stationary generators, fire pumps, and cargo handling-equipment. In the fall of 2006, MPA applied for an EPA grant to retrofit at least one ship-to-shore crane and several RTG cranes with Diesel Oxidation Catalysts. MPA understands that EPA will officially announce by the end of March 2007 that they will be awarded the grant. MPA annually exceeds EPA's 75% fleet vehicle alternative fuel purchasing requirements. To do so, MPA purchases bi-fuel (ethanol/gas) fleet vehicles. In addition, MPA purchased a hybrid (electric/gas) fleet vehicle in 2006. MPA performs outreach to employees on "ozone alert days" in order to reduce activities, such as vehicle fueling and combustion engine usage, which contribute to ozone pollution.

Park and Ride Lots
The SHA and MdTA have built 43 lots in the Baltimore region since the 1970's. This does not include Baltimore City, which builds its own projects. The SHA has made substantial space additions to three Park and Ride lots in the Baltimore region and has built a 56-space new lot on Maryland Route 7. Other Park and Ride lots have been expanded or improved in the attainment areas adjacent to the Baltimore region as well as the Washington Metropolitan area. These lots serve to accommodate carpool based work trips into the Baltimore region. The benefits of the reduction in VMT and vehicle trips (VT) in the Baltimore region provides for a reduction in regional congestion and vehicular emissions.

Landscaping and Reforestation
Landscaping and reforestation can have a positive effect on water and air quality. In the Baltimore region reforestation and/or landscaping efforts have been made adjacent to the following roadway facilities since 2005: MD 2, MD 468, MD 665, MD 216, MD 100, US 40, I-695, I-83, and the MD 43 extension.

Additional Clean and Efficient Strategies Enacted or Under Development
Charm City Circulator
http://www.charmcitycirculator.com/
The Circulator consists of four routes that run seven days a week using hybrid buses. Service is free. Air quality benefit calculations from this service started in 2009. The Transit Vehicle Purchases Project most recently added hybrid-electric buses to the Charm City Circulator to extend service to Fort McHenry National Monument and Historic Shrine.

Hunt Valley Shuttle
The Baltimore County Chamber of Commerce and the Hunt Valley Business Community are working to establish a bus shuttle between Hunt Valley and southern York County, PA, including the City of York.

Kent Street Transit Plaza
The Kent Street Transit Plaza and Pedestrian Corridor Project will expand bus ridership and safe access to the existing light rail system through design and construction of the Kent Street Plaza and Pedestrian Corridor from the Westport Light Rail Station to Annapolis Road.

MARC East Baltimore Station
A new station is planned for east Baltimore City in 2015. There is a potential tie-in with Baltimore City's proposed Greektown pedestrian and transit project.

Emergency Ride Home Program- proposed; the BRTB recommends moving forward with a program for the Baltimore region. (Note that the Washington, DC area already has Guaranteed Ride Home (GRH) as part of Commuter Connections.)

Baltimore Collegetown Network (BCN)
BCN operates a free bus service available to students registered at Goucher College, Towson University, Notre Dame of Maryland University, Loyola University Maryland, Johns Hopkins University, Maryland Institute College of Art, and Morgan State University. The Collegetown Shuttle, as it is known, is paid for by those institutions.

BWI Airport Low Emission Vehicles
The Maryland Aviation Administration's (MAA's) fleet of ground vehicles is extensive and consumes much fuel. To reduce the emissions associated with its vehicle fleet, MAA was a pioneer in encouraging the use of Compressed Natural Gas (CNG) vehicles. CNG vehicles offer air quality benefits, because they produce fewer emissions than gasoline-powered engines.

U.S. Department of Housing and Urban Development (HUD) Sustainable Communities and Clean Fuels Program Grants
Four federal grant programs were announced in August 2011: (1) clean fuel buses, (2) the Federal Transit Administration's (FTA) Transit Investments for Greenhouse Gas and Energy Reduction (TIGGER) III program; (3) the U.S. Department of Transportation's (USDOT) Transportation Investment Generating Economic Recovery Program (TIGER) III program; and (4) the HUD/EPA/USDOT Sustainability Grant Program. BMC will support grant applicants in the Baltimore region. These grant program projects are expected to help reduce emissions from on-road mobile sources.

US 40 Carbon Neutral Corridor
MDOT and Cambridge Systematics consultants are developing a comprehensive corridor vision that results in attaining smart growth, conservation and climate change goals where the net emissions from the corridor are significantly reduced. The corridor study area goes from Baltimore City to Aberdeen in Baltimore and Harford Counties.

Clean Technology and Commute Alternatives
http://www.baltometro.org/transportation-planning/transportation-improvement-program-2011-2014
A variety of projects have been implemented in the Baltimore region since 2007. Examples include hybrid fleet vehicles; hybrid replacement buses; hybrid taxis; and retrofits of fire trucks, medics, and shuttle buses. The projects have been implemented by private business, universities, and state and local governments.

9.0 REASONABLY AVAILABLE CONTROL MEASURE (RACM) ANALYSIS

Section 172(c)(1) of the Clean Air Act requires state implementation plans (SIPs) to include an analysis of Reasonably Available Control Measures (RACM). This analysis is designed to ensure that the Baltimore 8-hour Ozone Nonattainment Area is implementing all reasonably available control measures in order to demonstrate attainment with the 8-hour ozone standard on the earliest date possible. This chapter presents a summary of analyses conducted to determine whether the SIP includes all reasonably available control measures. Full details of the analysis are included in Appendix D.

The Maryland Department of the Environment (MDE) has prepared this RACM analysis using two independently developed lists of potential control measures. The first list consists of the RACM analysis performed for the Washington, DC Region's 8-hour ozone SIP. The MDE worked very closely with all the DC region's jurisdictions in the development of the DC Region's RACM analysis. Understanding that the adjacent Washington, DC non-attainment region is both extremely similar to the metropolitan Baltimore region and was also undertaking their RACM analysis, MDE incorporated the Washington, DC RACM criteria and analysis into this Baltimore SIP.

The Washington, DC RACM analysis included a series of regional calls over several months to review over 200 suggested measures from numerous sources to create a master listing of measures. Each of over 200 measures was individually evaluated against established RACM criteria (the criteria are explained below).

In addition to a careful review of the Washington, DC Region's RACM analysis, during the fall of 2006, the MDE also worked closely with the Baltimore Metropolitan Council (BMC) in developing a small list of potential transportation emission reduction measures. This analysis yielded a list of 24 specific measures that could be implemented in the Baltimore Nonattainment Area for emission reduction purposes. Based on the criteria used for RACM, none of these 24 measures is to be considered RACM but these measures shall be kept on a short list of measures if the region needs additional reductions.

At the completion of the RACM analysis it was determined that no measures met the criteria.

9.1 ANALYSIS OVERVIEW AND CRITERIA

The RACM requirement is rooted in Section 172(c)(1) of the Clean Air Act, which directs states to "provide for implementation of all reasonably available control measures as expeditiously as practicable". In its 1992 General Preamble for implementation of the 1990 Clean Air Act Amendments (57 FR 13498) EPA explains that it interprets Section 172(c)(1) as a requirement that states incorporate in a SIP all reasonably available control measures that would advance a region's attainment date. However, regions are obligated to adopt only those measures that are reasonably available for implementation in light of local circumstances. In the Preamble, EPA laid out guidelines to help states determine which measures should be considered reasonably available:

> If it can be shown that one or more measures are unreasonable because emissions from the sources affected are insignificant (i.e. *de minimis*), those measures may be excluded from further consideration…the resulting available control measures should then be evaluated for reasonableness, considering their technological feasibility and the cost of control in the area to which the SIP applies…In the case of public sector sources and control measures, this evaluation should consider the impact of the reasonableness of the measures on the municipal or other government entity that must bear the responsibility for their implementation.

In its opinion on *Sierra Club v. EPA*, decided July 2, 2002, the U.S. Court of Appeals for the DC Circuit upheld EPA's definition of RACM, including the consideration of economic and technological feasibility, potential of the measures to cause substantial widespread and long-term adverse impacts, collective ability of the measures to advance a region's attainment date, and whether an intensive or costly effort will be required to implement the measures. Consistent with EPA guidance and the U.S. District Court's opinion, both the Baltimore and Washington DC regions have developed specific criteria for evaluation of potential RACM measures. Individual measures must meet the following criteria:

- Will reduce emissions by the beginning of the 2008 ozone season (April 1, 2008)
- Enforceable
- Technically feasible
- Economically feasible (proposed as a cost of $3,500-$5,000 per ton or less)
- Would not create substantial or widespread adverse impacts within the region
- Emissions from the source being controlled exceed a *de minimis* threshold, proposed as 0.1 tons per day

An explanation of these criteria is given in succeeding sections.

9.1.1 Implementation Date

EPA has traditionally instructed regions to evaluate RACM measures on their ability to advance the region's attainment date. This means that implementation of a measure or a group of measures must enable the region to reduce ozone levels to the 84 ppb required to attain the eight-hour ozone standard at least one year earlier than expected. As the Baltimore region currently expects to reduce ozone levels to 84 ppb during the 2009 ozone season, any RACM measures must enable the region to meet the 84 ppb standard by April 1, 2008, the beginning of the 2008 ozone season.

9.1.2 Enforceability

When a control measure is added to a SIP, the measure becomes legally binding, as are any specific performance targets associated with the measure. If the state or local government does not have the authority necessary to implement or enforce a measure, the measure is not creditable in the SIP and therefore cannot be declared a RACM. A measure is considered enforceable when all state or local government agencies responsible for funding, implementation and enforcement of the measure have committed in writing to its implementation and enforcement.

In addition to theoretical enforceability, a measure must also be practically enforceable. If a measure cannot practically be enforced because the sources are unidentifiable or cannot be located, or because it is otherwise impossible to ensure that the sources will implement the control measure, the measure cannot be declared a RACM. One exception is voluntary measures, such as those implemented under EPA's Voluntary Measures Guidance.

9.1.3 Technological Feasibility

All technology-based control measures must include technologies that have been verified by EPA. The region cannot take SIP credit for technologies that do not produce EPA-verified reductions.

9.1.4 Economic Feasibility and Cost Effectiveness

EPA guidance states that regions should consider both economic feasibility and cost of control when evaluating potential RACM measures. Therefore, the Baltimore region has specified a cost-effectiveness threshold for all possible RACM measures. Measures for which the cost of compliance exceeds this threshold will not be considered RACM.

In setting this threshold, the region took into consideration two major factors. First, EPA has issued guidance regarding the relationship between Reasonably Available Control Technology (RACT) and RACM. In its RACM analysis for the Dallas/Forth Worth nonattainment area, EPA states this:

> RACT is defined by EPA as the lowest emission rate achievable considering economic and technical feasibility. RACT level control is generally considered RACM for major sources.

In the Baltimore region, RACT installation costs are as low as approximately $3,500 per ton. The region proposes a threshold of $3,500-$5,000 for cost effectiveness.

9.1.5 Substantial and Widespread Adverse Impacts

Some candidate RACM measures have the potential to cause substantial and widespread adverse impacts to a particular social group or sector of the economy. Due to environmental justice concerns, measures that cause substantial or widespread adverse impacts will not be considered RACM.

9.1.6 *De Minimis* Threshold

In the General Preamble, EPA allows regions to exclude from the RACM analysis measures that control emissions from insignificant sources and measures that would impose an undue administrative burden. Under moderate area RACT requirements, the smallest major source subject to RACT emits 25 tpy, or approximately 0.1 tpd.

Following these requirements and the precedent set by the San Francisco RACM analysis, the region will not consider control measures affecting source categories that produce less that 0.1 tpd NOx or VOC emissions.

9.1.7 Advancing Achievement of 0.08 ppm (84 ppb) Standard

In order for measures to be collectively declared RACM, implementation of the measures must enable the region to demonstrate attainment of the 0.08 ppm ozone standard one full ozone season earlier than currently expected.

9.1.8 Intensive and Costly Effort

When considered together, the implementation requirements of any RACM measure cannot be so great as to preclude effective implementation and administration given the budget and staff resources available to the Baltimore region.

9.2 RACM MEASURE ANALYSIS

9.2.1 Analysis Methodology

The sources of strategies analyzed for the Baltimore region include the following:

- Clean Air Act Section 108(f) measures (Transportation Control Measures)
- Transportation Emissions Reduction Measures (TERMs) listed in recent Transportation Improvement Programs (TIPs) for the Metropolitan Baltimore and Washington DC regions
- Measures identified through a review of the emission reduction strategies report prepared for the Baltimore Metropolitan Council
- Measures considered in Washington, Atlanta and Houston RACM analyses

These measures were then evaluated against the criteria discussed earlier in this chapter and documented in Appendix D.

9.2.2 Analysis Results

Appendix D provides lists (in tabular form) organized by source sector, of potential measures evaluated against the RACM criteria. Each specific RACM criterion was reviewed for each individual measure identified on the lists.

Based on this analysis, none of the measures reviewed were identified as RACM for the Baltimore 8-hour Ozone Nonattainment Area.

9.3 RACM DETERMINATION

Though the measures listed in Appendix D did not meet the criteria for RACM, many of the measures are worthwhile measures that reduce emissions. These measures will be considered potential control measures for future SIPs prepared for the Baltimore region.

References

US EPA, "State Implementation Plans; General Preamble for the Implementation of Title I of the Clean Air Act Amendments of 1990", (57 FR 13498), April 16, 1992.

US EPA Region VI, "Reasonably Available Control Measures (RACM) Analysis for the Dallas/Fort Worth Ozone Nonattainment Area", December 2000.

Bay Area Air Quality Management District, Metropolitan Transportation Commission and Association of Bay Area Governments, "Bay Area 2001 Ozone Attainment Plan," October 24, 2001, Appendix C.

E.H. Pechan & Associates, Inc., " Review of Emission Reductions Strategies", December 8, 2006.

10.0 MOBILE SOURCE CONFORMITY

Transportation conformity ("conformity") is a provision of the Clean Air Act that ensures that Federal funding and approval goes to those transportation activities that are consistent with air quality goals. Conformity applies to transportation plans and projects funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA) in areas that do not meet or previously have not met air quality standards for ozone, carbon monoxide, particulate matter, or nitrogen dioxide.

In order to balance growing metropolitan regions and expanding transportation systems with the need to improve air quality, EPA established regulations ensuring that enhancements to existing transportation networks will not impair progress towards air quality goals. Under the Clean Air Act Conformity Regulations, transportation modifications in a nonattainment area must not impair progress made in air quality improvements. These regulations, published in EPA's Transportation Conformity rule on November 24, 1993 in the Federal Register and amended in a final rule signed on July 31, 1997, require that transportation modifications "conform" to air quality planning goals established in air quality SIP documents. The 1997 amendments were followed by further amendments in 2002, 2004, and more recent years since.

In essence, this SIP submission includes mobile emissions budgets for nitrogen oxides (NOx) and volatile organic compounds (VOCs). These budgets, once found adequate by EPA, shall be used in all conformity documents for the Baltimore Nonattainment Area. In order for a transportation plan to "conform," the estimated emissions from the transportation plan can not exceed the emissions budgets set via this SIP submission. If the estimated emissions are shown to exceed the budget then mitigation measures must be taken to ensure emissions will not exceed the emission budgets.

Responsibility for Making a Conformity Determination

The policy board of a Metropolitan Planning Organization (MPO), in consultation with the Maryland Department of Transportation (MDOT) and MDE, is responsible for formally making a conformity determination on the MPO's transportation plans and transportation improvement programs (TIPs) prior to submittal to the FHWA and FTA for review. The EPA also may review and comment on proposed conformity determinations.

If a particular transportation plan's projected emissions exceed the mobile emissions budget, the MPO has a variety of mitigation options for reducing emissions. These may include but are not limited to specific transportation emission reduction measures such as High Occupancy Vehicle (HOV) lanes, transit enhancements, bicycle lanes, diesel retrofits, and idling reductions.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) was enacted on August 10, 2005. Under this act, amendments were made to the transportation conformity rules (Section 6011 of the Act), which required states that have nonattainment areas like Maryland to revise their existing transportation conformity SIPs. Maryland submitted a revised transportation conformity SIP to USEPA in February of 2007.

Because of changes mandated by SAFETEA-LU, conformity determinations have to be done at least every four years instead of the previous three years.

When a positive conformity determination is not made according to the required frequency, or in the event that emission mitigation can't be agreed upon, a nonattainment area is in conformity "lapse". This means that federal transportation funds allocated to the state, which contains the lapsed nonattainment area, can only be used for the following kinds of projects:

1. TCMs in Approved SIPs;
2. Non-Regionally Significant Non-Federal Projects;
3. Regionally Significant Non-Federal Projects - only if the project was approved by all necessary non-federal entities before the lapse. (See Approval of a Regionally Significant Non-Federal Project by a Non-Federal Entity later in this chapter.)
4. Project phases (i.e., design, right-of-way acquisition, or construction) that received funding commitments or an equivalent approval or authorization prior to the conformity lapse.
5. Exempt Projects - identified under 40 CFR §93.126and 40 CFR §93.127; and,
6. Traffic Synchronization Projects - however, these projects must be included in subsequent regional conformity analysis of MPO's transportation plan/TIP under 40 CFR §93.128.

The amount of federal funding a state receives is not reduced but such funds are restricted until the area can again demonstrate conformity.

10.1 MOBILE EMISSIONS BUDGET & THE BALTIMORE REGION TRANSPORTATION CONFORMITY PROCESS

Mobile source emissions in the long-range transportation plan known as the Baltimore Regional Transportation Plan (BRTP), and the shorter term Transportation Improvement Program cannot exceed the mobile emissions budget. The transportation plans are required to conform to the mobile budget established in the SIP for the short-term TIP years, as well as for the forecast period of the long-range plan, which must be at least twenty years.

In the Baltimore region, modifications to the existing transportation network are advanced through the Baltimore Regional Transportation Board (BRTB) by state, regional and local transportation agencies through periodic updates to the BRTP and TIP. The TIP is updated annually for the Baltimore region and includes transportation modifications and improvements on a four-year program cycle. Pursuant to the conformity regulations, the TIP must contain analyses of the motor vehicle emissions estimates for the region resulting from the transportation improvements. These analyses must show that the transportation improvements in the TIP and the plan do not result in a deterioration of ("conform to") the air quality goals established in the SIP.

10.2 BUDGET LEVEL FOR ON-ROAD MOBILE SOURCE EMISSIONS

As part of the development of the SIP, MDE, in consultation with the Baltimore Regional Transportation Board, establishes a mobile source emissions budget. This budget will be the benchmark used to determine if the region's long-range transportation plan (BRTP) and four-year transportation improvements program (TIP) conform to the SIP. Under EPA regulations, the projected mobile source emissions for 2012 (the region's attainment ozone season) become the mobile emissions budgets for the region unless MDE takes actions to set other budget levels.

Modeling and Data

The 2012 mobile emissions inventories are calculated using the following models and tools: EPA's MOVES and the Highway Performance Monitoring System (HPMS) model. A detailed explanation of the model and the emission estimating methodology can be found in Appendix E.

Attainment Year Mobile Budgets

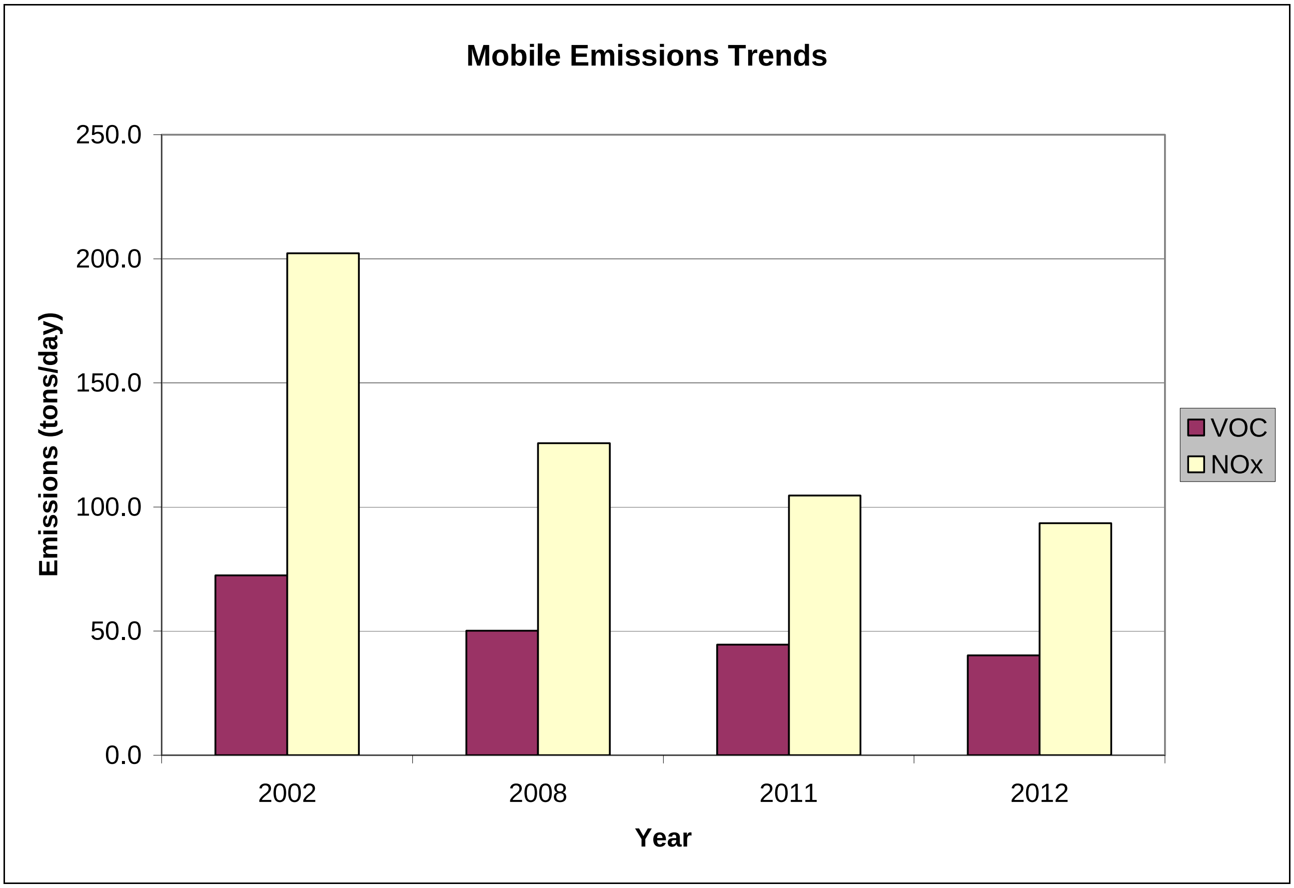
The mobile emissions budgets for the 2012 attainment year are based on the projected 2012 mobile source emissions accounting for all mobile control measures. The mobile emissions budgets for the 2012 attainment year, based upon the projected 2012 mobile source emissions, accounting for all the mobile control measures, are as follows:

Table 10-1: 2012 Attainment Year Mobile Budgets for the Baltimore Nonattainment Area

VOC (TPD)	**40.2**
NOx (TPD)	**93.5**

10.3 TRENDS IN MOBILE EMISSIONS

The mobile emissions budgets for 2012 for VOCs and NOx reflect a continuation of a downward trend in mobile emissions over time.



The steady reductions in mobile emissions are attributable largely to a series of increasingly stringent federal regulations requiring cleaner vehicles and fuels, including the federal Tier II regulations for motor vehicles. Trends toward reduced mobile emissions are occurring despite the negative effects of a shift toward the use of higher-emitting, less fuel-efficient sport utility vehicles instead of passenger cars and a steady increase in population, employment and vehicle miles traveled (VMT) within the Baltimore region.

The trends of increasing population, employment, and VMT are expected to remain strong well beyond 2009. The regional cooperative forecasting process (from the 2004 Baltimore Regional Transportation Plan) predicts that from 2000 to 2030, the regional population will grow by 14% and employment will grow by 22%. Regional VMT is predicted to still outpace these increases over the same time period with a projected growth of 37% on an average weekday. These trends, however, will not reverse the expected decline in regional mobile emissions resulting from cleaner fuels and improved vehicle technology. The Tier II passenger vehicle standards and regulations on emissions from heavy-duty diesel vehicles and fuels are expected to produce further dramatic reductions in VOC and NOx emissions as vehicles are replaced and retrofitted over the next 20 years. It is important to keep in mind, however, that despite cleaner fuels and improved vehicle technology, the relationship between land use planning, transportation, and air quality is important for long-term air quality goals.

11.0 SERIOUS AREA PLAN COMMITMENTS

Achieving the results shown in this Plan requires a commitment to implement the regulatory measures upon which the plan is based. Maryland is taking action to implement regional and local measures to effectively reduce ozone transport throughout the Baltimore and Washington Nonattainment Areas. Tables 11-1 and 11-2 provide information on the implementation of each measure.

11.1 SCHEDULES OF ADOPTED CONTROL MEASURES

Table 11-1:
Maryland Schedule of Adopted Control Measures
Baltimore, Washington DC, and Cecil County Nonattainment Areas

Control Measure	Regulation Number	Effective Date
Federally Mandated Measures		
High Tech Inspections & Maintenance	11.14.08	1/2/1995
Stage II Vapor Recovery Nozzle	26.11.24	2/15/1993
Federal Tier I Vehicle Standards and new Car Evaporative Standards	40 CFR part 86	Model Year 1994-1996; Evap Stds. 1996
Tier 2 Motor Vehicle Emission Standards	65 FR 6698	2/10/2000
Non-CTG RACT	See Table 11-2	-
Phase II Gasoline Volatility Controls	03.03.03.05	10/26/1992
EPA Non-Road Gasoline Engines Rule	40 CFR parts 90 and 91	12/3/1996
EPA Non-Road Diesel Engines Rule	40 CFR Part 9 et al.	Model Year 2000-2008 depending on engine size
State NOx RACT Requirements	26.11.29.08	5/10/1993
EPA Nonroad Spark Ignition Marine Engine Rule	40 CFR Parts 89, 90, 91	1998 Model Year
EPA Large Spark Ignition Engines Rule	40 CFR Parts 89, 90, 91, 94, 1048, 1051, 1065, and 1068	11/8/2002
Federal Programs		

Control Measure	**Regulation Number**	**Effective Date**
Reformulated Surface Coatings	63 FR 48849, 64 FR 34997, 65 FR 7736	9/11/1998, 6/30/1999, 2/16/2000
National Volatile Organic Compound Emission Standards for Consumer Products	63 FR 48819	9/11/1998
National Low Emissions Vehicle Program	26.11.20.04	3/22/1999
Emissions Controls for Locomotives	63 FR 18998	6/15/1998
Heavy-Duty Diesel Engine Rule	63 FR 54694	12/22/1997
State and Local Measures		
Reformulated Gasoline (on-road)	Federal - local opt-in	1/1/1995
Reformulated Gasoline (off-road)	Federal - local opt-in	1/1/1995
Surface Cleaning/Degreasing for Machinery/Automobile Repair	26.11.19.09	6/5/1995
Landfill Regulations	26.11.19.20	3/9/1998
Seasonal Open Burning Restrictions	26.11.07	5/22/1995
Stage I Expansion	26.11.13.04C	4/26/1993
Expanded Point Source Regulations to 25 tpy	26.11.19.01B(4)	5/8/1995
Graphic Arts Controls	26.11.19.11 & .18	6/5/1995 & 11/7/1994
Auto and Light Duty Truck Coating Operations	26.11.19.23	5/22/1995
Control of VOC Emissions from Vehicle Refinishing	26.11.19.23	5/22/1995
Portable Fuel Containers Rule: Phase I	26.11.13.07	1/21/2002
Architectural and Industrial Maintenance Coatings Rule	26.11.33	3/29/2004
Reformulated Consumer Products Rule: Phase I	26.11.32	8/18/2003
Control of VOC Emissions from Cold and Vapor Degreasing	26.11.19.09	6/5/1995
Maryland Healthy Air Act	26.11.27	Emergency Regulations effective 1/18/2007 - Permanent Regulations effective 7/16/2007
Industrial Adhesives and Sealants Rule*	26.11.35	4/21/2008, and amendment (permanent regulations) effective 6/1/2009

Control Measure	Regulation Number	Effective Date
Portable Fuel Containers Rule: Phase II*	26.11.13.07	6/18/2007
Reformulated Consumer Products Rule: Phase II*	26.11.32	6/18/2007
Regional Control Measures		
NOx Phase II Controls	26.11.27 & .28 26.11.29 & 30	10/18/1999

Table 11-2:
Maryland Non-CTG RACT
Baltimore and Washington Nonattainment Areas

Overall requirement in COMAR 26.11.19.02G effective 4-26-93 (20: Md. R 726)
The following case-by-case RACT regulations have been adopted to ensure consistency.

RACT Regulation	Regulation Number	Effective Date	MD Register
Plastic Parts Coating	26.11.19.07E	6-5-95	22:11 Md R 823
Definition of Gasoline to include JP-4	26.11.13.01	8-11-97	24:16 Md R. 1161
Printing on Plastic	26.11.19.07F	9-8-97	24:18 Md R 1298
Aerospace Coating Operations	26.11.19.13-1	9-22-97	24:19 Md R 1344
Yeast Manufacturing	26.11.19.17	11-7-94	21:22 Md R 1879
Expandable Polystyrene Operations	26.11.19.19	7-3-95	22:13 Md R 970
Commercial Bakery Ovens	26.11.19.21	7-3-95	22:13 Md R 970
Vinegar Generators	26.11.19.22	8-11-97	24:16 Md R 1161

RACT Regulation	**Regulation Number**	**Effective Date**	**MD Register**
Leather Coating	26.11.19.24	8-11-97	24:16 Md R 1161
Explosives and Propellant Manufacturing	26.11.19.25	8-11-97	24:16 Md R 1161
Reinforced Plastic Manufacturing	26.11.19.26	8-11-97	24:16 Md R 1162
Marine Vessel Coating Operations	26.11.19.27	10-20-97	24:21 Md R 1453

11.2 STATIONARY SOURCE THRESHOLDS

Under the “moderate” classification for the 8-hour ozone standard, the permit threshold is 50 tons per year VOC and 100 tons per year NOx. In order to prevent backsliding Maryland is required to maintain the Baltimore NAA permit threshold at 25 tons per year for both VOC and NOx.

12.0 CONTINGENCY MEASURES

12.1 PURPOSE OF CHAPTER

This chapter demonstrates that the Baltimore Nonattainment Area meets the requirements for SIP contingency measures related to both Reasonable Further Progress (RFP) and to the attainment of the ozone standard. If implemented, the contingency measures discussed in this chapter would result in reductions in addition to those required to demonstrate RFP (discussed in Chapter 5) and in addition to those that have been taken into account in the attainment demonstration (discussed in Chapters 5-7). Contingency measures ensure that if the Baltimore Nonattainment Area fails to achieve the required RFP reductions by the RFP milestone year, or fails to attain the ozone standard by the attainment year, additional reductions will occur without further state or federal action.

12.2 CONTINGENCY REQUIREMENTS

Section 172(c)(9) of the CAA and EPA's Phase 2 Rule require that nonattainment areas include contingency measures in their RFP and attainment SIPs. If a state receives a notification from EPA that a nonattainment area within its borders has failed to achieve the level of reductions demonstrated in the RFP SIP by the milestone year, or has failed to attain the standard by the attainment date, the area must be able to implement contingency measures within one year after EPA's notice.

The RFP contingency and the attainment contingency must each provide for reductions equivalent to at least 3% of the 2002 RFP Adjusted Base Year VOC emissions inventory.[23] The contingency reductions are in addition to the reductions required to demonstrate RFP and in addition to the reductions taken into account in the attainment demonstration.

12.3 RFP CONTINGENCY

As discussed in Chapters 5-7, MDE is meeting the RFP requirement to reduce emissions by 27 percent for the years 2002 to 2012 (15 percent RFP for the years 2002 to 2008, 9 percent RFP for the years 2008 to 2011, 3 percent RFP for the years 2011 to 2012) through a combination of reductions of NOx and VOCs.

To satisfy the contingency requirement, MDE must be able to demonstrate that if the Baltimore area fails to achieve the required RFP reductions, without further state or federal action, an additional 3% reduction could be achieved from control measures not already taken in account in calculation of the 27% RFP reduction.

According to EPA's interpretation of this requirement, the RFP contingency may be met by showing reductions in the 2012 RFP milestone year of at least 30% by 2012 (27% RFP + 3% RFP

[23] The RFP Adjusted Base Year Inventory is based on the MD 2002 Base Year Inventory adjusted for RFP purposes, as discussed in detail in Chapters 5-7.

contingency).[24] As demonstrated in Chapter 7, Table 7-3 and reproduced with additional information in Table 12-1 below, the Baltimore area has demonstrated reductions significantly greater than the 27% reductions needed to meet RFP requirements and the additional 3% reductions needed to meet the contingency requirements. Therefore, the Baltimore Nonattainment Area has met the RFP contingency requirement.

Table 12-1:
Baltimore Nonattainment Area
Comparison of 2012 Target Inventory plus 3% Contingency and 2012 Controlled Inventories

	Description	VOC	NOx
(a)	2012 Target Levels	220.38	328.49
(b)	RFP 3% Contingency Reductions (1.5% of VOC & NOx 2012 Target Levels in (a))	3.31	4.93
(c)	2012 Target Levels with Additional RFP Contingency (a)-(b)	217.07	323.56
(d)	2012 Controlled Emissions	199.90	232.88

12.4 ATTAINMENT CONTINGENCY

EPA will assess whether the Baltimore Nonattainment Area has attained the standard, presumably based on monitored ozone readings for 2010 - 2012. If the area is not meeting the standard based on readings for the 3-year period, EPA may issue a notification of failure to attain. The notification will trigger a requirement for MDE to implement contingency reductions within one year of the notification. For purposes of this contingency analysis, MDE is assuming that EPA would issue the notice in June 2013, and that the contingency measures would need to be in place by June 2014. Therefore, to meet the attainment contingency requirement, MDE must identify control measures that will achieve additional reductions in emissions after 2012 and by June 2014 from control measures that will be effective without any further state or federal action. One year from the date of notification, the identified contingency measures must be fully implemented. This means that the contingency measures must provide emission reductions in the 2014 timeframe to meet the contingency requirements.

The amount of additional reductions that must be achieved in order to meet the attainment contingency requirement is 3% of the 2002 RFP Adjusted Base Year VOC emissions. The amount of reductions is shown below.

Table 12-2: Required Attainment Contingency

	2002 RFP Adjusted Base Year Inventory (TPD)		3% of 2002 VOCs = Required Contingency Reduction
	VOC	NOx	
BNAA	258.69	369.69	**7.76**

[24] U.S. EPA Memorandum from Michael H. Shapiro to Region 1 through 10 Air Directors, *Guidance on Issues Related to 15% Rate-of-Progress Plans*, August 23, 1993.

While the required reductions (3%) are calculated as a percentage of the 2002 VOC emissions, NOx reductions can be used as a direct substitute for up to 90% of the required reductions. Therefore, only 0.3% of the reductions achieved by the contingency measures must be VOCs; this equates to 0.78 TPD in the BNAA.

Table 12-3: Minimum VOC Reductions Required for Attainment Contingency

Pollutant	Total Reductions Needed for Contingency	Pollutant Percentage	Contingency Amount per Pollutant (tpd)
VOC	7.76	10%	0.78
NOx	7.76	90%	6.98

MDE will meet this attainment contingency requirement by taking credit for emission reductions that will be achieved from the existing federal on-road mobile source control measures such as Fuel Standards and Heavy-Duty Engine Standards, and from the Maryland Low-Emission Vehicle (LEV) Program. These measures will continue to provide substantial VOC and NOx emission reductions through 2012 (and beyond) as newer, less-polluting vehicles replace the older fleet.

In addition some emission control strategies listed to meet the 2012 target level are expected to result in more emission reductions than are needed to meet the requirements. If other measures fail to meet expected reductions, the excess from the following measures will be used to make up the difference:

- On-road mobile
- Nonroad Mobile
- Ozone Transport Commission (OTC) - Portable Fuel Container Phase 1 and Phase 2
- OTC - Architectural Surface Coatings
- OTC – Commercial and Consumer Products
- Railroad Locomotives Tier 2

12.5 CONCLUSIONS

As shown in Table 12-4 below, which is a combination of Tables 5-5, 6-2, and 7-2 with RFP contingency information added, the Baltimore Nonattainment Area has met the RFP contingency by demonstrating that the reductions of VOC and NOx projected by 2012 are significantly greater than the 30% reduction that is required (27% for RFP and 3% for RFP contingency). For the attainment contingency, the reductions of VOC and NOx that will be achieved from the on-road mobile source control measures already in effect are significantly greater than reductions needed to meet the 3% attainment contingency requirement.

Table 12-4: Contingency Measure Calculations

VOC Target Level for 2012 Milestone Baltimore Nonattainment Area Emissions in Tons per Day			
		Formula	
A	2002 Base Year Inventory		485.97
B	Biogenic Emissions		223.20
C	2002 Rate-of Progress Base Year Inventory	A - B	262.77
D	FMVCP/RVP Reductions Between 2002 and 2008		4.08
E	2002 Adjusted Base Year Inventory Calculated Relative to 2008	C - D	258.69
F	Reduction Ratio		0.0800
G	Emissions Reductions Required Between 2002 and 2008	E * F	20.70
H	Target Level for 2008 [$TL_{(2008)}$]	C - D - G	238.00
Reclassification / Bump Up			
I	FMVCP/RVP Reductions Between 2008 and 2011		0.29
J	2002 Adjusted Base Year Inventory Calculated Relative to 2011	I - J	237.71
K	Reduction Ratio		0.0600
L	Emissions Reductions Required Between 2008 and 2011	J * K	14.26
M	Target Level for 2011 [$TL_{(2011)}$]	J - L	223.73
N	FMVCP/RVP Reductions Between 2011 and 2012		0.00
O	2002 Adjusted Base Year Inventory Calculated Relative to 2012	M - N	223.73
P	Reduction Ratio		0.0150
Q	Emissions Reductions Required Between 2011 and 2012	P * O	3.36
R	Target Level for 2012 [$TL_{(2012)}$]	O - Q	220.38
S	RFP Contingency (3% Total: 1.5% VOC/1.5% Nox)		3.31
T	Attainment Contingency Target Level with minimum VOC reductions		0.78
U	Contingency Target Level	R-(S + T)	216.30
	Emission Level Obtained 2012		199.90

NOx Target Level for 2012 Milestone
Baltimore Nonattainment Area
Emissions in Tons per Day

		Formula	
A	2002 Base Year Inventory		371.47
B	Biogenic Emissions		0.00
C	2002 Rate-of Progress Base Year Inventory	A – B	371.47
D	FMVCP/RVP Reductions Between 2002 and 2008		1.78
E	2002 Adjusted Base Year Inventory Calculated Relative to 2008	C – D	369.69
F	Reduction Ratio		0.0700
G	Emissions Reductions Required Between 2002 and 2008	E * F	25.88
H	Target Level for 2008 [$TL_{(2008)}$]	C - D - G	343.81
Reclassification / Bump Up			
I	FMVCP/RVP Reductions Between 2008 and 2011		0.00
J	2002 Adjusted Base Year Inventory Calculated Relative to 2011	I – J	343.81
K	Reduction Ratio		0.0300
L	Emissions Reductions Required Between 2008 and 2011	J * K	10.31
M	Target Level for 2011 [$TL_{(2011)}$]	J – L	333.49
N	FMVCP/RVP Reductions Between 2011 and 2012		0.18
O	2002 Adjusted Base Year Inventory Calculated Relative to 2012	M – N	333.32
P	Reduction Ratio		0.0150
Q	Emissions Reductions Required Between 2011 and 2012	P * O	5.00
R	Target Level for 2012 [$TL_{(2012)}$]	O - Q	328.49
S	RFP Contingency (3% Total: 1.5% VOC/1.5% Nox)		4.93
T	Attainment Contingency Target Level with minimum VOC reductions		6.98
U	Contingency Target Level	R-(S + T)	316.58
	Emission Level Obtained 2012		232.88

13.0 ATTAINMENT MODELING DEMONSTRATION

The 8-hour Ozone Standard Attainment Modeling Demonstration analyzes the potential of the Baltimore NAA to achieve attainment of the 8-hour ozone standard by June 15, 2013. The attainment modeling demonstration is comprised of the following five sections:

13.1 – Modeling Study Overview
13.2 – Domain and Data Base Issues
13.3 – Model Performance Evaluation
13.4 – Attainment Demonstration
13.5 – Procedural Requirements

13.1 MODELING STUDY OVERVIEW

13.1.1 Background and Objectives

Since the Baltimore 8-Hour Ozone Nonattainment Area (NAA) did not attain the 1997 8-hour ozone standard by its 2009 attainment date, EPA reclassified the Baltimore NAA from a "moderate" to a "serious" NAA. Baltimore is accordingly required to demonstrate attainment of the 8-hour ozone standard by 2012 using photochemical modeling and weight-of-evidence analyses. Chapter 14 contains all the weight-of-evidence analyses supporting the Baltimore NAA's attainment of the 8-hour ozone standard.

The objective of the photochemical modeling study is to enable the MDE to analyze the efficacy of various control strategies, and to demonstrate that the measures adopted as part of the State Implementation Plan (SIP) will result in attainment of the 8-hour ozone standard by June 15, 2013. The modeling exercise predicts future year 2012 air quality conditions based on the worst episodes in the base year 2002, and applies control measures to demonstrate the effectiveness of new control measures in reducing air pollution.

For the reason previously mentioned, the Ozone Transport Commission (OTC), on behalf of the Ozone Transport Region (OTR) member states, including Maryland, undertook a photochemical modeling study to demonstrate compliance with the 8-hour ozone NAAQS. The 8-hour ozone attainment modeling study was directed by the OTC Modeling Committee, which consisted of the following workgroups: OTC Photochemical Workgroup, OTC Meteorological Modeling Workgroup, OTC Emissions Inventory Development Workgroup, and the OTC Control Strategy Workgroup.

The OTC Air Directors served on the OTC Oversight Committee and provided oversight of the process.

Table 13-1 identifies all jurisdictions within the 8-hour ozone Baltimore NAA and Figure 13-1 provides a graphical representation of the 8-hour ozone Baltimore NAA.

Table 13-1: Jurisdictions within the 8-Hour Ozone Baltimore NAA

Area	Maryland Counties	Classification	Attainment Date
Baltimore Non-Attainment Area	Anne Arundel Baltimore Baltimore City Carroll Harford Howard	Serious	June 2013

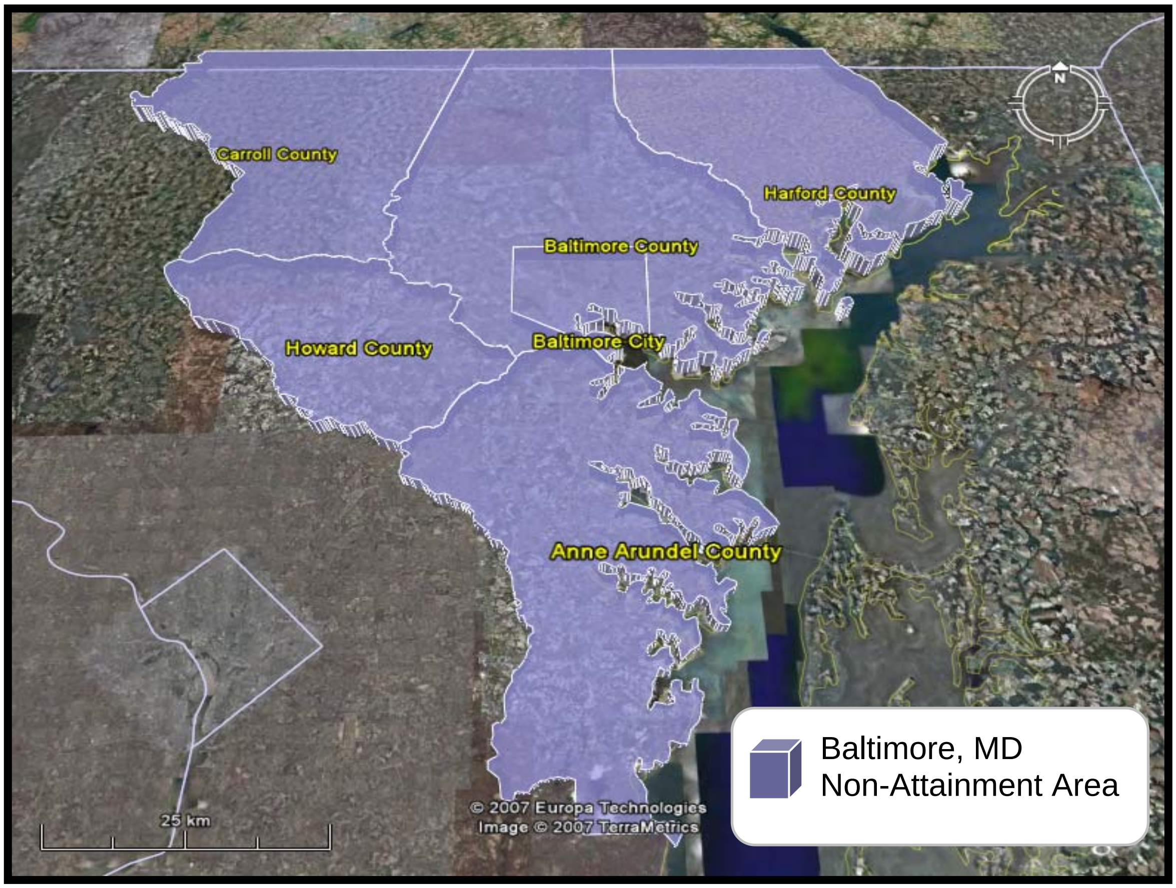


Figure 13-1: 8-Hour Ozone Baltimore NAA

The photochemical model selected for the attainment modeling demonstration was the EPA Models-3/Community Multi-scale Air Quality (CMAQ) modeling system, which is a "One-Atmosphere" photochemical grid model capable of addressing ozone at a regional scale and is considered one of the preferred models for regulatory modeling applications. The modeling analyses set forth in this report have been conducted in accordance with the Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, PM2.5, and Regional Haze (Draft 3.2- September 2006).

13.1.2 Relationship to Regional Modeling Protocols

The state of Maryland is a member of the OTC and, along with other member OTC states, was able to coordinate the modeling analyses performed for the Baltimore NAA with the regional modeling analysis conducted by the OTC Modeling Committee.

The lead agency for coordinating the running of the CMAQ model and performing the modeling runs for the OTC was the New York State Department of Environmental Conservation (NYSDEC). Modeling centers for the OTC included the NYSDEC, the University of Maryland at College Park (UMD), the Northeast States for Coordinated Air Use Management (NESCAUM), the New Jersey Department of Environmental Protection (NJDEP) and the Virginia Department of Environmental Quality (VADEQ). The lead modeling agency for coordinating the running of the CMAQ model for the OTC and performing the modeling runs was the NYSDEC, but member states of the OTC, within the frame-work of the OTC, managed the modeling project collectively. All OTC modeling inventories were provided by the Mid-Atlantic Regional Air Management Association (MARAMA) and developed, updated, and shared among the OTC states' modeling centers.

Installation of the CMAQ model at all participating modeling centers was completed and diagnostic procedures were run successfully. The CMAQ model was benchmarked against other modeling platforms across the OTR to ensure accurate results. The OTC Modeling Committee oversaw the modeling effort and reported to the OTC Oversight Committee through regular briefings and presentations, and offered additional information in cases where specific technical decisions had policy implications. MDE was a member of the various OTC committees to ensure that the Maryland ozone modeling protocol followed the same analyses being conducted by the OTC. Provided in Appendix F-1 is the Baltimore NAA ozone modeling protocol.

13.1.3 Conceptual Description

EPA recommends that a conceptual description of an area's ozone problem be developed prior to the initiation of any air quality modeling study. A "conceptual description" is a qualitative way of characterizing the nature of an area's non-attainment problem. Within the conceptual description of a particular modeling exercise, it is recommended that the specific meteorological parameters that influence air quality be identified and ranked in importance based on qualitative information.

NESCAUM prepared the conceptual description for this study for the OTR member states' use. The conceptual description document, *The Nature of the Ozone Air Quality Problem in the Ozone Transport Region: A Conceptual Description* (NESCAUM, October 2006), is provided in Appendix F-2. This document provides the conceptual description of the ozone problem in the OTR states, consistent with the EPA's guidance.

13.2 DOMAIN AND DATA BASE ISSUES

13.2.1 Episode Selection

The procedures for selecting 8-hour ozone modeling episodes seek to achieve a balance between the science and regulatory needs and constraints. Modeling episodes, once selected, influence technical and policy decisions for many years. Both the direct and implicit procedures used in selecting episodes warrant full consideration.

The rationale for the selection of 2002 meteorology as input to the air quality simulations includes a qualitative analysis (Ryan and Piety 2002) and a quantitative analysis (Environ 2005). These documents are provided in Appendix F-3.

Recent research has shown that model performance evaluations and the response to emissions controls need to consider modeling results over long time periods; in particular, full synoptic cycles or even full ozone seasons. Based on this factor, the entire ozone season was simulated for the 2012 SIP modeling runs (May 1 to September 30). As a result, the total number of days examined for the complete ozone season far exceeds EPA recommendations, and provides for better assessment of the simulated pollutant fields.

13.2.2 Size of the Modeling Domain

In defining the modeling domain, one must consider the location of the local urban area, the downwind extent of the elevated ozone levels, the location of large emission sources, and the availability of meteorological and air quality data. The domain or spatial extent to be modeled includes as its core the NAA. Beyond this, the domain includes enough of the surrounding area such that major upwind sources fall within the domain and emissions produced in the NAA remain within the domain throughout the day.

The boundaries of the OTC modeling domain are provided in Appendix F-4. This domain covers the Northeast region, including the northeastern, central and southeastern U.S. as well as southeastern Canada. The final SIP modeling analysis utilized this modeling domain.

13.2.3 Horizontal Grid Size

The OTC platform provided the basic platform for the Baltimore NAA modeling analysis and utilized a coarse grid continental United States domain with a 36 km horizontal grid resolution. The CMAQ domain is nested in the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5) domain. A larger MM5 domain was selected for the MM5 simulations to provide a buffer of several grid cells around each boundary of the CMAQ 36 km domain. This was designed to eliminate any errors in the meteorology from boundary effects in the MM5 simulation at the interface of the MM5 model. A 12 km inner domain was selected to better characterize air quality in OTR and surrounding Regional Planning Organization (RPO) regions. Appendix F-5 contains the horizontal grid definitions for the MM5 and CMAQ modeling domains.

13.2.4 Vertical Resolution

The vertical grid used in the CMAQ modeling was primarily defined by the MM5 vertical structure. The MM5 model employed a terrain following coordinate system defined by pressure. The layer averaging scheme adopted for CMAQ is designed to reduce the computational cost of the CMAQ simulations. Only the uppermost layers of the CMAQ domain were coalesced. All layers in the planetary boundary layer were left undisturbed in moving from the MM5 to the CMAQ simulation. This ensures that the near-surface processes that affect air pollution the most are faithfully represented in CMAQ, while the meteorological systems that are driven by upper-level winds are allowed to develop properly in MM5. The effects of layer averaging have a relatively minor effect on the model performance metrics when compared to ambient monitoring data.

Appendix F-6 contains the vertical layer definitions for the MM5 and CMAQ modeling domains.

13.2.5 Initial and Boundary Conditions

The objective of a photochemical grid model is to estimate the air quality, given a set of meteorological and emissions conditions. When initializing a modeling simulation, the exact concentration fields are not known in every grid cell for the start time. Therefore, typically photochemical grid models are started with clean conditions within the domain and allowed to stabilize before the period of interest is simulated. In practice, this is accomplished by starting the model several days, called spin-up time, prior to the period of interest.

The winds move pollutants into, out of, and within the domain. The model handles the movement of pollutants within the domain and out of the domain. An estimate of the concentration of pollutants at the edge of the domain and therefore the quantity of pollutants moving into the domain is needed. These are called boundary conditions. The 12 km grid boundary conditions were extracted from the 36 km CMAQ simulation. To estimate the boundary conditions for the modeling study, boundary conditions for the outer 36 km domain were derived every three hours from an annual model run performed by researchers at Harvard University using the GEOS-CHEM global chemical transport model (Moon and Byun 2004, Baker 2005). The influence of boundary conditions was minimized by using a 15-day spin-up period, which is sufficient to establish pollutant levels that are encountered in the eastern U.S. Additional information on the extraction of boundary conditions is provided in Appendix F-7.

13.2.6 Meteorological Model Selection and Configuration

The Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Meteorological Model (MM5) version 3.6 was used to generate the annual 2002 meteorology for the OTC modeling analysis. The MM5 model is a non-hydrostatic, prognostic meteorological model routinely used for urban- and regional-scale photochemical regulatory modeling studies. Professor Da-Lin Zhang (UMD) performed the MM5 modeling in consultation with the NYSDEC and MDE staff.

A more detailed description and performance evaluation of the MM5 modeling results are provided in Appendix F-8. Based on model validation and sensitivity testing, the MM5 configurations provided in Appendix F-9 were selected.

13.2.7 Emissions Model Selection and Configuration

The Sparse Matrix Operator Kernel Emissions (SMOKE) Emissions Processing System was selected for the OTC modeling analysis. SMOKE is principally an emissions processing system, and not a true emissions inventory preparation system in which emissions estimates are simulated from 'first principles'. This means that, with the exception of mobile and biogenic sources, its purpose is to provide an efficient, modern tool for converting emissions inventory data into the formatted, hourly, mapped emissions files required for a photochemical air quality model.

Inside the OTR, the emissions inventories prepared for the modeling analyses were developed through a coordinated effort between the OTR states and the Mid-Atlantic Northeast Visibility Union (MANE-VU) Regional Planning Organization (RPO).

The 2002 emissions were first generated by the individual OTR states. These inventories were then assembled and processed through the MANE-VU RPO. The 2002 emissions for non-OTR areas within the modeling domain were obtained from other RPOs for their corresponding areas.

These RPOs included the Visibility Improvement State and Tribal Association of the Southeast (VISTAS), the Midwest Regional Planning Organization (MRPO) and the Central Regional Air Planning Association (CENRAP). These emissions were then processed by the NYSDEC using the SMOKE (Version 2.1) processor to provide inputs for the photochemical model. Wherever possible, the mobile source emission inventories (in vehicle miles traveled, or "VMT" format) were replaced with Source Classification Code (SCC)-specific county level emissions to more accurately reflect actual emissions for a typical ozone season day.

The emissions inventories included a base case (2002), which serves as the "parent" inventory off which all future year inventories (i.e., 2012) are based. The future year emissions inventories include emissions growth due to projected increases in economic activity as well as emissions reductions due to implementation of control measures.

A detailed description of all SMOKE input files, such as area, mobile, fire, point and biogenic emissions files, and the SMOKE model configuration are provided in Appendix F-10.

13.2.8 Air Quality Model Selection and Configuration

EPA's Models-3/Community Multi-scale Air Quality (CMAQ) modeling system was selected for the attainment demonstration primarily because it is a "one-atmosphere" photochemical grid model capable of addressing ozone on a regional scale and is considered one of the preferred models for regulatory modeling applications. The model is also recommended by the *Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone,* $PM_{2.5}$*, and Regional Haze* (Draft 3.2- September 2006).

The CMAQ configuration is provided in Appendix F-11.

13.2.9 Quality Assurance

All air quality, emissions, and meteorological data were reviewed to ensure completeness, accuracy, and consistency before proceeding with modeling. Any errors, missing data or inconsistencies, were addressed using appropriate methods that are consistent with standard practices. All modeling was benchmarked through the duplication of a set of standard modeling results across different modeling centers.

Quality Assurance (QA) activities were carried out for the various emissions, meteorological, and photochemical modeling components of the modeling study. Emissions inventories obtained from the RPOs were examined to check for errors in the emissions estimates. When such errors were discovered, the problems in the input data files were corrected and the models were run again.

The MM5 meteorological model and CMAQ air quality model inputs and outputs were plotted and examined to ensure sufficiently accurate representation of the observed data in the model-ready fields, and temporal and spatial consistency and reasonableness. Both MM5 and CMAQ underwent operational and scientific evaluations in order to facilitate the quality assurance review of the meteorological and air quality modeling procedures, and these evaluations are discussed in greater detail in other sections of this SIP and the appendices.

13.3 MODEL PERFORMANCE EVALUATION

13.3.1 Overview

There are many aspects of model performance. This section will focus primarily on the methods and techniques recommended by EPA for evaluating the performance of the air quality model. It should be noted that other parts of the modeling process, the emissions and meteorology, also undergo an evaluation. In the interest of keeping this section concise, though, the air quality model is the primary focus.

The first step in the modeling process is to verify the model's performance in terms of its ability to predict ozone in the right locations and at the right levels. To do this, model predictions for the base year simulation are compared to the ambient data observed in the historical episode. This verification is a combination of statistical and graphical evaluations. If the model appears to be predicting ozone in the right locations for the right reasons, then the model can be used as a predictive tool to evaluate various control strategies and their effects on ozone. The purpose of the model performance evaluation is to assess the accuracy with which the model predicts ozone levels observed in the historical episode. Then CMAQ's predictions of future year air quality are put in the appropriate context when CMAQ performance and predictions are used to inform future policy decisions.

The results of a model performance evaluation were examined prior to using CMAQ's results to support the attainment demonstration. The performance of CMAQ was evaluated using both operational and diagnostic methods. Operational evaluation refers to the model's ability to replicate observed concentrations of ozone and/or precursors (surface and aloft), whereas diagnostic evaluation assesses the model's accuracy with respect to characterizing the sensitivity of ozone to changes in emissions (i.e., relative response factors).

The NYSDEC conducted a performance evaluation of the 2002 base case CMAQ simulation (May 15-September 30) on behalf of the OTR member states. Appendix F-12 provides comprehensive operational and diagnostic evaluation results, including spreadsheets containing the assumptions made to compute statistics. Highlights of this evaluation are provided in the following sections.

13.3.2 Diagnostic and Operational Evaluation

The issue of model performance goals for ozone is an area of ongoing research and debate. To evaluate model performance, EPA recommends that several statistical metrics be calculated for air quality modeling. Two of the common metrics that are most often used to assess performance are the mean normalized gross error and the mean normalized bias. The mean normalized gross error parameter provides an overall assessment of model performance and can be interpreted as precision, and the mean normalized bias parameter measures a model's ability to reproduce observed spatial and temporal patterns and can be interpreted as accuracy. EPA suggests the following criteria: a mean normalized gross error (MNGE) of < 35%, and a mean normalized bias (MNB) of < ±15% above a threshold of 40-60 ppb. These results are presented in Table 13-2 for the Baltimore NAA and in Tables 13-3 and 13-4 on a monitor-by-monitor basis averaged over all days for the 40 ppb and 60 ppb thresholds. Figure 13-2 shows the location of the monitors in the Baltimore NAA.

Table 13-2: Baltimore NAA Statistics for 8-hour Ozone

Location	Ozone Cutoff Threshold (ppb)	Mean Normalized Gross Error (MNGE) (%)	Mean Normalized Bias (MNB) (%)
Baltimore, MD NAA	40	12.94	-0.99
	60	12.49	-4.41

Table 13-3: Individual Site Statistics for 8-hour Ozone Using 40 ppb Cutoff

AIRS ID	Site Name	County	State	MNGE (%)	MNB (%)
240030014	Davidsonville	Anne Arundel	MD	12.49	-5.11
240051007	Padonia	Baltimore	MD	11.60	-1.34
240053001	Essex	Baltimore	MD	14.60	3.62
240130001	South Carroll	Carroll	MD	12.31	1.33

AIRS ID	Site Name	County	State	MNGE (%)	MNB (%)
240251001	Edgewood	Harford	MD	13.63	-2.50
240259001	Aldino	Harford	MD	12.35	-4.29

Table 13-4: Individual Site Statistics for 8-hr Ozone Using 60 ppb Cutoff

AIRS ID	Site Name	Jurisdiction	State	MNGE (%)	MNB (%)
240030014	Davidsonville	Anne Arundel	MD	12.31	-9.14
240051007	Padonia	Baltimore	MD	10.11	-5.38
240053001	Essex	Baltimore	MD	15.80	1.39
240130001	South Carroll	Carroll	MD	10.02	-2.50
240251001	Edgewood	Harford	MD	14.06	-5.35
240259001	Aldino	Harford	MD	12.36	-7.12

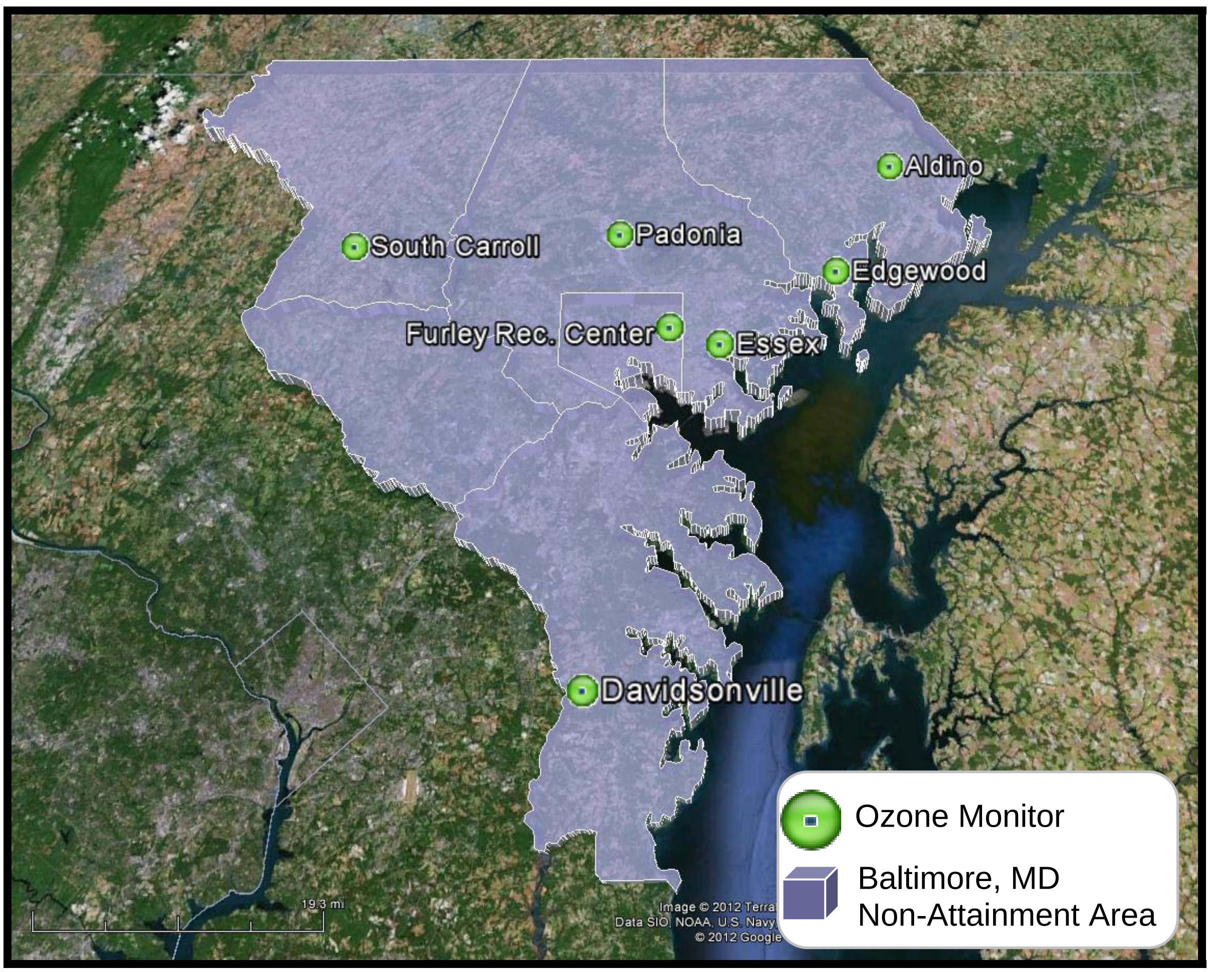


Figure 13-2: Locations of Ozone Monitors in the Baltimore NAA

The following statistics for the OTR domain have also been provided in Appendix F-12.

1. Archive file containing 8-hour average observed and predicted ozone organized by state.
2. Observed and predicted composite diurnal variations of selected species, including but not limited to ozone at SLAMS/NAMS sites; ozone at CASTNet and other sites; VOC species such as ethene, isoprene, and formaldehyde; and gas phase compounds such as CO, NO and NO_2.
3. Statistical evaluation of daily maximum 8-hour ozone at SLAMS/NAMS sites and CASTNet/other sites; statistics are computed using two different thresholds for observed daily maximum ozone of 40 and 60 ppb. Statistics are computed by date (all sites on a given day) and by site (one site over all days).
4. Statistical evaluation of daily maximum 8-hour ozone at SLAMS/NAMS sites that fall within non-attainment counties; statistics are computed by non-attainment area.
5. Statistical evaluation of daily average CO, NO, NO_2, and SO_2 at SLAMS/NAMS and other sites; statistics are computed by date and by site.
6. Statistical evaluation of daily average ethene, isoprene, and formaldehyde at SLAMS/NAMS and other sites; statistics are computed by date and by site.
7. Plots of composite time series for daily max 8-hour ozone, root mean square error and mean bias for illustrative purposes.
8. Maps of daily 8-hour maximum predicted ozone across the modeling domain, compared with actual observations.

13.3.3 Summary of Model Performance

The CMAQ model was employed to simulate ozone for the 2002 season (May through September).[25] A comparison of the temporal and spatial distributions of ozone and its precursors was conducted for the study domain, with additional focus placed on performance in the Baltimore NAA.

The CMAQ model performance for surface ozone is quite good with low bias and error. Model performance is generally consistent from day to day. The results of the 2002 ozone season show that the modeling system tends to over-predict minimum concentrations and slightly under-predict peak concentrations. The over-prediction of minimum concentrations is not of great regulatory concern since attainment tests are based on the application of relative response factors to daily peak concentrations. Prediction of minimum concentrations, though, is still important to appropriately model regional transport and nighttime ozone removal processes in order to accurately estimate peak concentrations.

The model performance for the Baltimore NAA averaged over all stations and all days meets the guidelines suggested by EPA. Applying those criteria to individual days is a much more stringent

[25] Note that the Maryland ozone season changed to April through October, in 2004; see 40 CFR 58, Appendix D, Table D-3.

test that is not required by EPA. If, however, those long-term average standards are applied to daily performance, those criteria for acceptable model performance are met on most individual days as well.

No significant differences in model performance for ozone and its precursors were encountered across different areas of the OTR. While there are some differences in the spatial data among sub-regions, there is nothing to suggest a tendency for the model to respond in a systematically different manner between regions. Examination of the statistical metrics by sub-region confirms the absence of significant performance problems arising in one area but not in another, building confidence that the CMAQ modeling system is operating consistently across the full OTR domain.

The evaluations discussed above show that the modeling system is doing a good job of appropriately estimating 8-hour average surface ozone throughout the OTR and in the Baltimore NAA. This confidence in the modeling results allows the modeling system to be used to support the development of emissions control scenarios and, more generally, the Baltimore NAA 8-hour Ozone SIP.

Also, as stated previously, the model performance for the 2002 ozone season meets all EPA guidelines and thus demonstrates that the modeling platform is appropriate for modeling emissions controls scenarios for the Baltimore NAA SIP. At the same time it must be remembered that CMAQ has been evaluated by using measures that reflect its ability to represent average conditions instead of its ability to respond to changes in emissions. Thus it is likely that although CMAQ has met the traditional performance measures as stated in EPA guidance, it may in fact under-predict the magnitude of ozone changes resulting from the modeling of various control measures. This means future year (i.e., 2012) modeling results should be viewed not in the traditional sense as being exact, but should be seen as an upper limit.

13.4 ATTAINMENT DEMONSTRATION

13.4.1 Overview

The 8-hour ozone standard attainment demonstration analyzes the potential of the Baltimore NAA to achieve attainment of the 8-hour ozone standard. The demonstration of the achievement of the 8-hour ozone standard is based on both the CMAQ modeling results and a number of weight-of-evidence analyses (provided in Chapter 14) that support the attainment modeling results. Details of the CMAQ modeling are provided in the following sections.

13.4.2 Modeling Attainment Test

The modeled attainment test applied at each monitor was performed using the following equation:

$$(DVF)_I = (RRF)_I \ (DVB)_I$$

Where:

$(DVB)_I$ = the baseline concentration monitored at site I, in ppb
$(RRF)_I$ = the relative response factor, calculated near site I
$(DVF)_I$ = the estimated future design value, in ppb, for the time attainment is required.

The future design value for each monitor in the Baltimore NAA is provided in Table 13-5 and in Figure 13-3.

Table 13-5: Modeling Attainment Test Using EPA Preferred Methodology

AIRS ID	Site Name	County	State	DVB	RRF	DVF
240030014	Davidsonville	Anne Arundel	MD	98.0	0.797	78
240051007	Padonia	Baltimore	MD	88.7	0.816	72
240053001	Essex	Baltimore	MD	91.3	0.838	76
240130001	South Carroll	Carroll	MD	88.7	0.816	72
240251001	Edgewood	Harford	MD	100.3	0.804	80
240259001	Aldino	Harford	MD	97.0	0.793	76

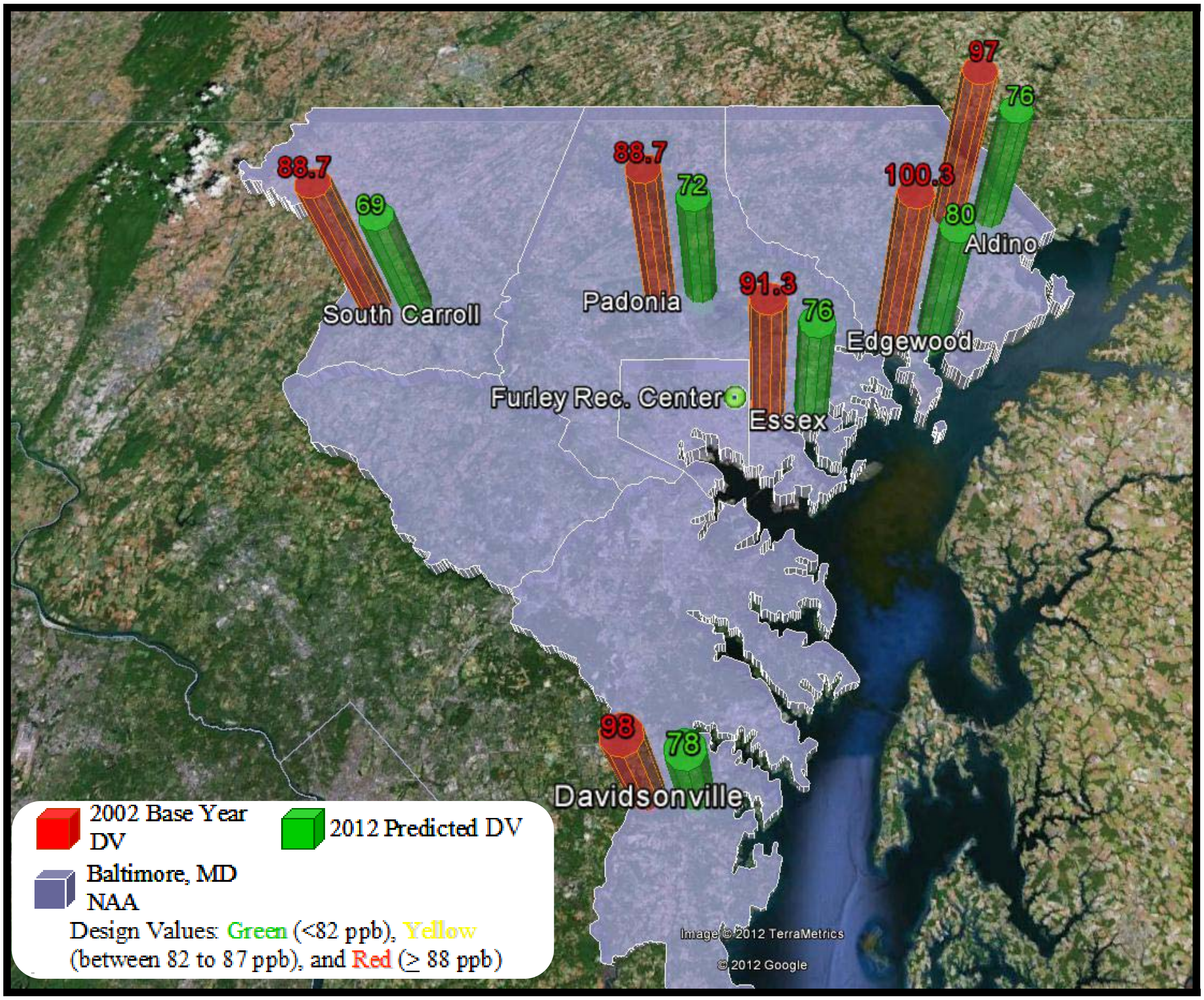


Figure 13-3: Baltimore NAA 8-Hour Ozone Base Year (2002) and Future Year (2012) Design Values

Current design values were calculated using the EPA approved method of averaging the three design value periods that include the baseline inventory year. Specifically, the average design value was calculated using the 2000-2002, 2001-2003, and 2002-2004 periods.

In the event that there were less than five years of available data at a monitoring site the following procedure was used:

1. 3 years of data - The current design value was based on a single design value.
2. 4 years of data - The current design value was based on an average of two design value periods.
3. Less than 3 years of data – The site was not used in the attainment test.

A 3x3 array of grid cells surrounding each monitor was used in the modeled attainment test as recommended by EPA for 12 km grid resolution modeling to calculate RRFs.

The predicted 8-hour daily maximum ozone concentrations from each modeled day were used in the modeled attainment test, with the nearby grid cell with the highest predicted 8-hour daily maximum ozone concentration with baseline emissions for each day considered in the test, and the grid cell with the highest predicted 8-hour daily maximum ozone concentration with the future emissions for each day in the test.

The RRFs used in the modeled attainment test were computed by taking the ratio of the mean of the 8-hour daily maximum predictions in the future, to the mean of the 8-hour daily maximum predictions with baseline emissions, over all relevant days, as defined below.

The following rules were applied to determine the number of days and the minimum threshold at each ozone monitor:

1. If there were 10 or more days with daily maximum 8-hour average modeled ozone > 85 ppb, an 85 ppb threshold was used.
2. If there were less than 10 days with daily maximum 8-hour average modeled ozone > 85 ppb, the threshold was reduced in 1 ppb increments to as low as 70 ppb, until there were 10 days in the mean RRF calculation.
3. If there were less than 10 days but more than 5 days with daily maximum 8-hour average modeled ozone > 70 ppb, then all days > 70 ppb were used.
4. No RRF calculations were performed for sites with less than 5 days > 70 ppb.

Provided in Appendix F-13 is additional information on the RRF and the modeled attainment test.

13.4.3 Unmonitored Area Analysis

An "unmonitored area analysis" using model adjusted spatial fields was performed. The basic steps of this process were as follows:

1. Interpolated ambient ozone design value data to create a set of spatial fields.
2. Adjusted the spatial fields using gridded model output gradients (base year values).
3. Applied gridded model RRFs to the model adjusted spatial fields.
4. Determined if any unmonitored areas are predicted to exceed the NAAQS in the future.

Recommended EPA guidance was utilized in the unmonitored area analysis.

Provided in Figure 13-4 is a map showing the spatially interpolated extent of 8-hour ozone above the NAAQS in the Baltimore NAA based on a future case (2012) modeling simulation.

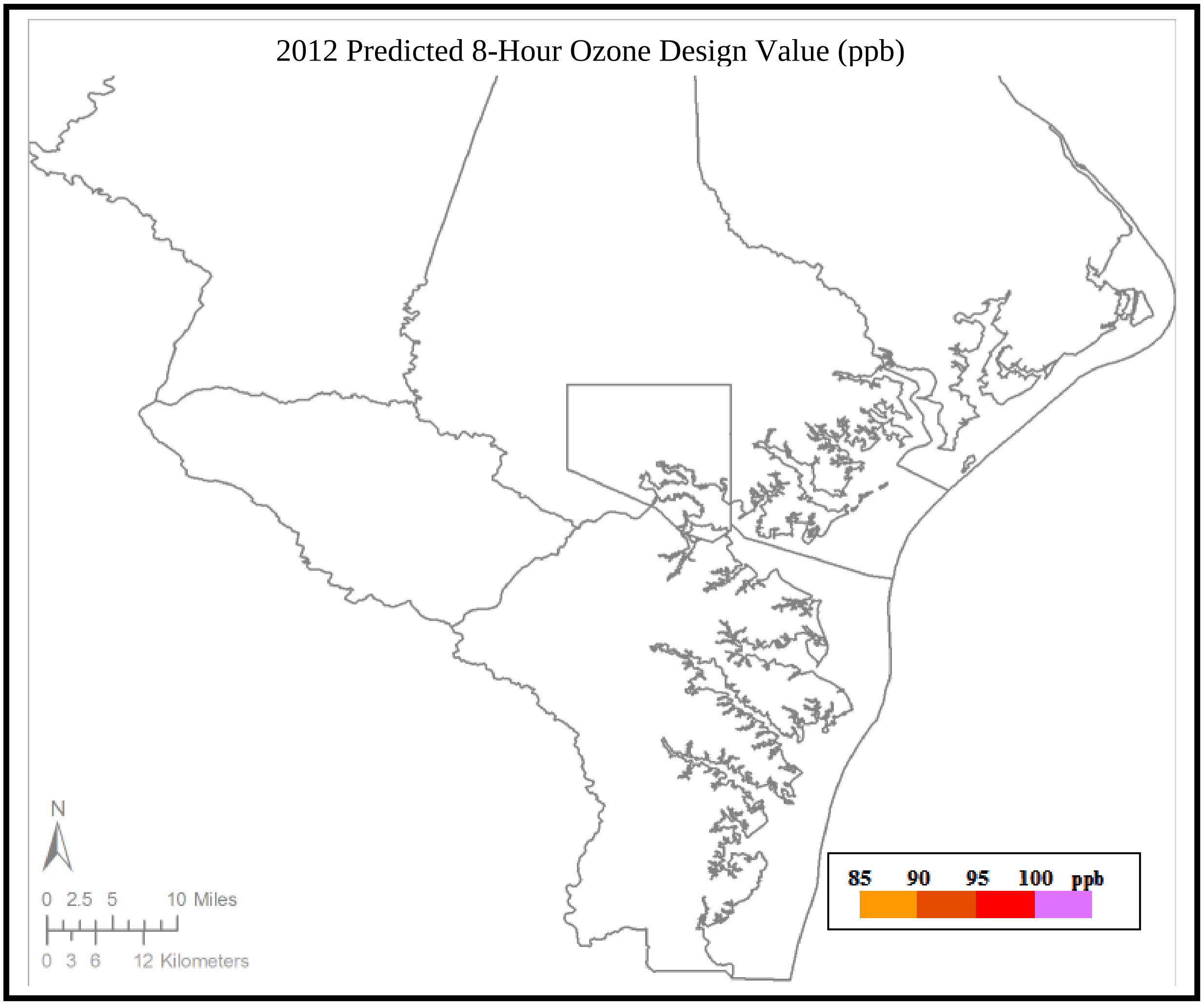


Figure 13-4: Spatially Interpolated Extent of the 8-Hour Ozone in the Baltimore NAA Using Predicted 2012 Design Values

In Figure 13-4 the clear areas within the Baltimore NAA indicate the areas that will be below the 8-hour NAAQS of 85 ppb. Figure 13-4 clearly demonstrates that all areas within the Baltimore NAA are predicted to be in attainment of the 8-hour ozone NAAQS by 2012.

13.4.4 Emissions Inventories

For areas with an attainment date of no later than June 15, 2013, the emission reductions need to be implemented no later than the beginning of the 2012 ozone season. A determination of attainment will likely be based on air quality monitoring data collected in 2010, 2011, and 2012. Therefore, the year to project future emissions should be no later than the last year of the three-year monitoring period; in this case, 2012.

The 2002 base year emissions inventory was projected to 2012 using standard emissions projection techniques discussed previously and in Appendix F-14. The 2012 inventories developed by MANE-VU were used in the attainment demonstration.

Emission inventory guidance documents were followed for developing projection year inventories for point, area, mobile, and biogenic emissions. These procedures addressed projections of spatial, temporal, and chemical composition change between the base year and projection year.

The OTC selected several control strategies for evaluation in the attainment demonstration. These were selected from groups of strategies developed by the technical subcommittees responsible for identifying and developing the regulations and/or control measures.

Consideration was given to maintaining consistency with control measures likely to be implemented in other RPOs. Technology-based emission reduction requirements mandated by the Clean Air Act were also included in projecting future year emissions.

Provided in Appendix F-14 is additional information on the emissions used in future year modeling.

13.4.5 Summary and Conclusions of Attainment Demonstration

The results of the future year (2012) modeling simulation indicate that the maximum 8-hour ozone design value for the Baltimore NAA will be in the range of 80 ppb at the Edgewood, MD ozone monitor. This translates into an 8-hour ozone design value reduction of approximately 20 ppb from 2002 to 2012. The significance of 80 ppb is that it falls below 82 ppb; according to EPA guidance, this means that only a basic supplemental analyses should be completed to confirm the outcome of the modeled attainment test that the future year (2012) design value will be less than the 8-hour ozone NAAQS.

The weight-of-evidence demonstration (Chapter 14) is meant to be a basic supplemental analysis that when combined with the modeling demonstration, presents significant evidence that the future year (2012) design value for the Baltimore NAA will be well below the 8-hour ozone NAAQS.

Presented in Figures 13-5 and 13-6 are two maps of the Baltimore NAA 8-hour ozone design values, for 2002 (the base year), and the predicted 8-hour ozone design values for the future year 2012, respectively. In each map of the Baltimore NAA, clear areas have 8-hour ozone design values below the NAAQS and the colored areas have design values that are equal to or exceed the 8-hour ozone NAAQS. These two design value maps clearly demonstrate the trend of improved air quality through 2012 and attainment of the 8-hour ozone NAAQS for the Baltimore region.

Presented in Figure 13-7 are the 2002 8-hour ozone design values and the predicted 8-hour ozone design values for future year 2012 for each ozone monitor in the Baltimore NAA. These design values demonstrate that the trend of improved air quality continues into 2012 and attainment of the 8-hour ozone NAAQS.

Based on a combination of the future year (2012) modeling simulation results and the basic supplemental weight-of-evidence (Chapter 14) analyses there is over whelming evidence to demonstrate that the Baltimore NAA will attain the 8-hour ozone NAAQS by June 15, 2013.

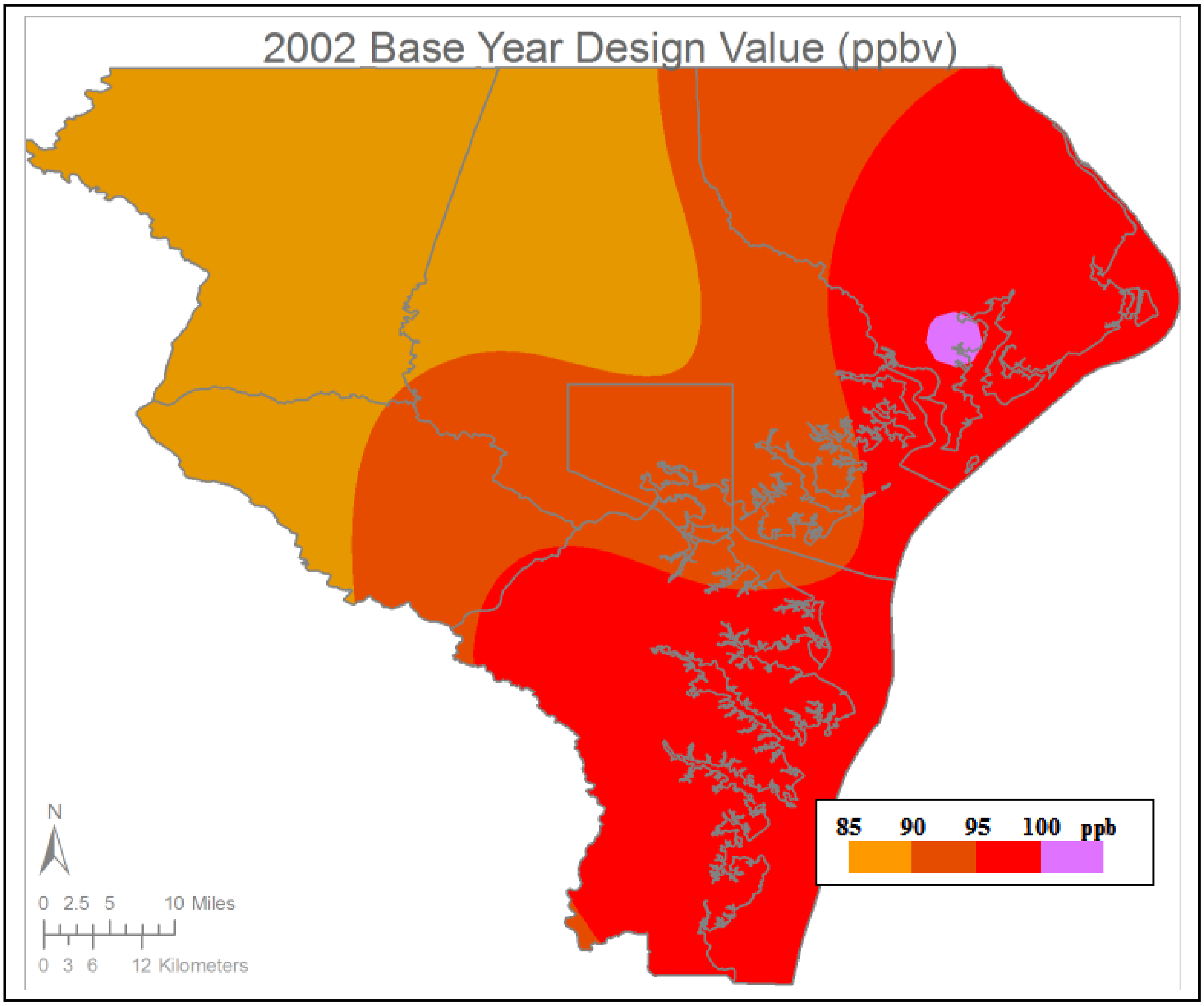


Figure 13-5: Spatially Interpolated Extent of the 8-Hour Ozone Within the Baltimore NAA Using 2002 Base Year Design Values

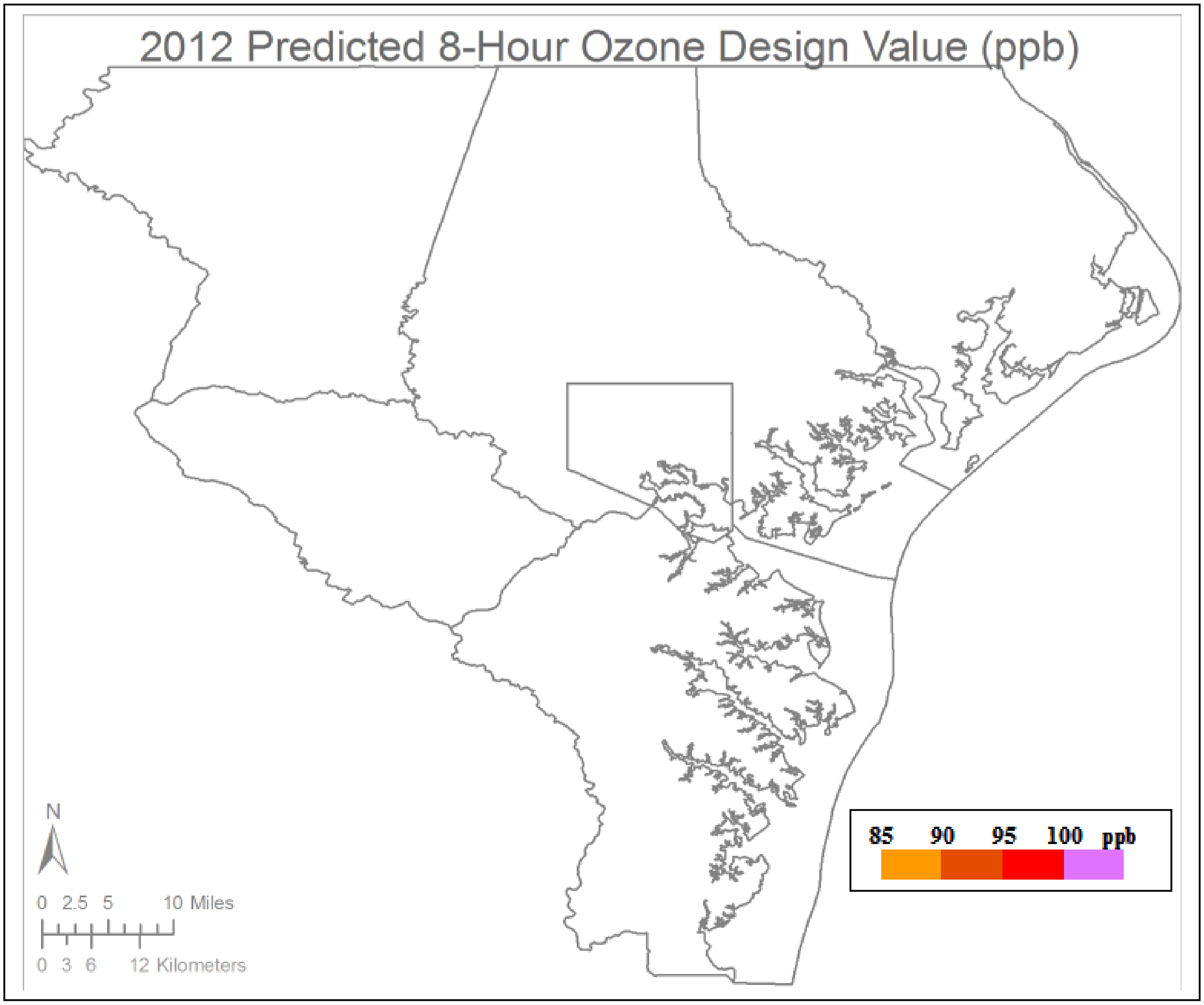


Figure 13-6: Spatially Interpolated Extent of the 8-Hour Ozone Within the Baltimore NAA Using 2012 Predicted Future Year Design Values

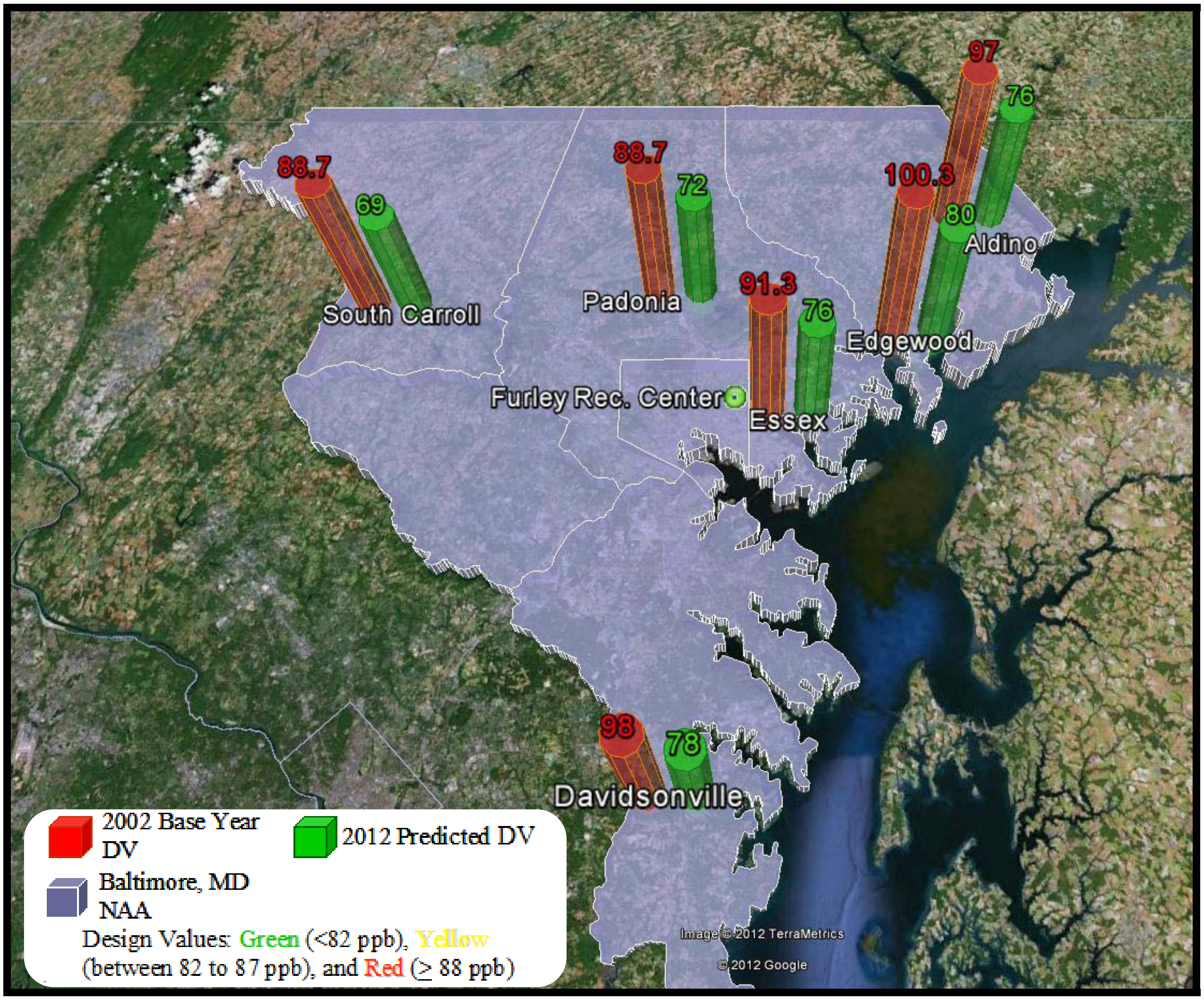


Figure 13-7: Baltimore NAA 8-Hour Ozone Base Year (2002) and Predicted Future Year (2012) Design Values

13.5 PROCEDURAL REQUIREMENTS

13.5.1 Reporting

Documents, technical memorandums, and data bases developed in this study are available for distribution as appropriate. This report contains the essential methods and results of the conceptual model, episode selection, modeling protocol, base case model development and performance testing, future year and control strategy modeling, quality assurance, weight of evidence analyses (Chapter 14), and calculation of 8-hr ozone attainment via EPA's relative response factor (RRF) methodology.

13.5.2 Data Archival and Transfer of Modeling Files

All relevant data sets, model codes, scripts, and related software required by any project participant necessary to corroborate the study findings (e.g., performance evaluations and control strategy runs) will be provided in an electronic format approved by the OTC Modeling Committee within the framework of the OTC. The OTC Modeling Committee has archived all modeling data relevant to this project. Transfer of data may be facilitated through the combination of a project website and the transfer of large databases via overnight mail. Database transfers will be accomplished using an ftp protocol for smaller datasets, and the use of IDE and Firewire disk drives for larger data sets.

GENERAL REFERENCES

Ryan, W.F., Piety, C. (2002) Summary of 2002 Pollution Episodes in the Mid-Atlantic. The Pennsylvania State University Department of Meteorology, State College, Pennsylvania and the University of Maryland Department of Meteorology, College Park, Maryland.

Stoeckenius, T., Kemball-Cook, S. (2005) Ozone Episode Classification Project for Ozone Transport Commission (Task 2b), ENVIRON International Corporation, Novato, California.

Moo, N. and D. Byun (2004) A Simple User's Guide For "geos2cmaq" Code: Linking CMAQ with GEOS-CHEM. Version 1.0. Institute for Multidimensional Air Quality Studies (IMAQS). University of Houston, Houston, Texas.

Baker, K. (2005) http://www.ladco.org/tech/photo/present/ozone.pdf

EPA GUIDANCE DOCUMENTS

Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze (Draft 3.2- September 2006). U.S. Environmental Protection Agency, Research Triangle Park, North Carolina.

14.0 WEIGHT OF EVIDENCE ATTAINMENT DEMONSTRATION

The approach that MDE has taken to Maryland's weight of evidence attainment demonstration is that of supplemental data analysis and modeling. These techniques provide a favorable indication that the Baltimore NAA will successfully attain the 8-hour ozone NAAQS in 2012.

14.1 AMBIENT AIR MONITORING MEASUREMENTS AND TRENDS

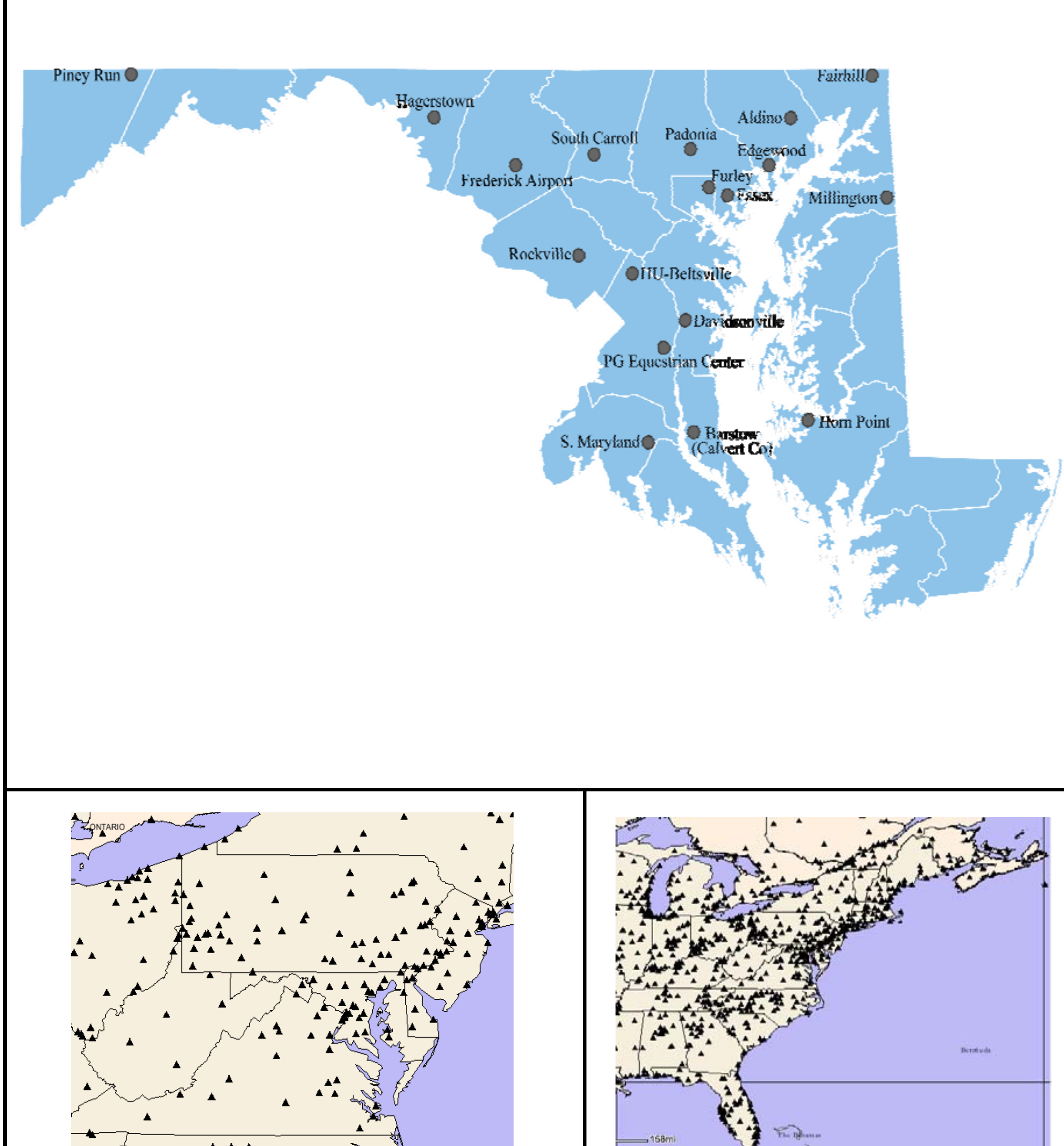
Measurements from surface monitoring stations provide the most fundamental indication of air quality improvement in the Baltimore NAA. Basic trends of ozone from the network of monitors show continuously improving air quality in Maryland and the Baltimore NAA with respect to multi-year design values, annual exceedance day counts, 24-hour daily peak concentrations, single-hour concentrations, warm weather days when ozone is usually highest, and finally ozone precursor trends.

14.1.1 The Ambient Monitoring Network

MDE operates a relatively dense network of ozone monitoring stations, which has enabled the collection of high resolution ozone data on various scales of time and space. Figure 14-1 shows maps of the ambient ozone monitoring network for Maryland, the Mid-Atlantic, and the Eastern U.S. Comparing the spatial density of monitoring sites on a wider domain of the Mid-Atlantic region shows that Maryland has no large expanses without monitors, like Virginia, West Virginia, and Pennsylvania. An even larger perspective over the entire eastern U.S. reveals that Maryland is covered by one of the more dense monitoring networks due to the required monitoring associated with the cluster of large metropolitan areas extending from Richmond, VA through New York, NY.

The Code of Federal Regulations requires four ozone sites for a metropolitan statistical area of greater than 10 million people for an 8-hour ozone non-attainment area (40 CFR 58 Appendix D §4.1). MDE currently has seven ozone sites deployed in the Baltimore NAA, which is currently classified by EPA to be in "moderate" non-attainment. Due to logistical reasons, slight changes are made in the deployment of sites over the years, such as the unavoidable relocation of the Fort Meade monitoring site due to the U.S. military's need for additional space on the grounds of the Fort Meade military post. MDE was fortunate to find a new location for the site at Beltsville, where interagency collaborations and opportunities for long-term studies are more viable. In addition, a site was located in Baltimore City at the Furley Elementary School Recreational Center in August 2006. On the whole, the number of sites has remained relatively constant.

Panel A – Maryland Ozone Network



Panel B – Mid-Atlantic Ozone Network | Panel C – Eastern U.S. Ozone Network

Figure 14-1: Maps of the 2012 Ozone Monitoring Sites

There are 17 ozone monitoring sites in the state of Maryland, a dense network for a relatively small state.

14.1.2 Ozone Trends

Ozone concentrations exhibit an improving air quality trend on multiple temporal scales. Perhaps the simplest regulatory measure of improving air quality is the downward trend in 8-hour ozone design values for the sites in Maryland. Design values offer the benefit of a multi-year metric, which removes the statistical bias of single high values by taking the fourth highest value of three consecutive years and averaging those values together. Figure 14-2 displays the decreasing trend of 8-hour ozone design values in Maryland. The trend is a good fit to the data with an R^2 of ~0.6 and a slope of -0.8 ppb / year. The decrease in ozone design values between 2003 and 2004 reflects the disproportionate benefit of the NO_x SIP Call, as this is when the majority of regional NOx controls were put in place on electric generating units (EGU's). This trend of decreasing ozone design values is expected to continue through 2012, as the Maryland Healthy Air Act (HAA), the first phase of which started in 2009, will significantly reduce Maryland EGU NO_x and SO_2 emissions.

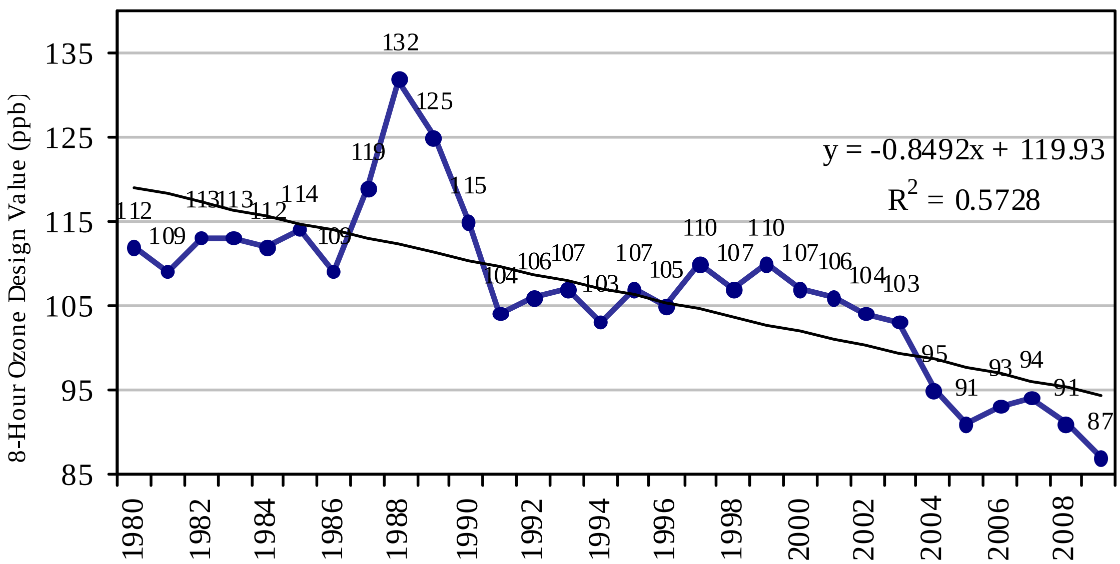


Figure 14-2: Trend in 8-hour Ozone Design Values per Year for all Maryland Sites

The downward trend in 8-hour ozone concentrations on an annual basis is highlighted in Figure 14-3 by showing the number of 8-hour ozone exceedance days per year. This trend is also a good fit with an R^2 of ~0.5 and a steeper declining slope of –1.4 days/year. Since 2002, an average of approximately 16 days per year, or approximately 2 weeks, have experienced 8-hour ozone concentrations ≥ 85ppb; this is a sharp contrast to the 2 months' worth of exceedance days which existed in the 1980s.

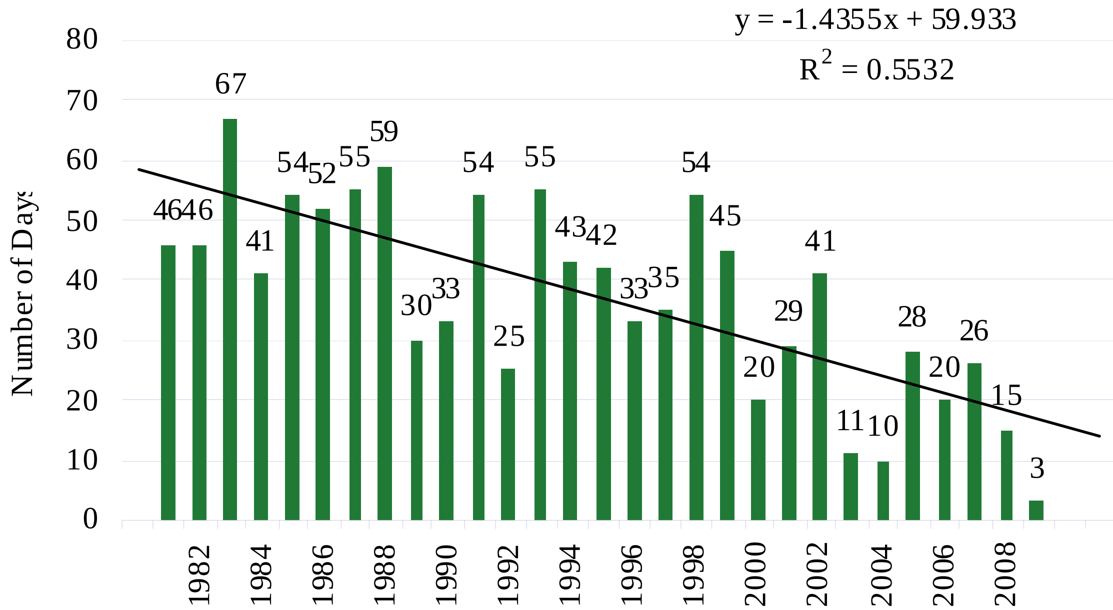


Figure 14-3: Trend in 8-hour Ozone Exceedance Days per Year for all Maryland Sites

The declining trend is an indicator of improving air quality.

The temporal scale trend next reviewed is the daily scale. Average daily peak 8-hour ozone is shown in Figure 14-4. In order to show a clearer picture of the trends without the noise of short-term fluctuations, the data are grouped in four-year bins. The methodology of choosing bins is carried out in reverse chronological order, beginning with the first four-year bin, 2006-2009. The scientific consensus is that ozone concentrations in the eastern U.S., outside of large urban areas, are NO_x-limited.[26] As a result, reductions in region-wide NO_x emissions (NO_x SIP Call) should reduce the overall background ozone concentrations. Local emissions and photochemistry will still lead to short-term spikes in ozone, often ≥ 85 ppb, but these spikes will occur on top of a lower base-level of ozone. The magnitude of each individual ozone spike should also have a reduced amplitude from the base-level. Such a change in the base-level of ozone was created by the NO_x SIP Call and is demonstrated in Figure 14-4.

[26] Ryan, W.F., "Local Ozone Forecasting and the NOx SIP Call Rule", EPA National Air Quality Conference, Orlando, FL, 2007.

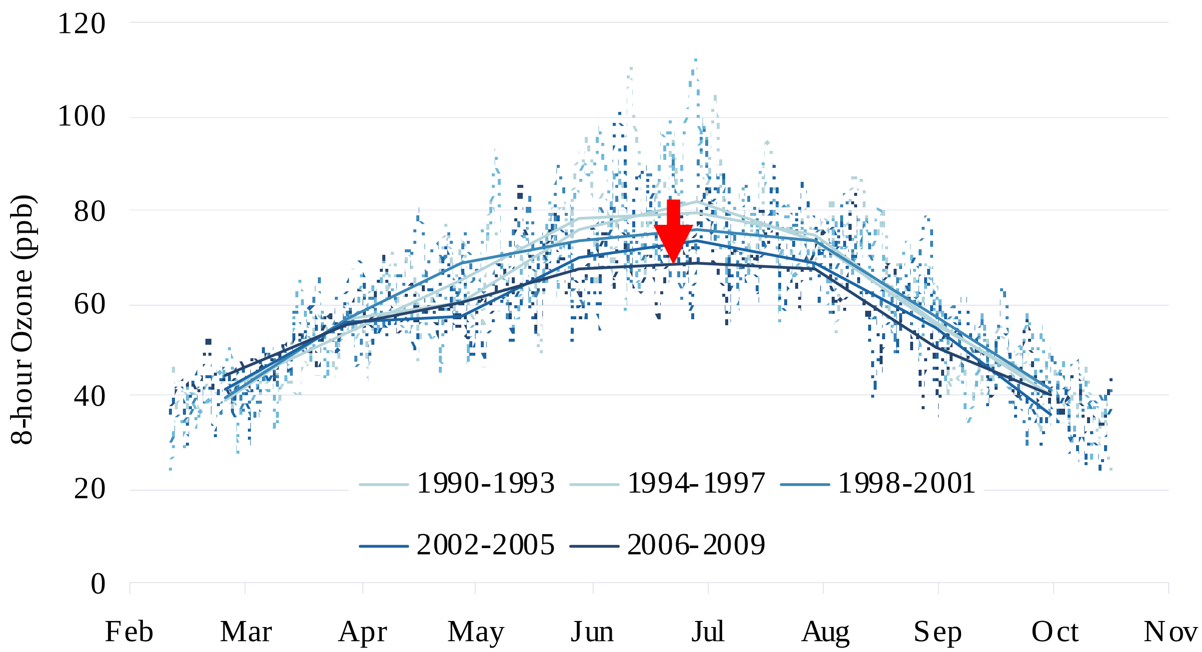


Figure 14-4: Trends in Average Daily Peak 8-hour Ozone for all Maryland Sites Binned by Four-year Periods

The red arrow indicates improving air quality shown by the decreasing trend of average daily peak 8-hour ozone. The solid lines are monthly averages.

Continuing in reverse chronological order, each of the prior bins also consisted of a four-year period for the sake of consistency. The most important feature of Figure 14-4 is the steady decline in the trend of each bin, indicated by the red arrow. The part of the summer when peak ozone concentrations occur (June-August) is exactly when the greatest benefit is seen with reductions in the daily peak 8-hour ozone. The improving trend in 1998-2001 is partially due to meteorology because the summers of 2000 and 2001 were not conducive to photochemical formation. Temperatures were cooler than normal, precipitation was more prevalent, and the synoptic scale systems rarely created long-lived high pressure centers over the southeastern U.S. which typically plays a large role in high ozone episodes. The improving trend in 2002-2005 shows another marked decrease in ozone values, a sign of the valuable impact of the NO_x SIP Call.

Not only have ozone concentrations been steadily declining during the part of the summer when ozone production is greatest, but ozone concentrations have also been steadily declining during the part of each day when ozone production is greatest. Being a photochemical pollutant, ambient ozone reaches its peak concentrations during the afternoon when the sun angle is high and temperatures are at their warmest. Figure 14-5 shows the diurnal trend in ozone from 1993 to 2009. The years are binned by 3-year rolling averages in order to eliminate the noise of hourly fluctuations present in the raw data. The steady progression from each rolling average to the next shows an improvement of air quality. The red arrow indicates the decline of ozone concentrations.

The last three rolling averages experienced a distinct decline in magnitude of hourly ozone after the NO_x SIP Call.

The red arrow indicates improving air quality shown by the decreasing trend of peak mid-day hourly concentrations.

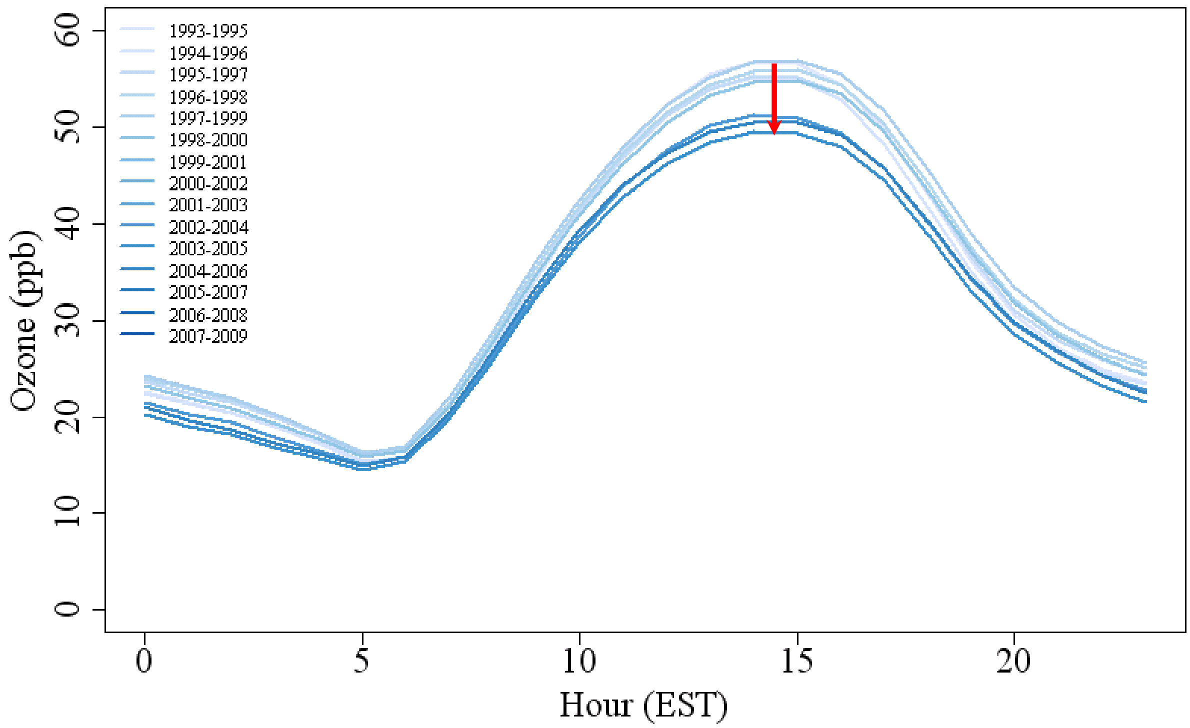


Figure 14-5: Trend in Diurnal Ozone by 3-year Rolling Averages for All Maryland Sites from the Summers (April 1 – October 31) of 1993 through 2009

The approach to trends thus far has focused entirely on the ozone concentrations themselves. A more comprehensive look at ozone trends must also consider meteorology and precursors. Ozone is a photochemical pollutant and as such, it is highly dependent upon meteorological conditions.

14.1.3 Temperature Adjusted Ozone Trend

The data shown in Figure 14-6 provide insight into the trend of 8-hour ozone with respect to temperature.

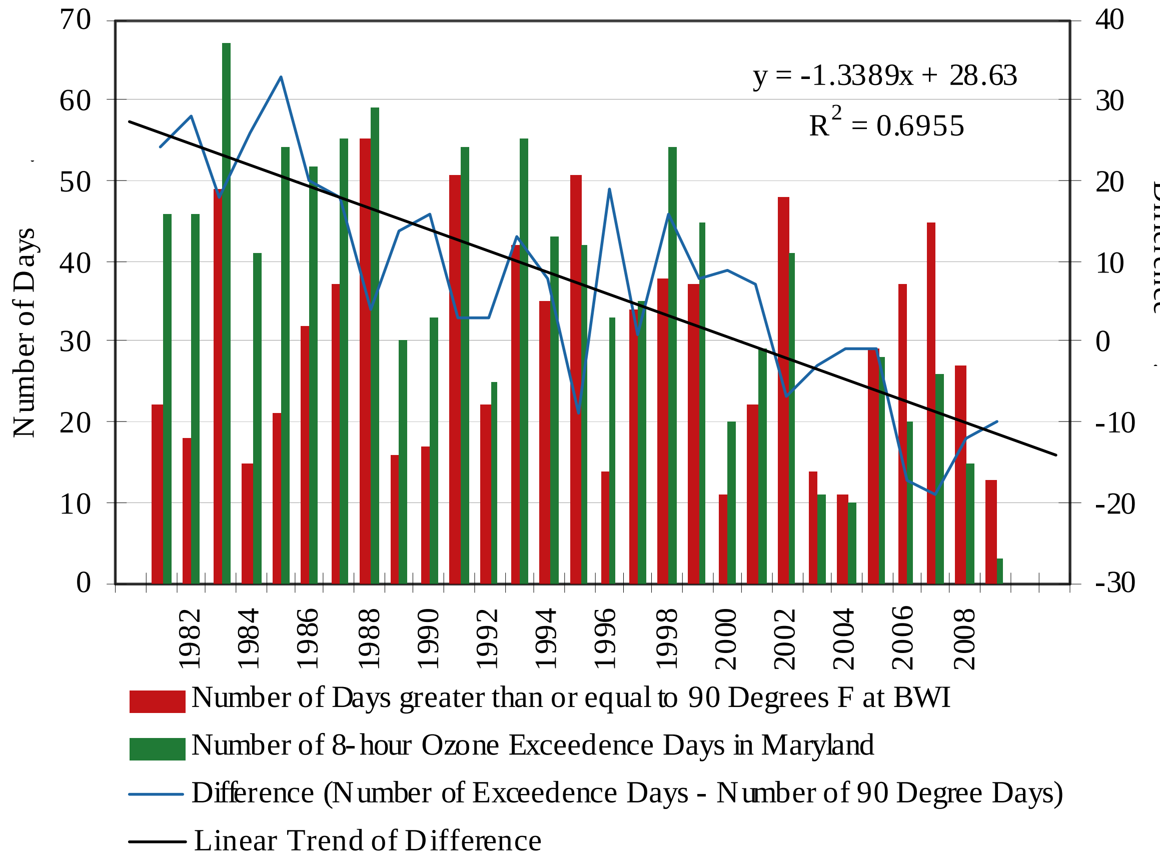


Figure 14-6: Maryland Air Quality: Days above 90°F and Ozone Exceedances, 1982-2008

Improving air quality in Maryland is shown by the downward linear trend (black line) of the difference between (blue line) the number of 8-hour ozone exceedance days per year (green bars) and the number of days with a daily maximum temperature > 90°F per year at BWI (red bars). The time period is 1981-2009.

Temperature is the single strongest environmental predictor of ozone concentrations; as such there has historically been a strong correlation between the number of 8-hour ozone exceedance days per year and the number of days with a daily maximum temperature ≥ 90°F per year at BWI. In fact, in the early 1980's the number of ozone exceedance days was typically double the number of 90°F days. This statistic has steadily changed, though, so that in 2006 the ratio was the exact opposite with the number of 90°F days double the number of exceedance days. The trend in the difference between the two counts (black line) has an R^2 of approximately 0.7 and a downward slope of –1.3. Despite stable numbers of 90°F days, ambient ozone concentrations continue to experience a downward trend reflecting improvements in air quality.

14.1.4 Ambient Ozone Precursor Trend

As described in Chapter 2, the precursors to ozone formation include VOCs and NO_x. VOCs are somewhat difficult to depict in terms of simple trends because the list of VOCs is very large. MDE collects 56 species of VOCs as part of the Photochemical Assessment Monitoring Sites (PAMS) network and a separate list (with some overlap) of 61 Toxic VOCs. VOC measurements have uniformly experienced declines in concentrations since 1994 due to the reformulated gasoline rule and hydrocarbon reductions for ozone. They have also received some associated benefits from restrictions on CFC (chlorofluorocarbon) emissions since the 1990s. NO_x on the other hand, is more simply analyzed and it is widely available. A given percent reduction of NO_x should result in an equal percent reduction of ozone. NO_x is measured by the same trace gas instrumentation used to simultaneously measure ambient NO and NO_2. NO_2 is commonly measured to show compliance with the NO_2 NAAQS. Figure 14-7 displays the decreasing trend of NOx for the Baltimore NAA since 1993.

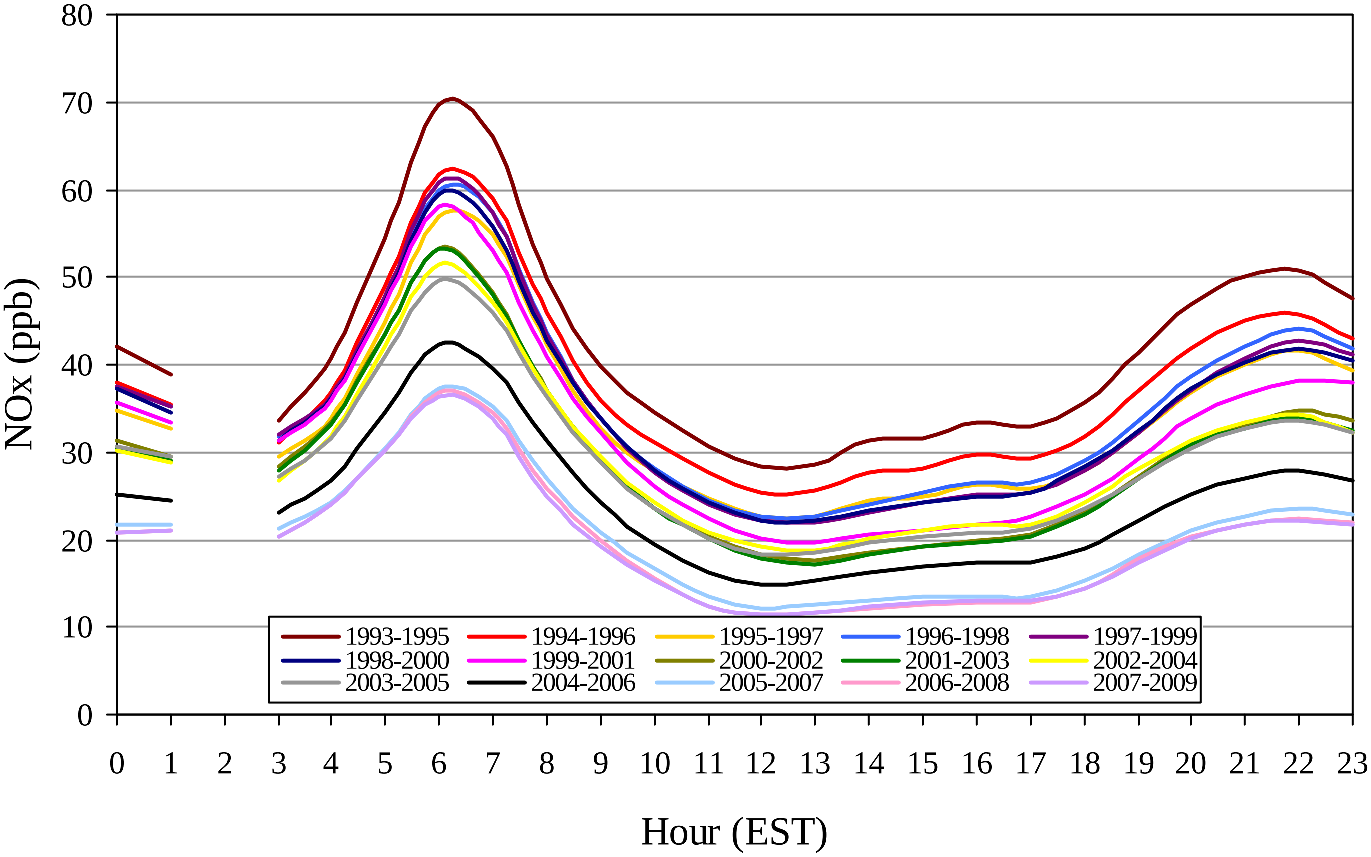


Figure 14-7: Trend in Diurnal NOx by 3-year Rolling Averages for All Sites in Maryland during the Summers (April 1 – October 31) of 1993 through 2009

Instrument calibration occurs during the data gap at 2:00 AM Eastern Standard Time (EST).

14.1.5 Supplemental Modeling

On July 6, 2011, the EPA released the final version of the Transport Rule, also know as the Cross-State Air Pollution Rule (CSAPR). The CAMx air quality model runs for the rule were documented in the *Air Quality Modeling Final Rule Technical Support Document* (June 2011), and can be found here: http://www.epa.gov/airtransport/pdfs/AQModeling.pdf.

The CSAPR modeling was performed for several emissions cases:

1. 2005 base year,
2. 2012 “no CAIR” case,
3. 2014 “no CAIR or CSAPR” case, and
4. 2014 “with CSAPR” case.

The 2005 average design value (Avg DV) was calculated by using a five-year weighted average of the three 3-year averages (2003–2005, 2004–2006, and 2005–2007) and was used to determine whether a monitor was in nonattainment for the CSAPR.

Based on the 2012 and 2014 modeling results, all monitors within the Baltimore NAA demonstrated compliance with the 1997 8-hour ozone NAAQS. The CSAPR modeling results are shown in Table 14-1.

Table 14-1 CSAPR Average Design Value Modeling Results for Baltimore NAA Monitors

Monitor	ID	2012 “without CAIR” (ppb)	2014 “without CAIR or CSAPR” (ppb)	2014 “with CSAPR” (ppb)
Edgewood	240251001	84.4	82.5	82.3
Davidsonville	240030014	78.6	77.6	77.3
Essex	240053001	78.7	77.3	77.1
South Carroll	240130001	74.2	72.2	72.0
Aldino	240259001	80.0	76.4	76.2
Padonia	240051007	70.0	68.3	68.2
Note: The Furley Elementary School Recreational Center (ID # 245100054) monitoring station was established in 2006 and thus did not have enough data to calculate an average 2005 ozone design value and for that reason was not included in this modeling analysis.				

Based on the attainment demonstration modeling (see Chapter 13), the weight of evidence data analysis, and the supplemental modeling that was completed, MDE is confident that the Baltimore NAA will attain the 8-hour ozone NAAQS standard by June 15, 2013.