MARYLAND DEPARTMENT OF THE ENVIRONMENT
1800 Washington Boulevard ? Baltimore MD 21230
410-537-3000 ? 1-800-633-6101

Robert L. Ehrlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Kendl P. Philbrick
Acting Secretary

Modification to the Rate of Progress Plan for Cecil County: Revising Mobile Emission Estimates with Mobile6

SIP Revision 03-16

(Proposed)

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Prepared for:

U.S. Environmental Protection Agency

Prepared by:

Maryland Department of the Environment

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1.0 Executive Summary

The purpose of this modification to the Rate of Progress Plan (ROP) for Cecil County is to revise the rate of progress analysis using mobile source emissions estimates generated with EPA's new mobile emission factor model, MOBILE6. The approved Rate of Progress Plan, Appendix C of *Modification to the Phase II Attainment Plan for Cecil County: Revising the Mobile Source Emission Budget, Adding Tier 2 Standards* demonstrates that Cecil County meets the requirements of Section 182(c)(2)(B)(i) of the Clean Air Act as applicable to Severe Areas, Section 182(d), for 2002 and 2005. This is the requirement that a severe area must make a reduction in volatile organic carbon (VOC) emissions equal to 3% of the 1990 baseline VOC emissions for each year beginning after 1996 through 2005. This subsequent revision demonstrates for the prescribed milestone year 2005, that the 2005 ROP target levels continue to be met despite increased mobile source emissions estimates from MOBILE6 ensuring that the required reductions have been made. Subsequently, the revision establishes the 2005 mobile source emission estimates used in this plan as the 2005 mobile sources emission budgets for ROP. This revision supersedes all other plans designed to meet this requirement.

Cecil County must meet the 2005 VOC target levels shown in Table 1.1 Summary of Emission Benefits for Cecil County to meet the rate of progress requirements. Maryland is relying on VOC control measures for <u>all</u> of the rate of progress requirements in this plan. This plan describes the reduction measures needed to lower VOC emissions and offset growth in emissions to reach this target level. This target level is sufficient to allow the region to meet the 42% VOC emissions reduction requirement. In fact, the 2005 target levels are more stringent than target levels in previous SIP revisions.

Based on the analysis in this plan and the fulfillment of the ROP requirement, the Cecil County mobile source emission budget for ROP for the year 2005 is 3.0 tons per day for VOC and 11.3 tons per day for NOx.

Table 1.1 Summary of Emission Benefits for Cecil County (Tons per Day)

	2005	
Control Measure	**VOC**	**NOx**
Enhanced I/M		
Tier I		
Reform Gas		
LEV		
HDDE		
Total Mobile	2.02	4.24
Stage II/Refuel	0.32	0.00
Open Burning	4.23	0.89
Surface Cleaning/ Degreasing	0.18	0.00
Architectural Coatings	0.17	0.00
Consumer Products	0.07	0.00
Auto Refinishing	0.29	0.00
Stage I Vapor Recovery	0.84	0.00
Nonroad Small Gasoline Engines	0.73	0.00
Nonroad Diesel Engines Tier I & II	0.00	0.68
Emissions Standards for Large Spark Emissions Eng.	0.02	-.01
Marine Engines	0.17	0.00
Railroads	0.00	0.21
Screen Printing	0.00	0.00
Graphic Arts-Lithography	0.08	0.00
Graphic Arts - Rotogravure & Flexographic	0.04	0.00
Nonroad RFG	0.70	0.00
Total	9.86	6.01
Projected Uncontrolled Emissions	17.26	20.75
Emission Level Obtained	7.41	14.74
Emission Level Required	7.73	15.88
Surplus	0.32	1.14

2.0 INTRODUCTION AND BACKGROUND

The purpose of this modification to the Rate of Progress Plan (ROP) for Cecil County is to revise the rate of progress analysis using mobile source emissions estimates generated with EPA's new mobile emission factor model, MOBILE6. The approved Rate of Progress Plan, Appendix C of *Modification to the Phase II Attainment Plan for Cecil County: Revising the Mobile Source Emission Budget, Adding Tier 2 Standards* demonstrates that Cecil County meets the requirements of Section 182(c)(2)(B)(i) of the Clean Air Act as applicable to Severe Areas, Section 182(d), for 2002 and 2005. This is the requirement that a severe area must make a reduction in volatile organic carbon (VOC) emissions equal to 3% of the 1990 baseline VOC emissions for each year beginning after 1996 through 2005. This subsequent revision demonstrates for the prescribed milestone year 2005, that the 2005 ROP target levels continue to be met despite increased mobile source emissions estimates from MOBILE6 ensuring that the required reductions have been made. This revision supersedes all other plans designed to meet this requirement.

2.1 CLEAN AIR ACT REQUIREMENTS

The original Air Pollution Control Act was passed in 1955 in response to public concerns raised over several air pollution episodes that resulted in many fatalities. The most famous episode was the four-day "killer fog" in London, England that claimed 4,000 lives. In 1948, a similar incident in Donora, Pennsylvania culminated in 20 fatalities and 7,000 illnesses. In response to public concerns, Congress adopted air pollution control laws.

With the passage of the original Air Pollution Control Act of 1955 and the Clean Air Act (the Act) of 1963 (amended in 1967, 1970, 1977, and 1990), Congress responded to the air pollution problem by offering technical and financial assistance to the states. The Act of 1963 and subsequent amendments are intended to protect public health and the environment from hazards associated with airborne pollutants. The 1970 Amendments to the Act sharply increased federal authority and responsibility for addressing the air pollution problem; however, Section 107(a) of the Act still provided that each state "shall have the primary responsibility for assuring air quality within the entire geographic area comprising the state". Despite the states' role in attaining and maintaining air quality standards within its borders, the challenges require an extensively cooperative state/federal partnership.

One of the most important components of the 1970 amendments to the Act was the creation of National Ambient Air Quality Standards (NAAQSs) for air pollutants, which endanger public health and welfare. A system of primary NAAQSs was established for the protection of human health and a set of secondary standards was established for the protection of public welfare, property, crops, animals and natural ecosystems. A geographic area that meets or does better than the primary standard is called an attainment area; areas that do not meet the primary standard are called nonattainment areas. The six criteria pollutants for which NAAQSs have been established are: lead (Pb), carbon monoxide (CO), particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3). The last three pollutants are serious respiratory irritants. They are highly reactive compounds that can oxidize or burn tissues of the mucous membranes and lungs. Prolonged exposure can cause permanent scarring of lung tissue and reduced lung capacity.

Despite the 1970 legislation, air quality in many areas of the country still did not meet the NAAQSs, especially for ozone. Congress amended the Act again in 1977, partly to address those areas that had not attained the NAAQSs. SIP revisions submitted pursuant to the requirements of the 1977 amendments yielded progress in meeting the NAAQSs. However, many areas remained nonattainment.

In 1990, Congress once again enacted comprehensive amendments to the Act to revise State Implementation Plan (SIP) requirements for nonattainment areas. The requirements of the 1990 Amendments to the Act represent an unprecedented commitment to protecting public health and the environment. Title I of the Act classifies areas that exceed national health-based air quality standards based upon the severity of their pollution problem. In accordance with these classifications, the Act sets new deadlines for achieving the standard, and requires a minimum set of basic measures for each classification to ensure early progress toward this goal. Areas with more severe classifications must implement increasingly stringent measures.

One major impact the Act had on the State of Maryland was to redefine and enlarge the ozone nonattainment areas. The Baltimore Nonattainment Area remained unchanged. Cecil County was added to the Philadelphia-Wilmington-Trenton nonattainment area in 1990. The Washington, D.C. Nonattainment Area expanded to include Calvert, Charles, and Frederick counties. Table 2.1 shows the current designations for the State of Maryland. This document deals only with Cecil County.

In addition to redefining and enlarging the nonattainment areas, the Act included specific emission reduction requirements depending on the severity of pollution in a nonattainment area. These emission reduction requirements insure that areas make continuous progress towards attainment of the NAAQSs. Mandatory emission control programs, specific emission reduction requirements and deadlines for attainment of the NAAQSs for ozone vary according to the classification of the nonattainment area. Areas with more serious nonattainment classifications must meet the mandates of the less severe classifications plus the more stringent requirements of their classification. The attainment date for Cecil County nonattainment area is the year 2005.

Congress established Rate of Progress requirements: specific emission reduction requirements where the timing and quantity of the reductions depends on the nonattainment area classification. A severe nonattainment area must reduce emissions of VOCs by 15 percent between 1990 and 1996, and reduce emissions of VOCs and/or NOx by 3 percent per year between 1997 and 2005. As a separate requirement, state and local air pollution agencies must show through computer modeling that emissions reduction strategies chosen for the area will ultimately result in attainment of the ozone NAAQS.

The ozone problem is regional in nature since ozone travels across county and state lines. The Act created regions such as the Ozone Transport Region (OTR) to facilitate coordination and consensus building between states in areas with pollution transport problems. The Northeast OTR comprises Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, Rhode Island, New Jersey, Delaware, Maryland, Pennsylvania, Washington, DC, and Virginia. The coordinating body for the Northeast OTR is the Ozone Transport Commission (OTC). All Maryland counties are part of the Northeast OTR. The OTR is not a nonattainment classification, but does have certain requirements associated with it.

Table 2.1: Maryland Ozone Classifications

AREA	CLASSIFICATION	ATTAINMENT DATE (NOVEMBER 15)
BALTIMORE, MD Anne Arundel County, Baltimore City, Baltimore County, Carroll County, Harford County, Howard County	Severe Nonattainment Part of the Ozone Transport Region	2005
WASHINGTON, D.C. Calvert County, Charles County, Frederick County, Montgomery County, Prince George's County	Reclassified to Severe Nonattainment (2003) Part of the Ozone Transport Region	2005
PHILADELPHIA/WILMINGTON/TRENTON Cecil County	Severe Nonattainment Part of the Ozone Transport Region	2005
KENT/QUEEN ANNE'S COUNTY Kent County, Queen Anne's County	Marginal Nonattainment Part of the Ozone Transport Region	1993
OTHER MARYLAND COUNTIES Allegany, Caroline, Dorchester, Garrett, Somerset, St. Mary's, Talbot, Washington, Wicomico, Worcester	Unclassifiable (Insufficient data to classify)[1] Part of the Ozone Transport Region	N/A

2.2 THE STATE IMPLEMENTATION PLAN (SIP) PROCESS

The Act requires states to develop and implement ozone reduction strategies in the form of a State Implementation Plan (SIP). The SIP is the state's "master plan" for attaining and maintaining the NAAQS. The SIP is revised as necessary to ensure that compliance with federal standards is achieved as expeditiously

1 Areas which are unclassified are not nonattainment areas.

as possible.

EPA has identified four criteria to determine whether emission reductions from control strategies are creditable in the SIP. These four criteria are outlined in the General Preamble to Title I of the Clean Air Act Amendments of 1990, which can be found in *Federal Register* 13567. The four criteria are:

- Emissions reductions ascribed to control measures must be quantifiable and measurable (*quantifiable*);

- 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 (*enforceable*);

- Measures are replicable (*real*); and

- The control strategies are 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 (*permanent*).

Once a SIP revision is approved by the Administrator of the EPA, it is enforceable as a state law and as federal law under Section 113 of the Act. If the SIP is found to be inadequate in the EPA's judgment and if the state fails to make amendments to rectify the problem, under §110(c)(1), the EPA Administrator issues binding amendments to the SIP. These amendments are referred to as the federal implementation plan (FIP). EPA has released guidance on how to take credit for voluntary measures in the SIP. Voluntary measures can be used to generate up to 3% of the required emission reductions if this guidance is followed.

EPA must impose sanctions if a state:

- Does not submit a SIP revision; or
- Submits a SIP revision that the EPA does not approve; or
- Fails to implement the SIP revision.

Possible sanctions include:

- Requiring new large industries, or those that want to expand, to offset emissions by 2:1, which could deter economic growth;
- Withholding federal highway funds;
- Withholding air quality planning grants; or
- Imposing a federal implementation plan (FIP).

The Act allows the EPA to exercise discretion in imposing sanctions under certain circumstances. In general, EPA can delay imposing sanctions for 18 months if a state is making a good faith effort to comply with the requirement. The EPA promulgated a rule regarding discretionary sanctions so that after 18 months mandatory sanctions would begin with 2:1 offsets for new stationary sources for the first six months followed by withholding federal transportation funds. Failure to submit or implement a SIP can have significant consequences for transportation plans under the transportation conformity requirements.

2.3 The Phase II Rate of Progress Plan

A March 2, 1995 Memorandum, entitled "Ozone Attainment Demonstrations" from EPA Assistant Administrator Mary D. Nichols to the EPA Regional Administrators sets forth guidance for an alternative approach to submitting these requirements to provide States flexibility in their planning efforts. The memorandum established a two-phased approach to development of the Post-1996 Rate-of-Progress Plan and the Attainment Demonstration. The SIP for the first phase was submitted to EPA on December 1997. The submittal consisted of a plan to fulfill the Rate of Progress requirement for 1999 and photochemical modeling completed to date. The Phase II SIP revision fulfills Rate-of-Progress requirements for 1999, 2002 and 2005 for Cecil County Nonattainment Area.

Unlike the emissions reductions required in the *15 Percent Rate-of-Progress Plan,* Section 182(c)(2) of the Act allows states to use NOx emission reductions to meet the 9 percent rate-of-progress requirement as well as VOC reductions. NOx emissions reductions can be substituted for VOC reductions provided they meet the criteria outlined in "EPA's NOx Substitution Guidance". Emission reductions of NOx may be substituted for required VOC reductions under the following criteria. The nonattainment area must show that NOx reductions are necessary to reach attainment. Emission reductions of NOx can be substituted for required VOC reductions at a ratio equal to the ratio of NOx to VOC emissions in the baseline inventory. This revision does not use any combination of VOC and NOx emission reductions to meet the 2005 Rate-of-Progress reduction requirements, as there were enough available VOC reductions to meet the VOC target level.

3.0 1990 BASE YEAR INVENTORY

3.1 BACKGROUND AND REQUIREMENTS

The Act requires states to compile an emissions inventory to use as the foundation for planning strategies necessary to attain the NAAQSs. The Act requires this base year inventory for all classes of nonattainment areas (42 U.S.C.A. Section 7511(a)(1)), and EPA requires a state-wide inventory for those states that are part of the Northeast OTR. The base year inventory is also the foundation for other required inventories that this chapter explains in greater detail:

- The adjusted base year inventory;
- The periodic inventory;
- The Reasonable Further Progress (RFP) inventory; and
- The projection inventory.

The 1990 Base Year Inventory was required as part of the November 15, 1992 SIP submittals. The complete inventory documentation is available for review and is entitled *1990 Base Year Inventory for Precursors of Ozone, Volatile Organic Compounds (VOC), Carbon Monoxide (CO), Nitrogen Oxides (NO_x) for the State of Maryland, Volumes 1-6, September 30, 1993* (MDE, 1993a). As methodologies for estimating emissions have improved, the inventory estimates have been modified to incorporate these new methodologies. The latest modification is revising the 1990 and 2005 mobile source emission estimates using the MOBILE6 emission factor model as documented in *Modification to the Phase II Attainment Plan for the Baltimore and Cecil County Nonattainment Areas: Revising the Mobile Source Emission Budgets Using MOBILE6 (May 2003).*

This chapter summarizes the approach used to develop the base year inventory for ozone precursors during the ozone season, and presents inventory results for each pollutant. The base year inventory is an inventory of actual emissions for calendar year 1990. It includes the ozone precursor pollutants: volatile organic compounds (VOCs) and oxides of nitrogen (NO_x). Emissions estimates are for a typical peak ozone season weekday. The peak ozone season for Cecil County is June, July and August.

3.2 SOURCE SECTORS

Emission sources are divided into five sectors:

- Point sources: industrial and commercial sources with sufficient emissions to quantify on an individual basis;

- Area sources: smaller industrial, commercial, and business sources whose emissions are too low to quantify individually but collectively contribute a significant amount of emissions;

- Onroad mobile sources: traditional highway vehicles, such as cars and trucks;

- Nonroad mobile sources: sources powered by internal combustion engines that are not traditionally used for highway transportation, such as lawn mowers, airplanes, boats and construction equipment; and

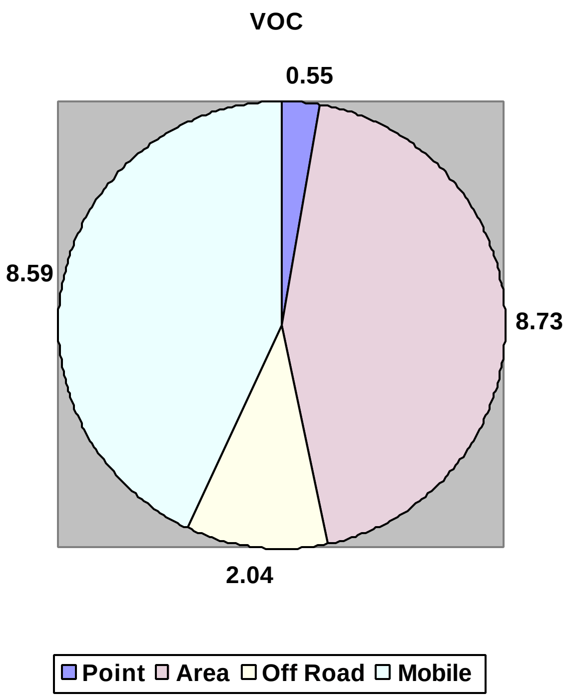
- Biogenic sources: natural emissions sources of VOCs, such as trees, grasses, and crops.

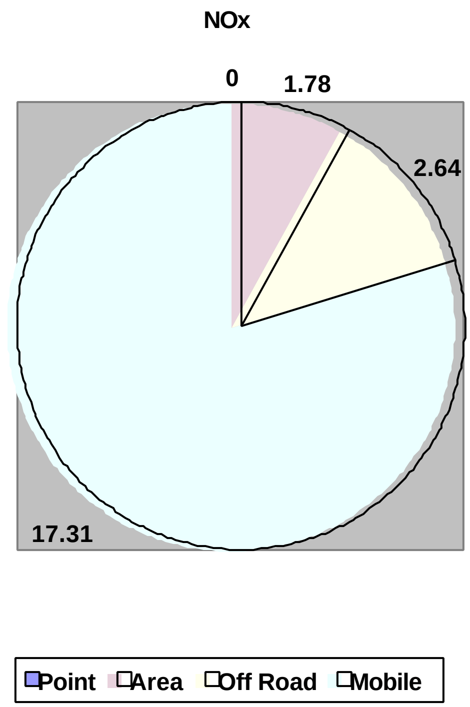
Table 3.1 presents the base year inventory by source type. Figure 3.1 displays that information for VOC and NOx emissions in Cecil County in graphical format.

Table 3.1: 1990 Base Year Ozone Precursor Emissions Inventory Emissions Summary By Source Type

Nonattainment Area	**Tons Per Day**	
Source Type	**VOC**	**NOx**
Cecil County Nonattainment Area		
Point Sources	**0.55**	**0.00**
Area Sources	**8.73**	**1.78**
Nonroad Sources	**2.04**	**2.64**
Mobile Sources	**8.59**	**17.31**
Subtotal:	**19.91**	**21.73**

Figure 3.1: 1990 Base Year Emissions Inventory (Tons/Day) Cecil County Nonattainment Area


VOC
0.55
8.73
2.04
8.59
Point
Area
Off Road
Mobile


NOx
0
1.78
2.64
17.31
Point
Area
Off Road
Mobile

3.2.1 POINT SOURCES

A point source in the base year inventory for Cecil County is defined as a stationary source of emissions that emits annually at least 25 tons of VOCs, 100 tons of CO or 25 tons of NOx.

Emissions for point sources are estimated using the following types of methodologies:

- EPA-supplied emission factors;
- Material balance emissions calculations;
- Source-based test data calculations; or
- Agency- or company-generated emission factors

EPA guidance requires that the Department adjust the inventory to take into consideration equipment failures and the inability of control programs to achieve 100% effectiveness at all times. This analysis, referred to as rule effectiveness (RE), means that when Department staff conduct RE studies, they take into account various factors including non-compliance with existing rules, control equipment downtime, operating and maintenance problems, and process upsets due to human or other errors. RE may also indicate errors in the projection of emissions estimates as well as the actual emissions themselves. RE adjusts emissions to correct for these failures and uncertainties to provide a more reliable estimate for planning and modeling.

The Department used the 80% default factor in several RE applications, and concentrated on RE improvements for key sources. Although the Department recognizes that the EPA default RE factor of 80% inadequately represents the variation that exists in the effectiveness of different industry process unit/control device combinations, staff limitations have precluded the Department's extensive use of surveys or Stationary Source Compliance Division (SSCD) studies to develop alternatives.

The Department did not apply RE to several source categories. RE was not applied to uncontrolled sources, to sources that have undergone an irreversible process change, nor to sources whose emissions were calculated using direct determinations (material balance), unless a control device was employed. Additionally, the Department did not apply RE to sources where the operation of process equipment without an operational control device is mechanically or electronically prevented. This included some solvent vapor recovery processes and web printing equipment. Although the Department concedes that these electronic lockouts can fail or be disabled, the former is rare and the latter is a criminal offense.

The Department has not collected extensive data on the temporal distribution of emissions. Typically, companies are required to quantify annual emissions by calendar quarter. For purposes of modeling, however, the Department obtained daily NO_x emissions for specific ozone episodes. More specific information will be collected under the Certified Emissions Statement regulation, Code of Maryland Regulations 26.11.01.05-1 (COMAR, 1993).

The Department calculated peak ozone season emissions by the following method:

1) The Department converted annual emissions in pounds per year into pounds per day emissions by dividing the annual emissions by the number of operating days in the year.

2) The pounds per day emissions were then multiplied by a seasonality factor. The seasonality factor was based on the quarterly percentage of operations (estimated by the company) for June, July, and August. The factor was calculated by multiplying the second quarter percentage by one third and the third quarter percentage by two thirds. The sum of the two results was then divided by 0.25 to calculate the seasonality factor.

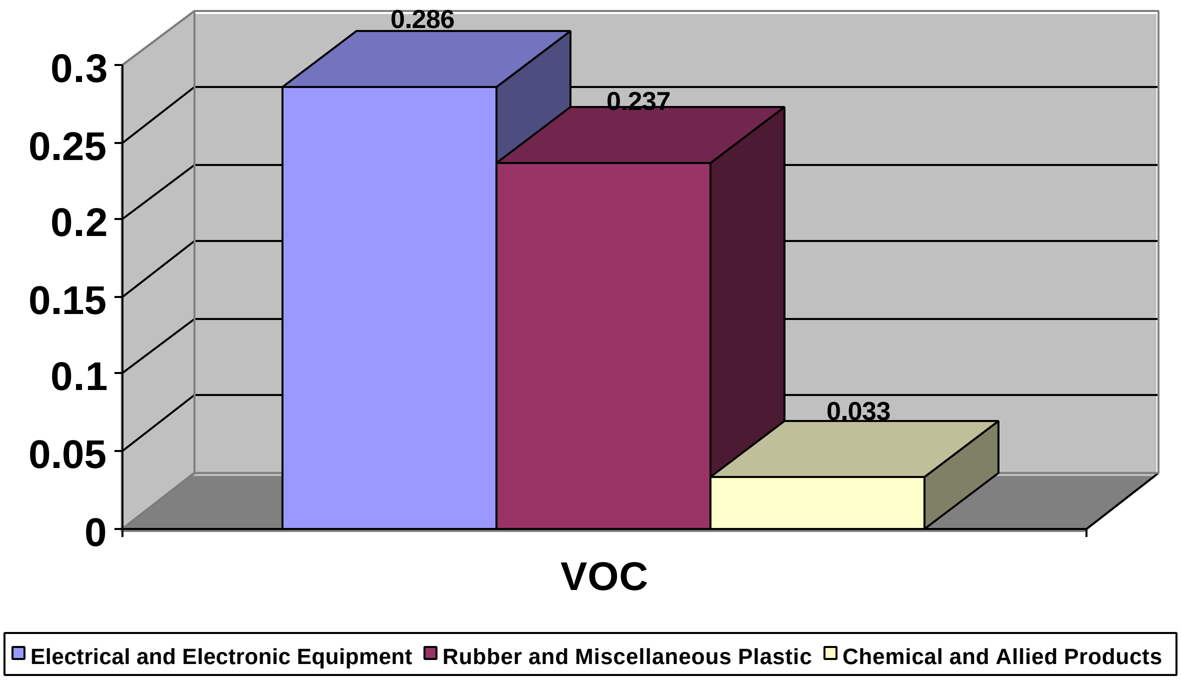
3) The seasonality factor obtained in Step 2 was then multiplied by the pounds per day emissions determined in Step 1 to get the seasonally adjusted emissions.

This methodology conforms to EPA-accepted practices. For a more detailed discussion of the methodology refer to *Volume 1, Section 2: Point Sources and Volumes 3-5: Documentation for Individual Point Sources* of the complete inventory documentation. Table 3.2 displays the VOC emissions for the Cecil County Nonattainment Area, a highly industrialized area of Maryland. Figures 3.2 and 3.3 illustrate, in the form of bar graphs, the comparative emissions levels from the various point sources present in the Cecil County ozone nonattainment area.

Table 3.2: 1990 Base Year Ozone Precursor Emissions Inventory Point Source Emissions Totals By Category In The Cecil County Nonattainment Area

Cecil County	**VOC** tons/day	**NOx** tons/day
Electrical and Electronic Equipment	0.286	0.00
Rubber and Miscellaneous Plastics	0.237	0.00
Chemical and Allied Products	0.033	0.00
Total	0.5545	0.00

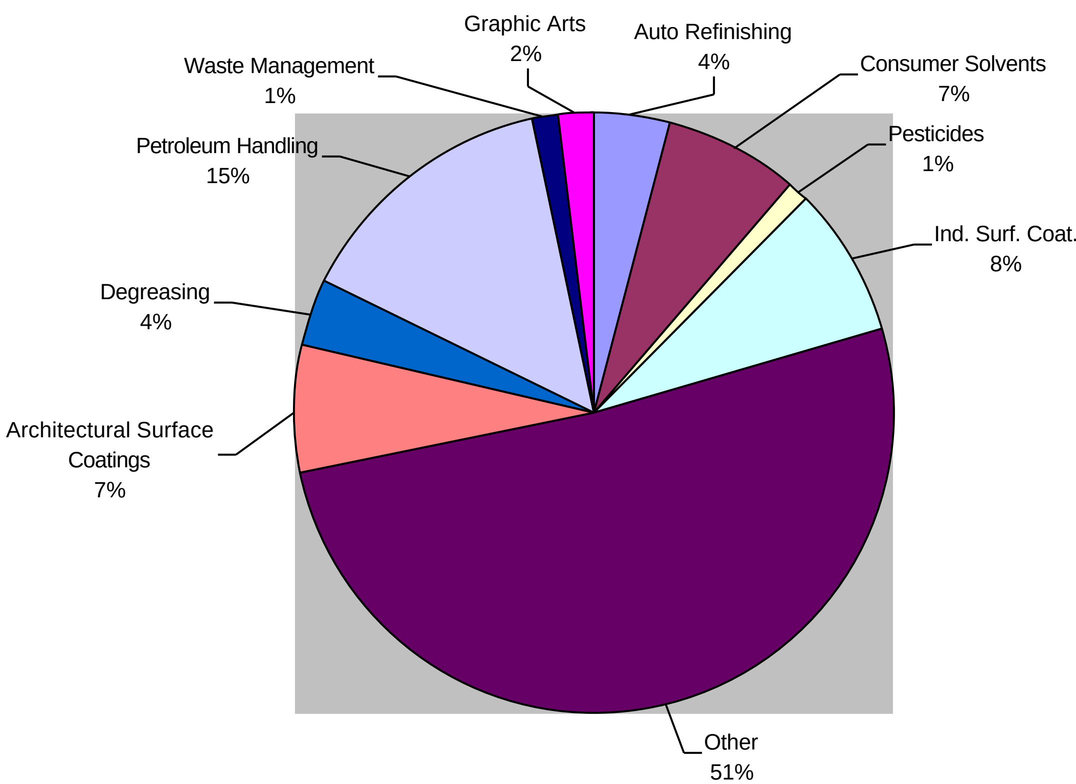
Figure 3.2: 1990 Base Year Ozone Precursor Emission Inventory Cecil County Nonattainment Area VOC Point Source Emission Distribution By Category



3.2.2 AREA SOURCES

The area source component of the emissions inventory is an estimate of the emissions of sources too numerous to quantify them on an individual basis. The amount of emissions from each individual source is small, but collectively emissions from these sources represent a sizable portion of the inventory. In some cases, an area source category may represent the emissions from a specific activity associated with source. For example, gasoline distribution is broken into tank breathing and refueling emissions. Both categories represent emissions from service stations. Gasoline distribution also includes emissions from tank trucks in transit, another area source category, and bulk terminals, which are included in the point source inventory. Figure 3.4 displays the VOC emissions for the Cecil County nonattainment area.

Figure 3.3: 1990 Base Year Ozone Precursor Emission Inventory Cecil County - Area Source Emission Distribution By Category (Tons per Day)



The Department developed area source emissions estimates by multiplying an EPA-published emission factor by the activity indicator for each source category. Since source activity can vary throughout the year (for example, pesticides are applied more during the summer) seasonal adjustment factors developed by the EPA are also used to compile the inventory. In addition, as per EPA guidance, a rule effectiveness factor of 80% is assumed where applicable.

Another important consideration in developing an area source inventory is variations in the level of activity throughout the week. For example, automobile-refinishing establishments may typically operate only five days per week while vehicles are refueled seven days per week.

The Department used one of four emission factor-based estimation approaches to calculate area source emissions:

- Per-capita emission factors;
- Commodity consumption-related emission factors;
- Level-of-activity-based emission factors; and
- Employment-related emission factors.

Most of the emission estimates are calculated using procedures described in the EPA guidance document entitled *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone, Volume I: General Guidance for Stationary Sources*.

The Department obtained activity and commodity level data from publications containing census and economic data, and from letter communications with individual companies and government agencies. Emission factors are from *Procedures, May 1991 and Compilation of Air Pollutant Emission Factors, Fourth Edition, Volume I: Stationary Point and Area Sources, AP-42.*

For certain categories, the Department subtracted ozone precursor emissions included in the point source inventory from the area source totals to avoid double counting. These categories include auto refinishing, industrial coating operations, and printing.

For a further discussion of the methodology used to calculate the area source emission inventory refer to *Volume 1, Section 3: Area Sources, and Volume 6: Area Source Supporting Documentation* of the complete inventory documentation.

3.2.3 ONROAD MOBILE SOURCES

The latest version of EPA's mobile emission factor model, MOBILE6, is a major revision based on new test and field data and accounts for changes in vehicle technology. The model also provides the capability to analyze the benefits of a number of new regulations. In addition, the model includes an improved understanding of in-use emission levels and the factors that influence them, resulting in the need for significantly more detailed input data.

As compared to MOBILE5b, the model previously used to estimate mobile emissions, MOBILE6 has a significant impact on the emission factors, benefits of available control strategies, effects of new regulations and corrections to basic emission rates.

Consequently, the emission rates are different and it is difficult to compare the results directly to previous runs conducted with MOBILE5b. For this reason, 1990 emission totals are reanalyzed using MOBILE6 and its features to process data collected earlier in the development of the emission estimates for previous SIPs.

<u>Cecil County</u>

Cecil County also utilizes a cooperative process to develop mobile source emission estimates and projections that are used in formulating mobile source emission budgets. The following agencies are involved in the process: the Maryland Department of the Environment, the Maryland Department of Transportation and the Wilmington Area Planning Council (WILMAPCO).

The Wilmington Area Planning Council (WILMAPCO) is the Metropolitan Planning Organization (MPO) for both Cecil County, Maryland and New Castle County, Delaware. Both of these counties are technically part of the Philadelphia severe Ozone Nonattainment Area that also includes parts of Pennsylvania and New Jersey under the MPO leadership of the Delaware Valley Regional Planning Commission (DVRPC). Due to the size of the nonattainment area, and the multi-state implications, a sub-regional mobile emissions budget process has been adopted. In other words, separate mobile budgets are established for both Cecil County and New Castle County by their respective state air agencies for use in the WILMAPCO transportation planning process. Sub-regional budgets are developed for Pennsylvania and New Jersey for the DVRPC activities.

The mobile source emission budgets for Cecil County are prepared in conjunction with the Maryland Department of Transportation. The projected traffic volumes developed for Cecil County are based on the Upper Eastern Shore MINUTP transportation-planning model. This model, developed by the Maryland State Highway Administration uses data from Cecil, Kent and Queen Anne's Counties in Maryland and New Castle County in Delaware to estimate traffic information.

The MINUTP model develops traffic volumes through a four-step process. Following a review of the model inputs, the outputs are input into a d-base program to produce network and trip ends data for use in the MOBILE 6 model. Emission factors are then developed using MOBILE 6. The emission factors developed include the following federal control programs: Federal Motor Vehicle Control Program (FMVCP) including Tier 1 and 2 vehicle standards, reformulated gasoline (RFG) Phase I and II, enhanced I/M, National Low Emissions Vehicle Program (NLEV), and heavy duty diesel engine 2 gram standard (HDDE2g) and were based on 2002 vehicle fleet characteristics.

The actual emission factor estimation method and post-processing method for Cecil County follows closely the process identified above for Baltimore. After the preparation of Mobile6 based transportation files, the model is run and all 28-vehicle classes are represented.

Land use inputs to the modeling process were provided by WILMAPCO. These land use inputs are 2002 based (with assistance from the 2000 Federal Census) and are synchronized with the land use assumptions used by WILMAPCO in their short term and long term transportation planning process.

3.2.4 NONROAD MOBILE SOURCES

Nonroad mobile sources include those vehicles and equipment which are powered by internal combustion engines, but which are not normally operated on public highways. This includes mobile construction and industrial machinery and farm equipment, lawn and garden equipment and recreational boats. Emissions from aircraft and airports, railroads, and sea vessels are also included in this portion of the inventory.

Section 213(a) of the Act mandates that the EPA conduct a study of emissions from nonroad engines and vehicles in order to determine if these emissions cause or significantly contribute to air pollution. The EPA contracted with Energy and Environmental Analysts, Inc. (EEA) to conduct an emissions inventory for 33 severe and serious ozone nonattainment areas. The study covered nine nonroad equipment categories:

- ✍ Lawn and garden equipment;
- ✍ Agricultural or farm equipment;
- ✍ Logging equipment;
- ✍ Industrial equipment;
- ✍ Construction equipment;
- ✍ Light commercial equipment;
- ✍ Airport service equipment;
- ✍ Recreational land vehicles or equipment; and
- ✍ Recreational marine equipment.

Data from the study entitled *Nonroad Engine and Vehicle Emission Study* was provided to the nonattainment areas under study for use in developing the 1990 base year inventory.

The EEA inventory weighted use equally throughout the week. A Baltimore survey of boat owners found that use of personal boats was split 40/60 weekday to weekend use. Maryland adjusted the EEA inventory to account for this and for a 50/50 split of weekday/weekend use of lawnmowers.

The remaining six nonroad categories not covered in the EEA study are railroads, commercial aviation, air taxis, general aviation, military aviation and vessels. Calculations for these categories were performed by the Department using methodologies in *Procedures for Emission Inventory Preparation, Volume IV: Mobile Sources, Revised.*

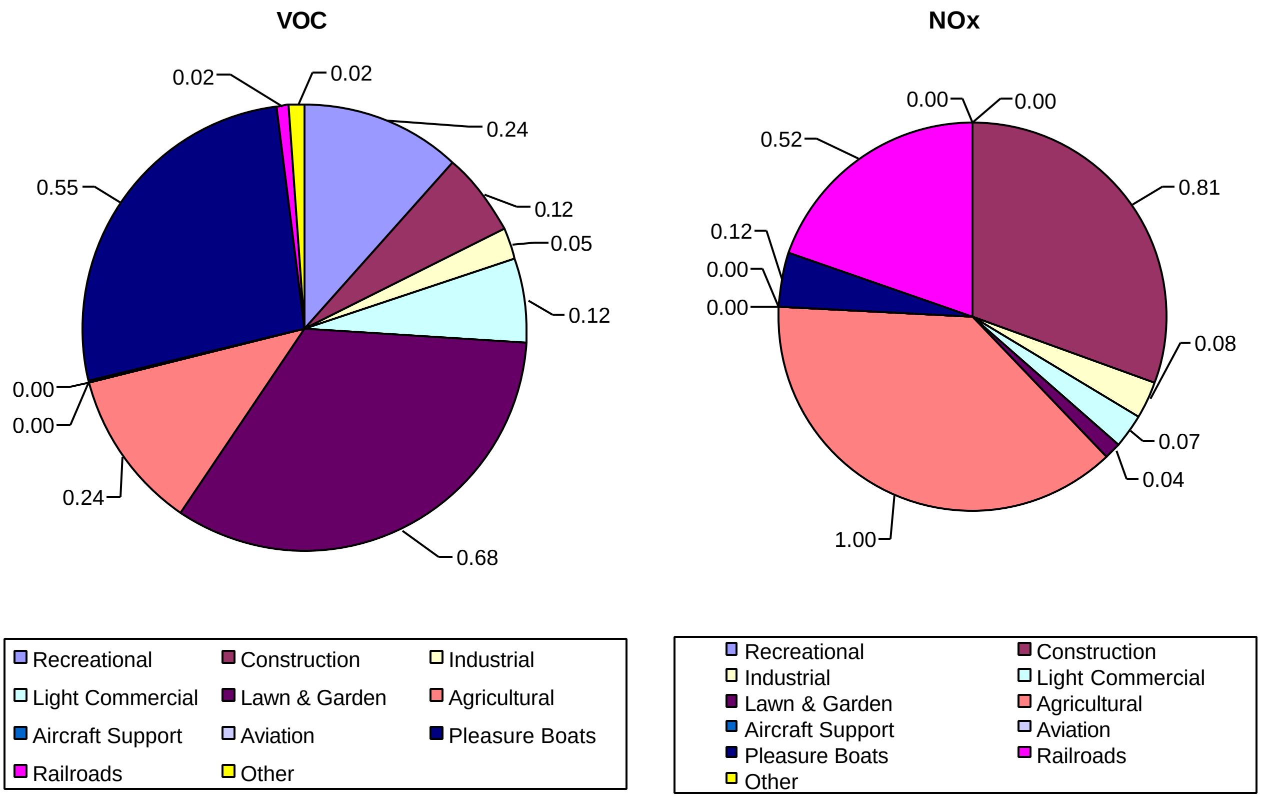
Aircraft, marine vessel and railroad activities were considered constant throughout the year. The data necessary to estimate a seasonal variation in their emissions was not readily available, and their emissions represent a small fraction of both the total inventory and the nonroad inventory.

Table 3.3: Nonroad Source Emissions In Cecil County

Nonroad Source Category	VOC Emissions (tons per day)	NOx Emissions (tons per day)
Lawn & Garden Equipment	0.68	0.04
Aircraft Services	0.00	0.00
Off-Road Vehicles	0.24	0.00
Recreational Boating	0.55	0.12
Construction	0.12	0.81
Industrial	0.05	0.08

Agricultural	0.24	1.00
Light Commercial	0.12	0.07
Logging	0.02	0.00
Other	0.02	0.52
Total	2.04	2.64

Figure 3.4: 1990 Base Year Ozone Precursor Emissions Inventory Cecil County Nonroad Source Emissions Distribution by Category



3.2.5 BIOGENIC EMISSIONS

VOCs are emitted from biogenic sources (vegetation). The Department used the EPA *Personal Computer Version of the Biogenic Emissions Inventory System* (PC-BEIS), to calculate emissions from biogenic sources. PC-BEIS calculates VOC emissions in tons per day based on land use, leaf biomass factors (mass of dry leaf related to forest area), emission factors for different chemical species, and meteorological data.

The hourly meteorological data (wind speed, temperature, sky cover and relative humidity) were obtained from the National Weather Service at Baltimore Washington International Airport for July 6, 1988. The Introduction to *User's Guide to the Personal Computer Version of the Biogenic Emissions Inventory System* (PC-BEIS), recommends for a base year inventory to select a day based on the following steps:

- Select top ten days with highest hourly ozone readings over most recent three years of monitoring
- Obtain National Weather Service data for daily maximum temperature on each of the ten days
- Rank temperature maxima from highest to lowest

✍ Select fourth highest based upon maximum daily temperature

✍ Use hourly meteorological data as above for this day as input to PC-BEIS

Using these criteria the Department selected July 6, 1988.

Land use data are from the Oak Ridge National Laboratory's GEOECOLOGY database. It is aggregated into 25 land use types. The forest types are designated as primarily oak, other deciduous and mostly coniferous to match published emission factors in Lamb et al.[2]

Table 3.4 summarizes the biogenic emissions for the state by county. Subtotals for the nonattainment areas are included.

Table 3.4: Emissions from Biogenic Sources by County

County	VOC (tpd)
Allegany	47.77
Anne Arundel	29.27
Baltimore	43.35
Calvert	22.01
Caroline	29.47
Carroll	38.91
Cecil	32.96
Charles	44.37
Dorchester	50.43
Frederick	57.95
Garrett	64.01
Harford	43.94
Howard	21.25
Kent	33.83
Montgomery	38.35
Prince George's	43.15
Queen Anne's	36.88
Saint Mary's	35.69
Somerset	23.83
Talbot	16.54
Washington	43.16
Wicomico	36.25
Worcester	43.94
Baltimore City	3.37
Baltimore Area	180.09
Washington Area (MD)	205.83
Kent/Queen Anne's	70.71

2 Lamb, B., A. Guenther, D. Gay, and H. Westburg (1987): A national inventory of biogenic hydrocarbon emissions. *Atmospheric Environment*, **21**, pp. 1695-1705.

Unclassified Counties	391.09

4.0 THE PROJECTED EMISSIONS INVENTORIES

The Act requires all ozone nonattainment areas classified as moderate and above to achieve a 15 percent reduction in actual VOC emissions by 1996. Also, the Act requires that emissions be reduced by 3 percent every year until 2005. The reduction must be calculated from the anthropogenic VOC and NOx emission levels reported in the state's 1990 base year inventory after those levels have been adjusted for pre-1990 controls. The 1990 base year inventory is reported in Section 3. This section presents the projection year inventories, the state's estimation of the level of VOC and NOx emissions to be expected if no further action is taken to control VOC or NOx emissions.

The VOC and NOx projected year emissions inventories were derived by applying the appropriate growth factors to the 1990 base year emissions inventories. The EPA guidance describes four typical indicators of growth. In order of priority, these are:

- ✍ Product output,
- ✍ Value added,
- ✍ Earnings, and
- ✍ Employment

The population, households, and employment factors were based on Round 5 forecasts. For point and area, the Bureau of Economic Analysis (BEA) factors were used to project growth except for utilities and nonroad mobile sources. For these categories, the Economic Growth Analysis System (EGAS) was used as recommended by the EPA.

The results from using earnings data to project the point, area and nonroad sources using BEA and EGAS factors are presented. Mobile source growth is based on the computer modeling of travel demand for the Baltimore nonattainment area. Separate documentation of the travel demand modeling from the Baltimore Metropolitan Council transportation staff. A brief discussion of the indicators and a detailed description of the BEA and EGAS methodology is provided in this section.

4.1 GROWTH FACTOR METHODOLOGY – BEA EARNINGS METHODOLOGY

4.1.1 DESCRIPTION OF DATA SOURCE

Growth rates for most point and area source categories in this study are derived from projection of industrial earnings made by the U.S. Department of Commerce, Bureau of Economic analysis (BEA, 1990). Using BEA industrial earnings to project emissions is consistent with EPA guidance on preparing emission projections. BEA projects State-specific industrial earnings for 57 industrial groups for the following years: 1995, 2000, 2005, 2010, and 2040. These 57 industrial groups can, for the most part, be matched with 2-digit Standard Industrial Classification (SIC) codes. Some new pseudo-SIC codes were assigned in the (99x) range for composite categories or categories not covered in the SIC system, such as population and vehicle miles traveled (VMT).

4.1.2 GROWTH PROJECTION METHODOLOGY

Growth rates for area source and VOC point sources came from the BEA earnings data. The methodology for developing NOx point source, and nonroad mobile source growth is presented separately in this section, along with justification for the distinct methodologies used. The methodology for calculating VMT growth rates is also presented separately, later in this section. BEA supplies historical data for 1973, 1979, 1983, and 1988 for each category for which it makes projections.

The first step in developing growth rates based on BEA factors is to estimate earnings in the base year (1990) and the projection years for which earnings data do not exist (1996, 1999, 2007). This is done by assuming straight-line growth between the two closest years for which data exists. For example, 1990 earnings were estimated using the following formula:

$$EARN_{90}=EARN_{88}+[2/7*(EARN_{95}-EARN_{88})]$$

where:

$EARN_{XX}$ = BEA earnings estimate in year xx

After using this process to estimate data for the base year and all projection years, average annual growth rates were calculated between the base year and each projection year:

$$AAGR_{BYPY} = [(EARN_{PY}- EARN_{BY}) * (PY-BY)]*100$$

where:

$AAGR_{BYPY}$ = average annual growth rate from the base year to the projection year (percent)
$EARN_{PY}$ = earnings in the projection year
$EARN_{BY}$ = earnings in the base year

4.1.3 OFFSET PROVISIONS

The Act requires that emission growth from major stationary sources in nonattainment areas be offset by reductions that would not otherwise be achieved by other mandated controls. The offset requirement applies to all new major stationary sources and existing major stationary sources that have undergone major modifications. Increases in emissions from existing sources resulting from increases in capacity utilization are not subject to the offset requirement. For the purposes of the offset requirement in severe ozone nonattainment areas such as the Baltimore nonattainment area or Cecil County, major stationary sources include all stationary sources exceeding 25 tons per year of VOC and NOx emissions, and 100 tons per year of CO emissions.

4.2 GROWTH FACTOR METHODOLOGY - EGAS GROWTH FACTORS

EGAS is composed of three tiers: a national economic tier, a regional economic tier, and a growth factor tier. Each of these tiers will be discussed briefly.

Tier 1: The National Economic Tier

The national economic tier includes a Regional Economic Modeling Institute (REMI) model of the United States which includes a baseline forecast calibrated to the one released by the Bureau of Labor Statistics (BLS). Although the BLS forecast is updated every two years, REMI updates the forecast using data released annually by BEA. In addition, the EGAS national economic tier contains the option to use economic forecasts from Wharton Economic Forecasting Association (WEFA). WEFA forecasts national economic activity under low growth, base case high growth, and cyclical growth scenarios.

The function of the national tier in EGAS is two-fold. First, the inclusion of a national forecasting capability allows EPA to forecast urban and regional economic growth using a common assumption about national economic growth. Second, it provides users with the ability to use the most current national economic forecasts and to simulate the effects of different levels of national growth on emission-producing activity in nonattainment areas.

Tier 2: The Regional Economic Tier

The regional economic tier includes separate economic models for each of the nonattainment areas and attainment portions of the States. The largest geographic area covered by an economic model is a State.

The regional economic models included in EGAS were built by REMI. The models simulate interaction between the 14 major sectors of an economy and produce estimates of employment and value added for 210 sectors. The 210-sector outputs are identified by BLS industrial codes. The BLS codes are closely related to three-digit SIC codes. Outputs from the regional models are used as input data for the growth factor tier.

The REMI models are designed to forecast future activity in an area and to simulate the effects of a policy change in an area. The models come with a capability for the user to simulate the effects of changes in almost 400 economic policy variables and over 70 demographic variables. The list of policy variables included with EGAS was reduced to 84 variables. Two criteria were used for choosing which policy would be included in the system: whether the policy variable relates to the implementation of the Act and whether the variable is one which local personnel using EGAS would be knowledgeable of, particularly changes of proposed changes. For example, industrial capital costs were included as a variable because that variable satisfies the first criterion. This variable will allow users to simulate the effects of control costs associated with the Act. Policy variables that satisfy the second criterion include local tax rates and State and local government spending. Policy variables that do not satisfy either criterion, and therefore are not in EGAS, include demographic variables such as birth and survival rates, and economic variables such as demand for goods not affected by the Act.

The REMI models and outputs contribute to the development of credible growth factors for future-year inventories in the following ways:

- ✍ Forecasts of activity from emission-producing sources were to be developed for both the attainment and nonattainment portions of States, allowing growth rates to differ between rural and urban portions of a State.

- ✍ Outputs form the models are used to produce area-level estimates of fuel consumption and physical output.

- ✍ The effects of a nonattainment area policy on the surrounding areas can be assessed.

- ✍ Information on local policies can be entered directly into the REMI models. This ability allows users to include the effects of local policies when developing forecasts.

REMI outputs and the growth factor tier are linked in the following specific ways:

- ✍ REMI models provide income forecasts for estimating residential fuel consumption.

- ✍ REMI models provide population and personal income forecasts for estimating commercial energy consumption.

- ✍ REMI models provide the forecasts of the relative costs of capital, labor, and materials for estimating industrial fuel consumption.

- ✍ REMI models provide industry-specific employment and value added forecasts for estimating physical output.

Tier 3: The Growth Factor Tier

The third tier of EGAS is the largest portion of the system. Housed within the third tier are commercial, residential, industrial, and utility energy models; a physical output module; and a Crosswalk. Each of these modules will be discussed.

Utility Energy Models

The energy models in the system were developed by Argonne National Laboratories (ANL) and are currently being used for the National Acid Precipitation Assessment Program (NAPAP). The residential energy model, the Household Model of Energy (HOMES), was modified for use in the NAPAP model set in the mid-1980s. In 1989-1990, ANL updated HOMES to include the capability to model residential fuel consumption at the State, rather than Census, level. For use in EGAS, two changes were made to HOMES. First, the base year of the model projections was updated to 1990 using data from the State Energy Data

Report (SEDS). Additionally, the capability to estimate growth in residential fuel consumption at the sub-State level was developed. REMI forecasts of population data for nonattainment areas and attainment portions of States are input with State-level fuel price forecasts to develop estimates for residential fuel consumption growth for seven fuels for each of the nonattainment areas and attainment portions of States in EGAS.

Commercial Energy Model

The Commercial Sector Energy Model (CSEMS), was also developed for use in the NAPAP model set in the mid-1980s and updated in 1989-1990 to estimate commercial fuel consumption at the State level. Like HOMES, the model was modified for use in EGAS to estimate commercial energy consumption growth for six fuels for nonattainment areas and surrounding attainment portions of States. The base year for the model projections was updated to 1990 using data form SEDS. Inputs to CSEMS include State-level fuel price forecasts and REMI forecasts of population and personal income at the sub-State level.

Industrial Energy Model

The Industrial Regional Activity and Energy Demand Model (INRAD), was developed to predict how energy use will be influenced by energy prices and the general level of economic activity. INRAD was developed to model energy consumption of fossil fuels and electricity for seven energy-intensive industries and an eighth "other" category with aggregates the non-energy-intensive industries. Two modifications to INRAD were made for use in EGAS. first, additional industrial categories were modeled. Second, INRAD was modified to estimate fossil fuel consumption by fuel type. With the modifications, INRAD can estimate coal, oil, gas, and electricity consumption for the following sectors: food, textiles, upstream paper products, down stream paper products, upstream chemicals, downstream chemicals, glass, glass products, and metals. Inputs to INRAD include State-level forecasts of fuel prices and REMI forecasts of the relative costs of capital, labor, and materials at the sub-State level.

Physical Output Module

The physical output module estimates physical output form value added data generated by the REMI models. Industrial VOC sources were ranked by their contributions to industrial VOC emissions and equations were developed for the largest VOC sources. These equations relate changes in physical output by three-digit SIC categories (as identified by BLS code) with changes in value added and a time trend to capture technological change. These equations provide better estimates of VOC-producing activity than value added alone because they estimate change in actual material output, which is related to the use of VOC producing materials, such as surface coatings and degreasers. For industrial VOC categories for which equations were not developed, activity levels are forecast using value added forecasts form the REMI models.

Electricity Generation Model

Electricity generation by electric utilities is forecast by the Neural Network Electric Utility Model

(NUMOD). NUMOD is a behavioral model that uses three embedded neural networks to calculate annual generation activity indices and annual generation resulting from combustion of coal, oil, and natural gas in each of the 48 contiguous states. Although NUMOD forecasts state aggregate generation, it assumes that states are grouped into power pools. It also assumes that generation needed to meet demand in any state may be partially located in other states in the power pool. In contrast to traditional electric utility models, NUMOD used artificial intelligence to learn to relate the amount of electricity generated from data describing generation capacity, climate, peak loads, fuel prices, and power pool effects. The model operates by reading input records, each of which describes one state for one year. Each record is independent of every other record, allowing NUMOD to run any number of scenarios during a single model run.

The Crosswalk

The Crosswalk is the final component of the EGAS system. The Crosswalk translated growth factors from the energy and physical output modules into growth by SCC. The growth factors from the industrial energy and physical output modules are desegregated to the two-, three-, and sometimes four-digit SIC level, while growth factors from the electric utility model can be desegregated to the plant or county level by type of fuel consumption. The commercial and residential sector energy models desegregate consumption by fuel type only. The Crosswalk was developed by individually matching each of the approximately 7000 SCCs with the appropriate growth factor from the modules. This allows different growth factors to be applied to different emission sources form the same industrial category. For example, forecasts of fuel consumption in upstream chemical manufacturing are developed by INRAD, while forecasts of physical output of upstream chemical products are developed in the physical output module. This methodology takes into account that future emissions associated with a SIC code will vary by type of emission. This is consistent with the SCC system of clarification that differentiates according to not only industrial category, but also to processes within that category.

4.2.1 NOx POINT SOURCE GROWTH

EGAS will be used to project the AIRS point source inventories that are housed in the AIRS Facility Subsystem (AIRS/FS). These projected inventories will be used in photochemical grid modeling and RFP inventories. Because the AIRS/FS inventories will be projected on a source-specific basis, the user will be able to choose each growth factor. For example, if a user has information from permits or plant surveys about the expected growth of a point source, the user may use that information to predict future growth of that source within EGAS. The ability of the user to override default growth factors may be most important for electric utilities, which are permitted sources and are major emitters of oxides of nitrogen. EGAS produces default growth factors for commercial and industrial energy consumption, fuel consumption by electric utilities, and physical output by Bureau of Labor Statistics code, which represent groups of three- and four-digit SICs. These growth factors are then translated, via the EGAS CROSSWALK, into default growth factors by SCC. Because there is no direct linkage between EGAS and AIRS, users may alter the EGAS growth factor based on information that they have on specific emission sources.

EGAS uses the following information for projecting point source growth:

- ✍ Value added estimates for 210 non-farm industrial categories;
- ✍ Physical output estimates for 210 some major VOC-emitting sources; and
- ✍ Estimates of fuel consumption by type of fuel for the commercial, industrial, and electric utility sectors.

4.2.2 NONROAD GROWTH

Until the EPA develops it computer model for determining nonroad emissions, EGAS growth factors will also be used to determine future emissions from these sources.

The full text of the EPA guidance on projection of emissions from nonroad sources may be found in an EPA memo entitled "Guidance on Projection of Nonroad Inventories to Future Years", dated February 4, 1994. This guidance builds on a previously released report and subsequent development of nonroad inventories for use in 33 ozone and/or carbon monoxide nonattainment areas. These inventories were estimated as a product of equipment population, activity rates and emission factors.

EPA guidance recommends that states use one of the following five alternative methodologies to project nonroad inventories:

1. Project the original or state-modified (A+B)/2 inventory for 1990 to future years by projecting the indicator variables used to estimate the population and activity level of each engine-equipment type within the current A inventory.

2. Develop surrogates for the indicator variable(s) used to develop equipment population estimates for inventory A and use projections of the surrogate variables to project the indicator variables required under the first approach.

3. Project the 1990 inventory by multiplying 1990 emissions by the ratio of future to 1990 human population within the same nonattainment area.

4. Projecting emissions by multiplying 1990 emissions by the growth factors developed for EGAS

5. Project the 1990 inventory by using other projected data on equipment populations and activity levels specific to the nonattainment area in question in conjunction with EPA-provided in-use emission factors.

The Department has chosen option number four to project growth in emissions from nonroad sources.

Within EGAS, the surrogate indicators for nonroad sources are value added or population as identified in the table below.

Table 4.1: EGAS Surrogate Indicators for Projecting Growth in Nonroad Sources

Source Category	Relevant EGAS Growth Factors
Agricultural Equipment	Value Added: Farm
Aircraft	Value Added: Air Transportation
Airport Service Equipment	Value Added: Air Transportation
Commercial Marine	Value Added: Water Transportation
Construction Equipment	Value Added: Construction
Industrial Equipment	Value Added: Durable & Nondurable Mfg.
Lawn & Garden Equipment	Population
Light Commercial Equipment	Value Added: Retail, Wholesale, Services
Logging Equipment	Value Added: Logging
Military Vessels	Total Government
Railroads	Value Added: Railroad Transportation
Recreational Equipment	Population
Recreational Marine	Population

While these indicators appear to be the most appropriate considering the general application of EGAS, other area-specific factors may influence growth in these nonroad categories. For example, water surface area constraints may affect growth in marine vessel use, and population density and climatic conditions may affect emissions from lawn and garden equipment.

4.3 GROWTH FACTOR METHODOLOGY – MOBILE SOURCE GROWTH

Available data allows the onroad mobile source 1990 base year inventory to be projected to the attainment year of 2005 by transportation modeling techniques. The transportation model is run using the current vehicle fleet on the 2005 planned highway network. Appropriate population, household and employment growth are input through forecasting techniques. After projection of the uncontrolled emissions, pre-1990 CAAA controls are added and the emissions with this level of control becomes the projected mobile inventory.

4.4 ASSUMPTIONS MADE IN CALCULATING GROWTH

The following section will summarize the basic assumptions applied in the construction of the projected emissions inventory. The issues involved include the use of actual versus allowable emissions in deriving the milestone emissions for each source category, and rule effectiveness and rule penetration assumptions.

4.4.1 USE OF BEA METHODOLOGY VS. USE OF EGAS METHODOLOGY

In projecting emission estimates the Department used the two methodologies described above, BEA and EGAS growth factors. The selection between these two methodologies was done based upon guidance from the EPA and through the analysis of both factors to each source category.

The EPA recommends the use of EGAS growth factors for the projection of nonroad emissions and NOx emissions from point sources.   In addition, the Department analyzed these methodologies for NOx point sources. An analysis was developed for the projected estimates between EGAS and BEA growth factors. For example, EGAS uses a fossil fuel model, which the Department feels projects realistically the use of fossil fuels for the Baltimore nonattainment area. This is important since fossil fuel-use by sources, such as utilities, are the major components of the point source emissions for NOx.

As recommended by the EPA, BEA growth factors were used for area sources and point source emissions of VOC. An analysis was also developed for these source categories using both methodologies. For the area source category, commercial and consumer products and new motor vehicle refinishing were projected by EGAS to decrease over the next ten years due to a population decrease in the Baltimore nonattainment area. This contradicts industry projections and the expectations of the Department.

In using the EGAS system, specific settings were chosen to run the model. The first setting was in the national tier, where the Department chose the BLS model over the WEFA model. Time constraints did not allow for a through comparison of the two models. In the regional tier, no policy changes were enacted, and the default settings for the Maryland Region were used. This was again due to time constraints and may be studied in the future.

4.4.2 ACTUAL VS. ALLOWABLE EMISSIONS IN THE CONSTRUCTION OF THE PROJECTED EMISSIONS INVENTORY

For the purposes of calculating 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 currently subject to a regulation and the state does not anticipate subjecting the source to additional regulation, emissions projections should be based on actual emissions levels. Actual emissions levels should also used to project for sources or source categories that are currently unregulated. For sources that are expected to be subject to additional regulation, projections should be based on new allowable emissions.

To simplify comparisons between the base year and the projected year, EPA guidance states that comparison should be made only between like emissions: actual to actual, or allowable to allowable, not actual to allowable. At this time, the Department does not have data to calculate allowable emissions for all sources that will be controlled in the future. Therefore, all base year and all projection year emissions estimates are based on actual emissions.

Formally, the distinction between "actual emissions" and "allowable emissions" is drawn under Title 26.11.01.01 of Maryland air quality regulations (COMAR, 1993). The term "actual emissions" means the average rate, in tons per year, at which a source discharged a pollutant during a 2-year period which preceded the date or other specified date, and which is representative of normal source operation. Actual emissions are calculated using the sources operating hours, production rates, and types of material processed, stored, or burned during the selected time period.

"Allowable emissions" are defined as "the maximum emissions a source or installation is capable of discharging after consideration of any physical, operations, or emissions limitations required by Maryland regulations or by federally enforceable conditions which restrict operations and which are included in an applicable air quality permit to construct or permit to operate, secretarial order, plan for compliance, consent agreement, court order, or applicable federal requirement".

4.4.3 EFFECT OF RULE EFFECTIVENESS

For the purposes of constructing the 1990 base year inventory, rule effectiveness was calculated using the EPA 80% default factor except for gasoline marketing where a Stationary Source Compliance Division study was done. Rule effectiveness was applied to the projected emissions reductions where appropriate using both the 80% default factor and state-specific factors where available.

4.5 PROJECTION INVENTORY RESULTS

The VOC and NOx projection year emission inventory results are summarized by component of the inventory in Table 4.2 for Cecil County. The area and nonroad categories are projected with no controls applied. The 1990-point source emissions as controlled in 1990 were projected to the milestone years. The 1990 mobile source emissions are projected to the milestone years and pre-1990 CAAA controls are applied to produce the projected mobile inventory.

Table 4.2: Projection Year Emission Inventory Results for Cecil County

	VOC Emissions (tpd)					NOx Emissions (tpd)				
Source	**1990**	**1996**	**1999**	**2002**	**2005**	**1990**	**1996**	**1999**	**2002**	**2005**
Mobile	8.59	5.63	5.13	5.55	5.00	17.31	16.72	15.62	16.42	15.57
Point	0.55	0.57	0.59	0.61	0.62	0.00	0.00	0.00	0.00	0.00
Area	8.73	8.91	9.00	9.09	9.17	1.78	1.83	1.91	2.02	2.15
Nonroad	2.04	2.20	2.30	2.39	2.47	2.64	2.76	2.84	2.92	3.02
Total	19.91	17.32	17.02	17.64	17.26	21.73	21.31	20.37	21.36	20.75

Area and Offroad Projections

Category	Indicator	VOC 1990	VOC 1996	VOC 1999	VOC 2002	VOC 2005	NOx 1990	NOx 1996	NOx 1999	NOx 2002	NOx 2005
Service Station Refueling	GAS	0.400	0.428	0.441	0.456	0.470	0.000	0.000	0.000	0.000	0.000
Tank Truck Unloading	GAS	0.820	0.877	0.904	0.934	0.964	0.000	0.000	0.000	0.000	0.000
Tank Breathing	GAS	0.040	0.043	0.044	0.046	0.047	0.000	0.000	0.000	0.000	0.000
Tank Trucks in Transit	GAS	0.010	0.011	0.011	0.011	0.012	0.000	0.000	0.000	0.000	0.000
Aircraft Refueling	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pet. Vessel Unloading	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cold Cleaning Degreasing	EMP	0.320	0.318	0.318	0.317	0.316	0.000	0.000	0.000	0.000	0.000
Architectural Surface Coatings	POP	0.580	0.614	0.628	0.641	0.654	0.000	0.000	0.000	0.000	0.000
Auto Refinishing	EMP	0.370	0.421	0.444	0.462	0.479	0.000	0.000	0.000	0.000	0.000
Graphic Arts	EMP	0.178	0.194	0.202	0.207	0.212	0.000	0.000	0.000	0.000	0.000
Pesticide Application	NONE	0.110	0.110	0.110	0.110	0.110	0.000	0.000	0.000	0.000	0.000
Commercial/Consumer Solvents	POP	0.620	0.657	0.672	0.686	0.699	0.000	0.000	0.000	0.000	0.000
Cutback Asphalt	POP	0.050	0.053	0.054	0.055	0.056	0.000	0.000	0.000	0.000	0.000
Emulsified Asphalt	POP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Traffic Marking	POP	0.030	0.032	0.032	0.033	0.034	0.000	0.000	0.000	0.000	0.000
Factory Finished Wood	EMP	0.044	0.044	0.045	0.045	0.045	0.000	0.000	0.000	0.000	0.000
Furntiure and Fixtures	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Electrical Insulation	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Metal Cans	EMP	0.178	0.154	0.147	0.139	0.132	0.000	0.000	0.000	0.000	0.000
Misc. Finished Metals	EMP	0.070	0.070	0.070	0.069	0.069	0.000	0.000	0.000	0.000	0.000
Machinery and Equipment	EMP	0.026	0.026	0.026	0.026	0.026	0.000	0.000	0.000	0.000	0.000
Appliances	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
New Motor Vehicles	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
OtherTransportation Equipment	EMP	0.050	0.051	0.052	0.052	0.053	0.000	0.000	0.000	0.000	0.000
Marine Coatings	EMP	0.036	0.037	0.037	0.038	0.038	0.000	0.000	0.000	0.000	0.000
Misc. Manufacturing	EMP	0.082	0.082	0.082	0.082	0.082	0.000	0.000	0.000	0.000	0.000
Industrial Maintenance Ctgs.	EMP	0.110	0.095	0.091	0.086	0.082	0.000	0.000	0.000	0.000	0.000
Other Coatings	EMP	0.110	0.095	0.091	0.086	0.082	0.000	0.000	0.000	0.000	0.000
Municipal Landfills	POP	0.090	0.095	0.097	0.100	0.101	0.000	0.000	0.000	0.000	0.000
Incinerators	POP	0.001	0.001	0.001	0.001	0.001	0.005	0.005	0.006	0.006	0.007
POTWs	HHS	0.010	0.011	0.011	0.011	0.011	0.000	0.000	0.000	0.000	0.000
Structure Fires	POP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Slash/Prescribed Burning	NONE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Forest Fires	NONE	0.010	0.010	0.010	0.010	0.010	0.000	0.000	0.000	0.000	0.000
Open Burning	NONE	4.370	4.370	4.370	4.370	4.370	0.920	0.920	0.920	0.920	0.920
Leaking U.S.T.	NONE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
R/C/I Fuel Use - Coal	POP	0.006	0.006	0.006	0.007	0.007	0.527	0.558	0.604	0.668	0.753
R/C/I Fuel Use - Fuel Oil	POP	0.002	0.003	0.003	0.003	0.003	0.147	0.156	0.169	0.186	0.210
R/C/I Fuel Use - Natural Gas	POP	0.004	0.004	0.004	0.004	0.005	0.144	0.152	0.165	0.183	0.206
R/C/I Fuel Use - LPG	POP	0.001	0.001	0.001	0.001	0.001	0.041	0.043	0.047	0.051	0.058
Bakeries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breweries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Wineries	EMP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Oil Spills	POP	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Biogenic*	NONE	32.960	32.960	32.960	32.960	32.960	0.000	0.000	0.000	0.000	0.000
Total		**8.728**	**8.914**	**9.004**	**9.089**	**9.169**	**1.784**	**1.834**	**1.910**	**2.015**	**2.155**

Category	Indicator	VOC 1990	VOC 1996	VOC 1999	VOC 2002	VOC 2005	NOx 1990	NOx 1996	NOx 1999	NOx 2002	NOx 2005
Recreational Equipment	EGAS	0.240	0.260	0.272	0.283	0.291	0.000	0.000	0.000	0.000	0.000
Construction Equipment	EGAS	0.120	0.135	0.144	0.155	0.166	0.810	0.913	0.975	1.044	1.118
Industrial Equipment	EGAS	0.050	0.055	0.059	0.064	0.069	0.080	0.089	0.095	0.102	0.110
Light Commercial Equipment	EGAS	0.120	0.134	0.146	0.158	0.172	0.070	0.078	0.085	0.092	0.100
Lawn & Garden Equipment	EGAS	0.680	0.740	0.770	0.798	0.824	0.040	0.044	0.045	0.047	0.048
Farm Equipment	NONE	0.240	0.240	0.240	0.240	0.240	1.000	1.000	1.000	1.000	1.000
Logging Equipment	EGAS	0.020	0.021	0.023	0.024	0.026	0.000	0.000	0.000	0.000	0.000
Aircraft Support	EGAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Commercial Aviation	EGAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
General Aviation	EGAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Air Taxis	EGAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Military Aviation	NONE	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Vessels	EGAS	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pleasure Boats	EGAS	0.550	0.599	0.623	0.645	0.666	0.120	0.131	0.136	0.141	0.145
Railroads	EGAS	0.020	0.019	0.019	0.019	0.019	0.520	0.504	0.499	0.499	0.499
Total		**2.040**	**2.204**	**2.297**	**2.387**	**2.473**	**2.640**	**2.758**	**2.835**	**2.925**	**3.020**

5.0 CALCULATING THE VOC EMISSION TARGET LEVELS FOR THE POST-1996 MILESTONE YEARS

To determine the amount of emissions reductions required after the year 1996, the Department must calculate the target level for VOC emissions at each milestone year for Cecil County. The target level is the maximum amount of VOC emissions that can be emitted to comply with the Act's requirements. Table 5.1 demonstrates the target level of VOC emissions at each milestone year for Cecil County. A discussion on how the target level is calculated is discussed in Section 5.2. These target levels have been recalculated based on MOBILE6 modeling.

Table 5.1: Cecil County Emission Target Levels for Post-1996 Milestone Years

Milestone	VOC Emissions	NOx Emissions
1996	13.70	NA
1999	11.92	21.45
2002	10.46	21.13
2005	9.36	20.48

5.1 NOx SUBSTITUTION

If a nonattainment area cannot meet the VOC emission target level, Section 182(c)(2)(C) of the Act allows for the substitution of actual NOx emission reductions which occur after 1990 to meet the VOC emission target level. This may be done provided that such reductions meet the criteria outlined in the EPA's December 15, 1993 NOx Substitution Guidance (Appendix G).

One of the conditions for meeting the VOC emission target level using NOx substitution is that the sum of all creditable VOC and NOx emission reductions must equal 3 percent per year averaged over each applicable milestone period. In other words, any combination of VOC and NOx emission reductions that totals 3% per year will satisfy these criteria.

The following equation generally describes the method to calculate the total 3% per year emission reductions:

$R_V/VOC(Adj.) + R_N/NOx(Adj.) >= 0.03$

where:

RV = typical summer day VOC reductions
RN = typical summer day NOx reductions
VOC(Adj.) = human-made 1990 adjusted VOC emissions inventory, and
NOx(Adj.) = human-made 1990 adjusted NOx emissions inventory.

The values of R_V and R_N include only the creditable emission reductions from the nonattainment area of concern. For instance, VOC and NOx reductions from automobile tailpipe and gasoline volatility standards adopted prior to the Act's amendments of 1990 are excluded from these values. The Act specifically excludes these as programs that may be not credited toward Rate-of Progress.

The values of VOC (Adj.) and NOx (Adj.) include the 1990 adjusted emissions inventories. These values are equal to the 1990 man-made base year inventory minus reductions from the pre-enactment automobile tailpipe and gasoline volatility standards.

The second condition for using NOx substitution requires the amount of NOx emission reductions used to meet the *Post-1996 RPP* be consistent with the amount of NOx emission reductions mandated by the urban airshed model. The urban airshed model determines the amount of reductions necessary to bring an area into attainment with the ozone standard. Therefore, the reductions required by the model must be met in addition to those required by the RPPs. However, due to the chemical reactions the maximum amount of NOx reductions required is that dictated by the model. NOx reductions have the potential of increasing ozone. In conclusion, when using NOx substitution to meet the RPP requirements the amount of NOx reductions is capped to the amount required by the model.

In order to use NOx substitution, separate target levels of emission need to be calculated for both NOx and VOC. The EPA developed an approach where a target level for VOC and NOx emissions is determined. Maryland did not need to use the NOx substitution methodology for this revision since there were enough VOC reductions to meet the 42% target level.

Detailed calculations and flowcharts of the target levels following the EPA's guidance are included below.

5.2 CALCULATION OF THE VOC EMISSION TARGET LEVELS FOR THE POST-1996 TARGET LEVELS

The target level of emissions represents the maximum amount of emissions that a nonattainment area can emit for a given target year while complying with the three percent per year reduction requirements.

Two equations are presented in the General Preamble to describe the calculation of the target levels. These equations can be generalized into the following single equation:

Target level = (previous milestone's target level) - (reductions required to meet the rate-of-progress requirement) - (fleet turnover correction term).
or
TLx = TLy - BGx - FTx
where:

TLx = Target level of emissions for current milestone
TLy= Target level of emissions for previous milestone
BGx= Emission reduction requirement for current milestone

FTx = Fleet turnover correction term for current milestone

This equation can be used to calculate the target level of emissions for each post-1996 milestone year. The target level for each milestone year (TLx) is obtained by subtracting the 3 percent per year rate-of-progress emission reduction

(BGx) and the fleet turnover correction term (FTx) from the previous milestone year (TLy).
There are six major steps in calculating a post-1996 target level of emissions. The first four steps are needed to calculate the 3 percent per year rate-of-progress emission reductions. Steps 1 and 2, developing the 1990 base year inventory and the 1990 rate-of-progress inventory, were required in the 15 percent rate-of-progress plan.

The 1996-2005 target levels have been revised from those included in the Phase I Plan submittal for the Baltimore area. The target levels are revised to take into account new estimates for mobile emissions.

The new 1996 target levels are the following:

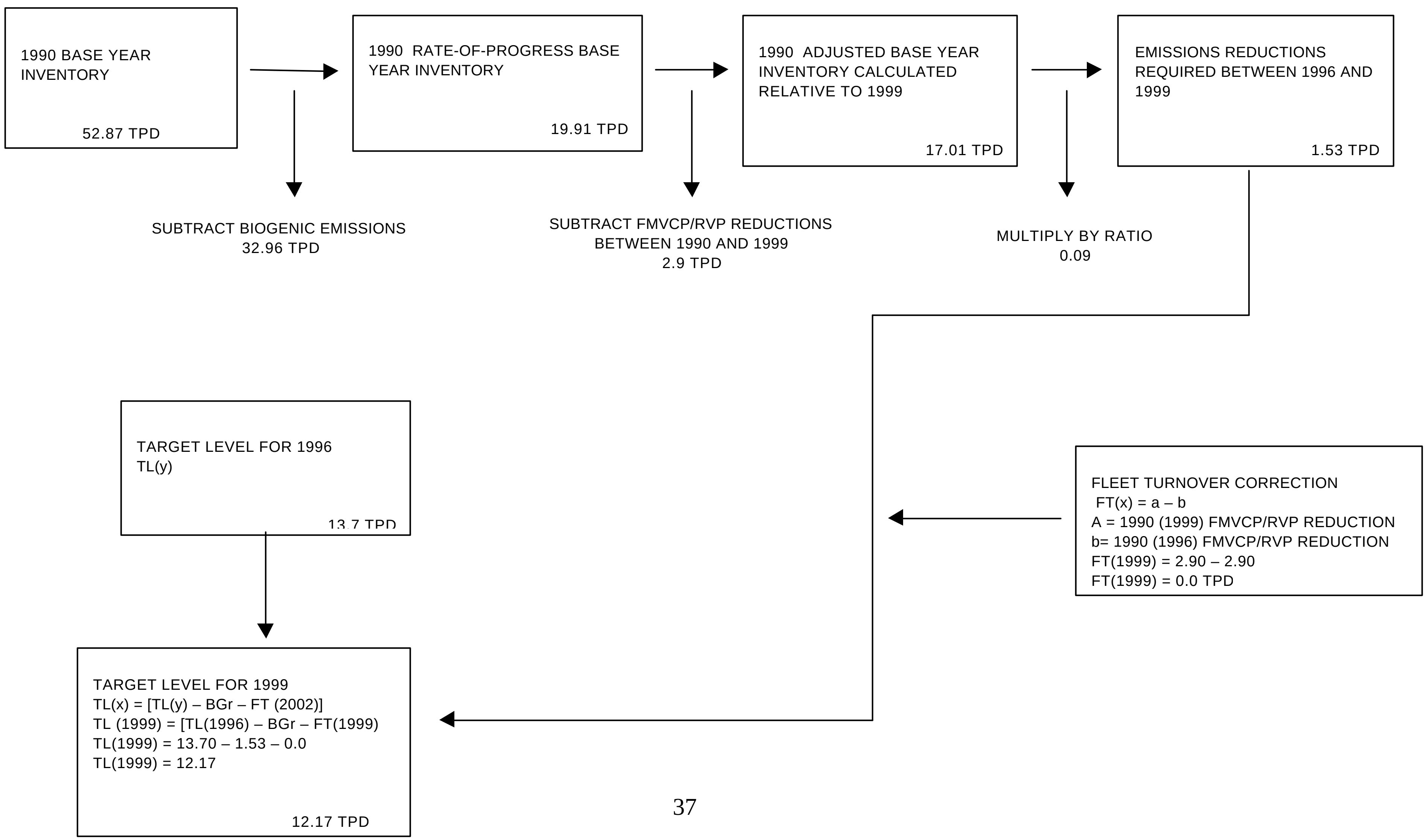
Cecil County

CALCULATION OF 15% REDUCTION TARGET		**Formula**	**Cecil (tpd)**
a	1990 Base Year Inventory (Anthropogenic + Biogenic)		52.870
b	Biogenic (Vegetative) Emissions		32.960
c	1990 Rate-of-Progress Base Year Inventory (a) - (b)	(a) - (b)	19.910
d	Reductions from Federal Motor Vehicle Control Program (FMVCP) and Gasoline Volatility Regulations (RVP)		3.040
e	Reductions from Federal Motor Vehicle Control Program (FMVCP) and Gasoline Volatility Regulations (RVP) between 1996-1999		0.640
f	1990 Adjusted Base Year Inventory	(c) - (d)	16.870
g	15 % Reduction Requirement	(0.15) x (f)	2.531
h	Expected Emissions Growth (1990 - 1996)		0.364
i	Total Emissions Reductions Needed	(g) + (h)	2.895
j	1996 Target Level of Emissions	(c) - (g) - (d) - (e)	13.700

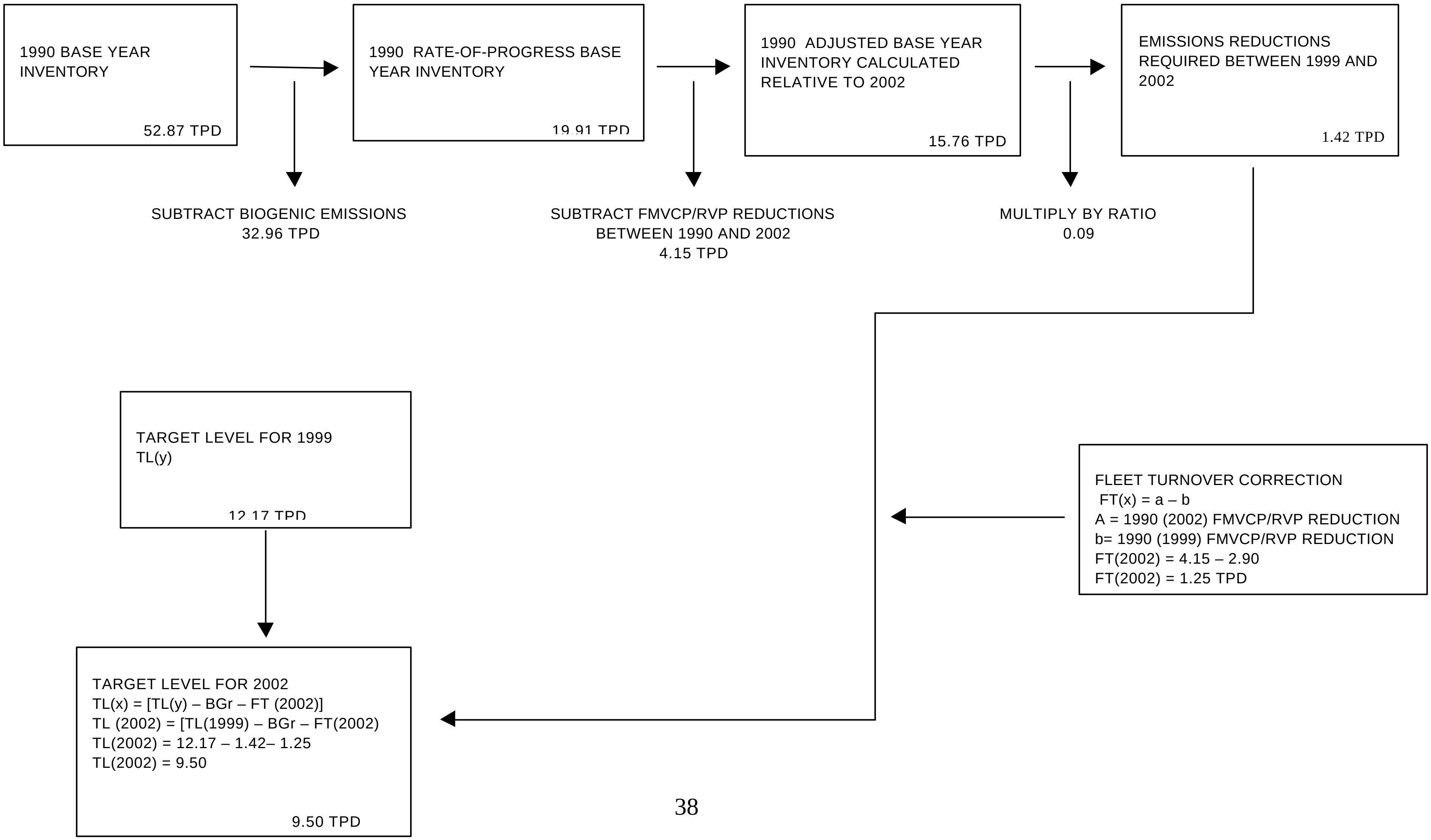
The following figures contain the calculation for the 1999, 2002 and 2005 target levels.

5.3 TARGET LEVEL FLOWCHARTS

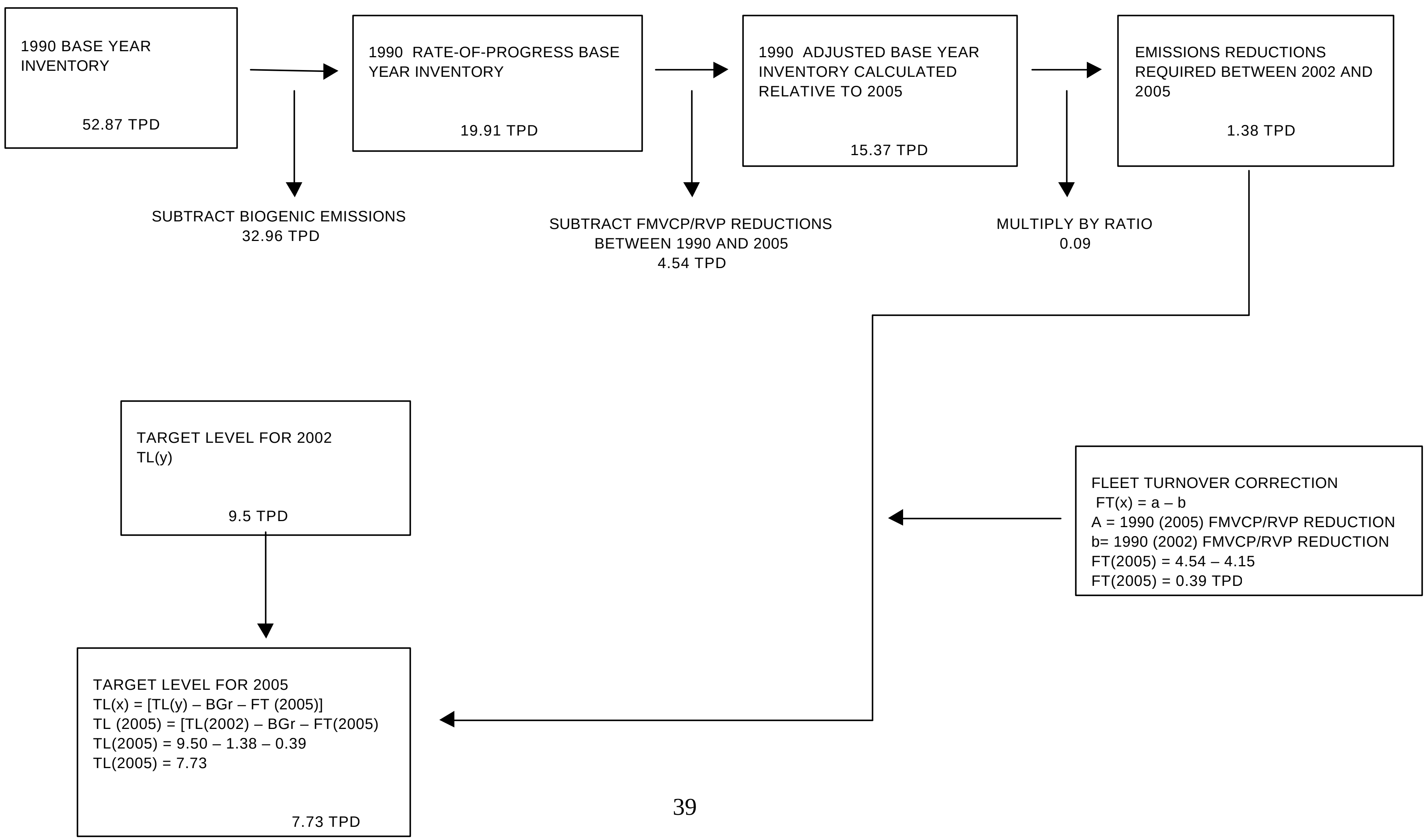
Flowchart for VOC Target Level for 1999 Milestone
Cecil County



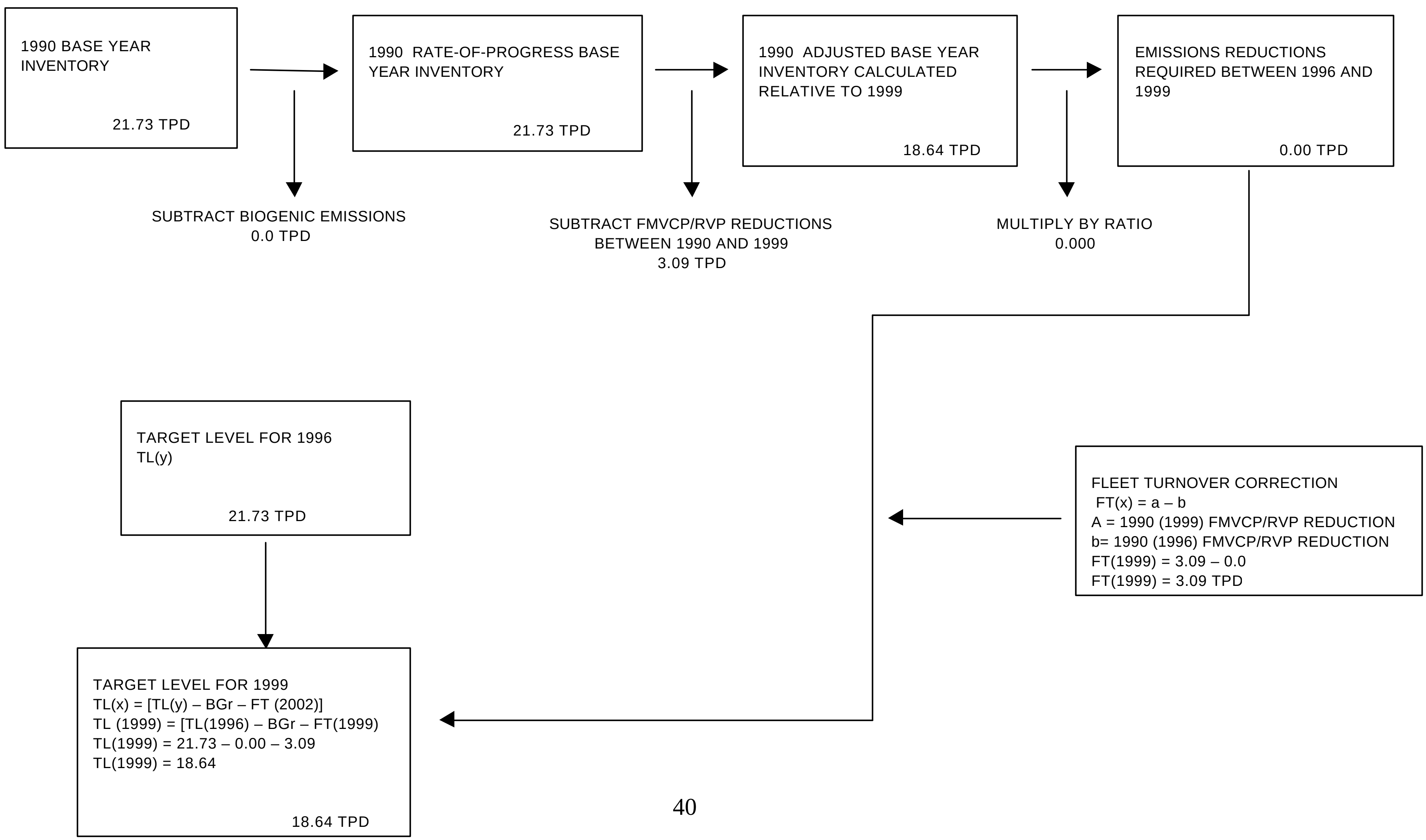
Flowchart for VOC Target Level for 2002 Milestone
Cecil County



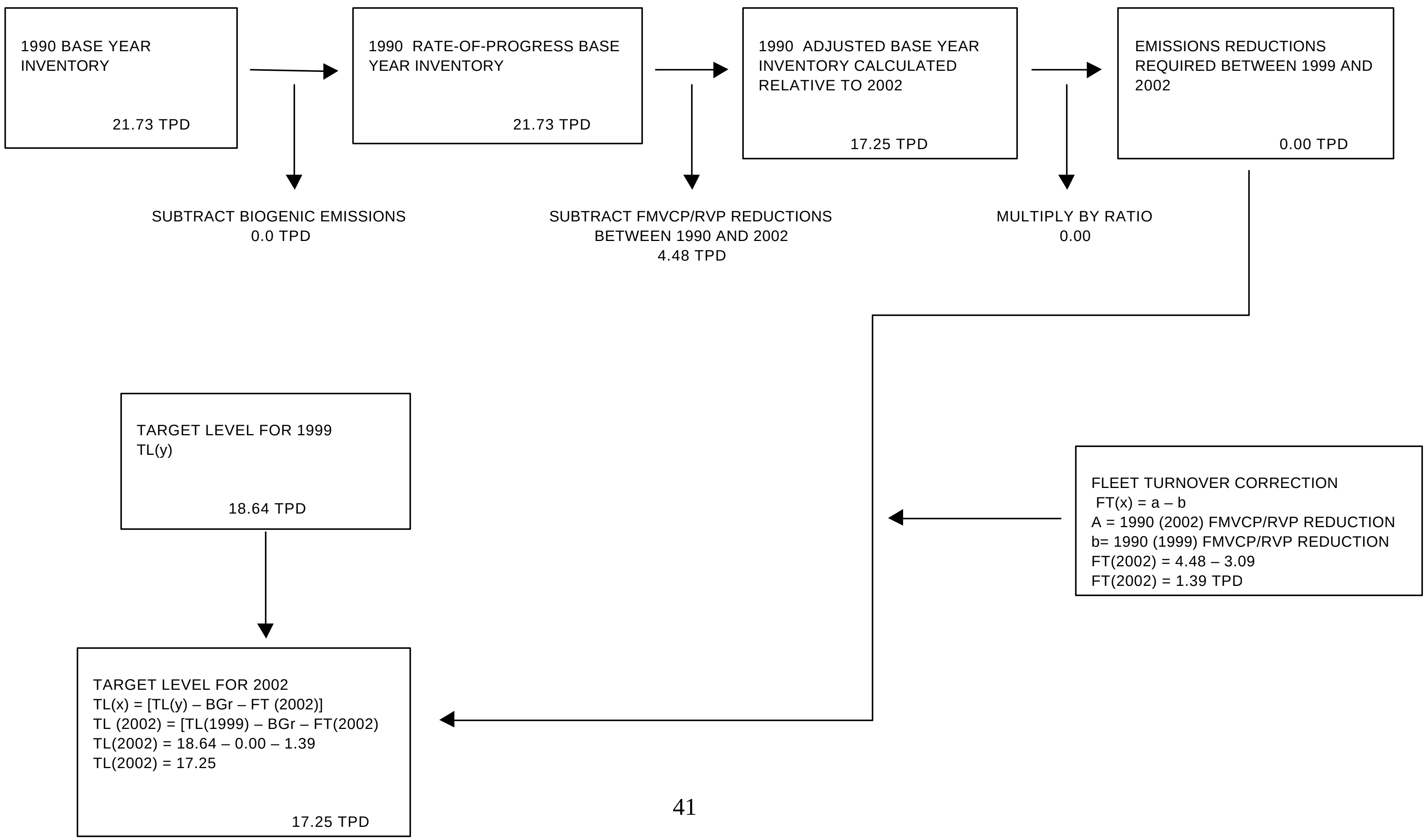
Flowchart for VOC Target Level for 2005 Milestone
Cecil County



Flowchart for NOx Target Level for 1999 Milestone
Cecil County



Flowchart for NOx Target Level for 2002 Milestone
Cecil County



Flowchart for NOx Target Level for 2005 Milestone
Cecil County

1990 BASE YEAR INVENTORY

21.73 TPD

SUBTRACT BIOGENIC EMISSIONS
0.0 TPD

1990 RATE-OF-PROGRESS BASE YEAR INVENTORY

21.73 TPD

SUBTRACT FMVCP/RVP REDUCTIONS BETWEEN 1990 AND 2005
5.85 TPD

1990 ADJUSTED BASE YEAR INVENTORY CALCULATED RELATIVE TO 2005

15.88 TPD

MULTIPLY BY RATIO
0.00

EMISSIONS REDUCTIONS REQUIRED BETWEEN 2002 AND 2005

0.00 TPD

TARGET LEVEL FOR 2002
TL(y)

17.25 TPD

FLEET TURNOVER CORRECTION
FT(x) = a – b
A = 1990 (2005) FMVCP/RVP REDUCTION
b= 1990 (2002) FMVCP/RVP REDUCTION
FT(2005) = 5.85 – 4.48
FT(2005) = 1.37 TPD

TARGET LEVEL FOR 2005
TL(x) = [TL(y) – BGr – FT (2005)]
TL (2005) = [TL(2002) – BGr – FT(2005)
TL(2005) = 17.25 – 0.00 – 1.37
TL(2005) = 15.88

15.88 TPD

6.0 CONTROL MEASURES TO MEET THE RATE OF PROGRESS REQUIREMENTS

This section briefly summarizes the control measures that account for the emission reductions required to meet the Rate-of-Progress requirements for the 2005 milestone. Table 6.1 demonstrates the summary of emission reductions expected from considering the control measures used to meet the 2005 milestone.

Table 6.1: Summary of Emission Benefits For Cecil County (Tons Per Day)

	2005	
Control Measure	**VOC**	**NOx**
Enhanced I/M		
Tier I		
Reform Gas		
LEV		
HDDE		
Total Mobile	2.02	4.24
Stage II/Refuel	0.32	0.00
Open Burning	4.23	0.89
Surface Cleaning/ Degreasing	0.18	0.00
Architectural Coatings	0.17	0.00
Consumer Products	0.07	0.00
Auto Refinishing	0.29	0.00
Stage I Vapor Recovery	0.84	0.00
Nonroad Small Gasoline Engines	0.73	0.00
Nonroad Diesel Engines Tier I & II	0.00	0.68
Emissions Standards for Large Spark Emissions Eng.	0.02	-.01
Marine Engines	0.17	0.00
Railroads	0.00	0.21
Screen Printing	0.00	0.00
Graphic Arts-Lithography	0.08	0.00
Graphic Arts - Rotogravure & Flexographic	0.04	0.00
Nonroad RFG	0.70	0.00
Total	9.86	6.01
Projected Uncontrolled Emissions	17.26	20.75
Emission Level Obtained	7.41	14.74
Emission Level Required	7.73	15.88
Surplus	0.32	1.14

6.1 On-Road Mobile Measures

The EPA's mobile emissions model, MOBILE6, with locality-specific inputs and appropriate design parameters for Maryland was used to estimate the VOC and NOx emissions reductions obtained from the following mobile source control strategies. Time and resource constraints prohibited the calculation of individual benefits for each mobile source control strategy. A single table totaling the benefits from all the mobile strategies follows the descriptions of the control programs. The specific methodologies and assumptions associated with modeling these programs can be found in the input stream for the model runs used to prepare the 2005 mobile source emissions budget (see Appendix B.)

6.1.1 Enhanced Vehicle Inspection and Maintenance (Enhanced I/M)

This measure involves implementing a vehicle emission inspection and maintenance program with stricter requirements than the "basic" program.

Description of Source Category

This measure affects light duty gasoline vehicles, light duty gasoline trucks and heavy-duty gasoline vehicles up to 26,000 pounds.

Control Strategy

The Act requires enhanced motor vehicle inspection and maintenance (I/M) programs in serious, severe, and extreme ozone nonattainment areas with urbanized populations of 200,000 or more. In Maryland, this required enhanced I/M program impacts the 8 jurisdictions currently operating a basic I/M program as well as 6 new jurisdictions, for a total of 14 of the 23 jurisdictions in the state.

Maryland obtained VOC emissions reductions by adopting regulations for an enhanced vehicle emissions I/M program that contains test procedures that will detect more emissions-related faults, cover a larger geographic area in the state, and allow fewer waivers from emissions standards. Tailpipe emissions will be 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. Evaporative emissions control equipment will be checked for function and integrity, resulting in large emissions reductions not achieved with the current program. The geographic expansion will bring approximately 500,000 additional cars into the program. In addition, the projected waiver rate will decrease from approximately 15% of failed vehicles to 3%.

Estimated Emissions Reductions and Methodology

The EPA's mobile emissions model, MOBILE6, with locality-specific inputs and appropriate design parameters for Maryland's enhanced I/M program, was used to estimate the VOC and NOx emissions reductions obtained from this control strategy. The specific methodologies and assumptions associated with modeling the enhanced I/M program can be found in the input stream for the model runs used to prepare the 2005 mobile source emissions budget (see Appendix B.)

Maryland Department of the Environment
Mobile Sources Control Program
Cecil County MOBILE6 Modeling Emission Analysis
Rate of Progress Plan for 1996, 1999, 2002 & 2005

Year of Evaluation	Emission Inventory Type	VOC	NOx	VMT	Scenario	Remarks
	1990 Baseline Emissions	**8.59**	**17.31**	**2.69**	**A**	From MOBILE6 SIP Budget
1996	**1996 Tier-Zero Emissions**	**5.63**	**16.72**	**2.93**	**B**	1990 Controls, 96 VMT, NO 90 CAA, 96 RVP
	1996 Emission Estimates	**5.31**	**16.23**	**2.93**	**C**	1996+ Controls & 1996 VMT
	1990 Adjusted Baseline 1n 1996	**5.55**	**14.62**	**2.69**	**D**	1990 Controls & VMT, NO 90 CAA, 96 RVP
1999	**1999 Tier-Zero Emissions**	**5.13**	**15.62**	**2.85**	**E**	1990 Controls, 99 VMT, NO 90 CAA, 99 RVP
	1999 Emission Estimates	**4.83**	**14.55**	**2.85**	**G**	1999+ Controls & 1999 VMT
	1990 Adjusted Baseline 1n 1999	**4.91**	**14.22**	**2.69**	**G**	1990 Controls & VMT, NO 90 CAA, 99 RVP
2002	**2002 Tier-Zero Emissions**	**5.55**	**16.42**	**3.32**	**H**	1990 Controls, 02 VMT, NO 90 CAA, 99 RVP
	2002 Emission Estimates	**4.15**	**13.87**	**3.32**	**I**	2002+ Controls & 2002 VMT
	1990 Adjusted Baseline 1n 2002	**4.44**	**12.83**	**2.69**	**J**	1990 Controls & VMT, NO 90 CAA, 99 RVP
2005 Netwk w/New Truck Model	**2005 Tier-Zero Emissions**	**5.00**	**15.57**	**3.57**	**K**	1990 Controls, 05 VMT, NO 90 CAA, 99 RVP
	2005 Emission Estimates	**2.98**	**11.33**	**3.57**	**L**	2005+ Controls & 2005 VMT
	1990 Adjusted Baseline 1n 2005	**4.05**	**11.46**	**2.69**	**M**	1990 Controls & VMT, NO 90 CAA, 99 RVP
	2005 incl. Stage II Ref. Emissions	**3.13**	**11.33**	**3.57**	**N**	2005+ Controls & 2005 VMT+Refueling
	2005 Refueling. Emissions	**0.15**				**Scenario N minus Scenario L**

Note:
1) Emision units: tons per Summer WeekDay (SWD)
2) VMT units: million miles per SWD
4) NonCreditable Emission Benefits from Federal FVMCP & RVP Programs i.e, NCs = (Base 1990 Emissions - minus Adjusted Baseline Emisions)

Prepared by: MDE's Mobile Sources Control Program, Phone (410) 537-4183 **Oct. 8, 2003**

6.1.2 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 required a uniform level of evaporative emission controls, which are more stringent than most evaporative controls used in existing vehicles.

Description of Source Category

These federally implemented programs will affect light duty vehicles and trucks.

Control Strategy

The federal program requires more stringent exhaust emissions standards as well as a uniform level of evaporative emissions controls, demonstrated through new federal evaporative test procedures. The Tier I exhaust standards are to be phased in beginning with model year 1994.

Expected Emissions Reductions and Methodology

The MOBILE6 emissions factor model automatically applies these controls unless the input file has been modified to disable the Act's tailpipe standards and the evaporative test procedure.

6.1.3 Reformulated Gasoline in On-road Vehicles

This federally mandated measure requires the use of lower polluting "reformulated" gasoline in Cecil County.

Description of Source Category

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 will be reduced by this control strategy.

Control Strategy

The Act requires significant changes to conventional fuels for areas that exceed the health-based ozone standard. They require the EPA to establish specifications for reformulated gasoline that would achieve the greatest reduction of VOCs and toxic air pollutants achievable considering costs and technological feasibility.

At a minimum, reformulated gasoline must not cause an increase in NOx emissions, must have an oxygen content of at least 2.0% by weight, must have a benzene content no greater than 1.0% by volume and must not contain any heavy metals. Most importantly, the Act requires a reduction in VOC and toxic emissions of 15% over base year levels beginning in 1995 and 25% beginning in the year 2000.

Since January of 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. Other ozone nonattainment areas are permitted to "opt-in" to the federal reformulated gasoline program.

Use of reformulated gasoline is required in Cecil County.

Expected Emissions Reductions and Methodology

The emissions factor used in calculating the reduction from this measure was determined using MOBILE6. Activity levels were developed using both HPMS VMT data and locality specific transportation model data.

6.1.4 Tier 2 Program,

On December 21, 1999, the EPA announced new regulations effecting emissions standards for the production of new vehicles beginning in 2004 and known as Tier 2 standards. The emissions reduction benefits of this Tier 2 program for the Maryland region will be significant. The new tailpipe standard will take into account all classes of passenger vehicles (including SUV's and light trucks) beginning in 2004. In effect, the rule forces SUV's (Sport Utility Vehicles) and light trucks to meet the same tailpipe emission standards as cars. Simultaneously, the EPA announced lower sulfur in gasoline standards, as part of the new tailpipe standard, which is necessary to enable passenger vehicles to meet Tier 2 emission standards.

As part of the EPA's program for cleaner vehicles, cleaner gasoline, and more protective tailpipe emission standards, the EPA announced lower sulfur in gasoline standards. Lower sulfur content in gasoline is needed to enable passenger vehicles to meet the Tier 2 standards

The benefits of this Tier 2 program for the Maryland region will be significant. The new tailpipe standard will take into account all classes of passenger vehicles (including SUV's and light trucks) beginning in 2004. New sulfur in gasoline standards requires refiners to place caps on sulfur in fuel. These refiners have a great deal of flexibility under the new standard system that allows them to phase the standard in and even use credits from refiners who reduce emissions early.

Description of Source Category

These federally implemented programs will affect light duty vehicles and trucks.

Control Strategy

On December 21, 1999, federal regulations were announced tightening tailpipe emission standards for the third time. In the early 1980's, the Federal Motor Vehicle Control Program began with Tier 0 tailpipe standards. These standards reduced emissions by over 90% from pre-control levels. Implementation of Tier 1 tailpipe standards began with the model year 1994. This round of standards made substantial reductions in carbon monoxide and nitrogen oxides. The new tailpipe standard (Tier 2) will take into account all classes of passenger vehicles (including SUV's and light trucks) beginning in 2004.

6.1.5 National Low Emission Vehicle Program

The NLEV program is a vehicle technology program that will provide motor vehicles that are significantly cleaner than pre-1998 models. The National LEV program was developed through an unprecedented, cooperative effort by the northeastern states, auto manufacturers, environmentalists, fuel providers, U.S. EPA and other interested parties.

National LEV vehicles will be 70 percent cleaner than 1998 models. The National LEV program will result 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.

Description of Source Category

These federally implemented programs will affect light duty vehicles and trucks.

Control Strategy

National LEV vehicles will be 70 percent cleaner than 1998 models. The National LEV program will result 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.

6.1.6 Federal Heavy-Duty Diesel Engine Rule

In 1999, EPA proposed tighter tailpipe emissions standards for cars and light trucks weighing up to 8,500 pounds. Commonly referred to as Tier 2, these standards would take effect beginning in 2004 when manufacturers would start producing passenger cars that are 77 percent cleaner than those on the road today. Light-duty trucks, such as 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. EPA's heavy-duty engines rule will address all vehicles weighing more than 8,500 pounds, and ensure that the heaviest passenger vans and SUVs will also meet Tier 2 standards.

Description of Source Category

These federally implemented programs will affect all vehicles weighing more than 8,500 pounds.

Control Strategy

On December 21, 1999, federal regulations were announced tightening tailpipe emission standards for the third time. In the early 1980's, the Federal Motor Vehicle Control Program began with Tier 0 tailpipe standards. These standards reduced emissions by over 90% from pre-control levels. Implementation of Tier 1 tailpipe standards began with the model year 1994. This round of standards made substantial reductions in carbon monoxide and nitrogen oxides. The new tailpipe standard (Tier 2) will take into account all classes of passenger vehicles (including SUV's and light trucks) beginning in 2004. EPA's heavy-duty engines rule will address all vehicles weighing more than 8,500 pounds, and ensure that the heaviest passenger vans and SUVs will also meet Tier 2 standards.

Expected Emissions Reductions and Methodology

The MOBILE6 emissions factor model automatically applies these controls unless the input file has been modified to disable the Act's tailpipe standards and the evaporative test procedure.

Expected Total Mobile Emissions Reductions and Methodology

Using MOBILE6, the expected emissions reductions for all of the above Mobile measures (Sections 6.1.1 through 6.1.6) are listed below.

	2005 VOC	**2005 NOx**
Cecil	2.02	4.24

6.1.7 Stage I Vapor Recovery

This control measure requires Stage I Vapor Recovery RACT regulations to be extended into Cecil County. This control measure already applied in the Baltimore nonattainment area and was adopted for the rest of the state on April 26, 1992.

Description of Source Category:
VOCs are released when gasoline delivery trucks fill gasoline storage tanks. The incoming gasoline forces vapors produced in the tank into the atmosphere. Emissions are directly related to gasoline throughput.

Control Strategy for Source Category:
RACT for gasoline storage/handling requires tank trucks refilling underground storage tanks at service stations use a vapor recovery system to return the vapors from the underground tank to the tank truck. The vapor-filled tank returns to the bulk storage facility where the vapors are cycled through control devices to eliminate VOC emissions.

Expected Emissions Reductions, Methodology and Sample Calculation:

The Department expects several sources in Cecil County, to which to this regulation never applied, to be affected by this amendment. Waste management regulations regarding underground storage tanks have led to the use of submerged fill tanks throughout Maryland.

Therefore, 1990 baseline emissions were calculated using emissions factors appropriate for submerged filling (0.0073 lbs/gal). Emissions for tank truck unloading for Cecil County were 0.82 tons per day. The emissions reductions were calculated as follows:

Percentages of submerged, balanced submerged and splash-fill tanks were determined with the assistance of MDE Waste Management. MDE staff reported no splash filling at Maryland service stations in 1999. All underground storage tanks within the nonattainment areas of the State of Maryland are required to use vapor-balance submerged filling methods. Waste Management's underground tank inspection program and regulations concerning underground storage tanks have eliminated splash-fill tanks in the state. A recent SSCD study determined that the rule effectiveness factor for vapor balance controls was 91%.

Calculation of 1999 Projected Emissions with Stage I Vapor Recovery Controls

Submerged Filling Emission Factor: 0.0073 lbs/gallon
Balanced Submerged Filling Emission Factor: 0.0003 lbs/gallon

Control Efficiency Calculation:

$$CE \; ? \; \frac{0.0073 \; ? \; 0.0003}{0.0073}$$

$$CE \; ? \; 0.9589$$

Balanced Submerged Emission Factor Corrected with Rule Effectiveness and Rule Penetration Applied

$$EFcorrected = EF \times \frac{1 - (CE \times RE \times RP)}{(1 - CE)}$$

$$EFcorrected = 0.0003 \times \frac{1 - (0.9589 \times 0.91 \times 1.0)}{(1 - 0.9589)}$$

$$EFcorrected = 0.0003 \times 3.10734146$$

$$EFcorrected = 0.0009322$$

Total Percent Reduction Including Rule Effectiveness and Rule Penetration

$$\text{Re}\,ductionPercent = \frac{EFold - EFcorrected}{EFold}$$

$$\text{Re}\,uctionPercent = \frac{0.0073 - 0.0009322}{0.0073} \times 100\%$$

$$\text{Re}\,ductionPercent = 87.26\%$$

2005 Emission Reductions = Emissions_{1990} x GF_{2005} x Reduction Percent

2005 Emission Reductions = 0.82 x 1.175 x 0.8726

2005 Emission Reductions = 0.84075 tons per day

	2005 VOC	**2005 NOx**
Cecil	0.84	0.00

6.1.8 Stage II and New Vehicle On-Board Vapor Recovery Systems

These two separate measures require the installation of Stage II vapor recovery nozzles at gasoline pumps and the requirement of onboard refueling emissions 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.

Description of Source Category

When motor vehicle fuel tanks are refueled at a gasoline dispensing facility, gasoline vapors in the fuel tank are displaced by incoming gasoline. The vapors are discharged directly to the air.

Vehicle refueling emissions are the fuel vapors displaced from a vehicle tank when it is filled. These emissions account for a significant portion of the volatile organic compounds (VOCs) released into the air by motor vehicles and contribute to the formation of ozone and smog. In addition, gasoline vapors contain air toxics.

Control Strategy

The Stage II vapor recovery regulation requires that the dispensing system be equipped with nozzles that are designed to return the vapors through a vapor line into the gasoline storage tank. The vapors may be forced back to the storage tank by the pressure of the incoming liquid (vapor balance system) or by a vacuum pump or other mechanical device that creates a vacuum at the nozzle to more efficiently contain the vapors (vapor assist system). Maryland requires all systems used to be approved by the California Air Resources Board (CARB) which ensures a minimum control efficiency of 95 percent.

In addition, an EPA rule requires the use of onboard refueling vapor recovery (ORVR) systems for new passenger cars and light trucks beginning in model 1998. Light trucks include pickups, mini-vans, and most delivery and utility vehicles. Heavy-duty vehicles and trucks over 8,500 pounds gross vehicle weight rating (GVWR) are exempt from the ORVR requirement. Upon full implementation, the ORVR rule will cover over ninety percent of all new gasoline-powered vehicles sold in Maryland.

Essentially, the ORVR system operates by storing the vapors displaced from the fuel tank during a refueling event and subsequently routing these VOC vapors to the engine, where the vapors are burned during vehicle operation. The EPA has allowed manufacturers to retain some flexibility in meeting the requirements. Although the EPA has not prescribed any particular technology, most past ORVR designs have been canister-based. In such a system, the displaced VOC vapors are stored in a canister by being adsorbed onto a bed of activated carbon contained within the canister. During vehicle operation, a manifold vacuum is used to pull ambient air over the carbon bed, stripping the VOCs from the canister. This VOC-rich purge gas is then routed to the engine and burned.

Expected Emissions Reductions and Methodology

The 2005 emissions reductions were calculated as follows:

$$\text{Emission reductions for 2005} = \left\{ \text{1990 Emissions (Tons per Day)} \times \text{2005 BEA Growth Factor} \right\} - \text{2005 Emission Level from MOBILE6}$$

$$= \left\{ 0.40 \times 1.175 \right\} - 0.15$$

$$= 0.32 \text{ tpd}$$

Using MOBILE6, the expected emissions reductions for these measures are listed below.

	2005 VOC	**2005 NOx**
Cecil	0.32	0.0

6.2 Area Source Measures

6.2.1 Burning Ban

This control measure bans open burning during the peak ozone season.

Description of Source Category

Open burning refers to the method of burning that releases uncontrolled emissions. 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 alike. Emissions from open burning include oxides of nitrogen, hydrocarbons, carbon dioxide, carbon monoxide and other toxic compounds. Emissions levels from open burning are high due to the inefficient and uncontrolled manner in which the material is burned.

Control Strategy

The Department adopted a regulation that prohibits open burning during the peak ozone period (June to August). The seasonal prohibition affects only those counties that lie within the serious and severe nonattainment areas. Certain exemptions however must be in place so as not to adversely affect the agriculture industry or restrict fire training and recreational activities.

Estimated Emissions Reductions and Methodology

The 1990 base year emissions estimate for Cecil County using EPA approved emission factors for this category was 4.37 tons per day of VOC and 0.92 tons per day of NOx. No growth is assumed for the projected emissions.

The control measure for this category consists of an open burning ban (control efficiency = 100%). A rule effectiveness factor of 96.8% is used. This factor was obtained from a study prepared by E.H. Pechan for the Mid-Atlantic Regional Air Management Association/Mid-Atlantic Northeast Visibility Union (MARAMA/MANE-VU) regarding emission factors and rule effectiveness for open burning.[3]

Since no growth is assumed, the expected emission reductions for 2005 are calculated in a similar manner. The emission reductions were calculated as follows:

Expected VOC Emission Reductions	=	1990 Emissions (Tons per Day)	*	Rule Effectiveness (Percent)
Expected VOC Emission Reductions	=	4.37 * 0.968		
Expected VOC Emission Reductions	=	4.23 Tons per Day		

3 "Open Burning in Residential Areas, Emissions Inventory Development Report," E.H. Pechan & Associates, Inc., January 31, 2003. Prepared for the Mid-Atlantic/Northeast Visibility Union

The expected emission reductions by in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	4.23	0.891

6.2.2 Surface Cleaning/Degreasing

This control measure requires small degreasing operations like gasoline stations, autobody paint shops and machine shops to use less polluting degreasing solvents.

Description of Source Category

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.

Control Strategies for Source Categories

The regulation, COMAR 26.11.19.09, requires the reformulation of cold degreasers to either aqueous solutions or low VOC formulations.

The control requirement involves the use of a reformulation and the emissions are calculated by means of direct determination. EPA guidance on rule effectiveness (RE) states that RE is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010). However, EPA Region 3 has recommended the application of rule effectiveness to this source category.

After a detailed review of all cost-effective approaches to reduce emissions from this source category, the Department adopted a final rule that will achieve greater reductions that originally projected. Maryland's regulation required that the vapor pressure of the degreasing solvent not exceed 1 mm Hg, which will produce a greater than 67 percent reduction in the vapor pressure of degreasing materials. As a result of this part of the regulation, the final rule will achieve emission reductions of 5.76 tons per day. This regulation became effective on June 5, 1995 and was submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation should result in a 70 percent reduction in VOC emissions.

The 2005 emission reductions for the Cecil County were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) * Rule Effectiveness = Expected Emissions Reduction in 2005 (Tons per day)

0.32 per day * 0.987 * 0.70 * 0.80 = 0.177 Tons per day

The expected emission reductions in tons per day are the following:

	2005 VOC	2005 NOx
Cecil	0.177	0.00

6.2.3 Architectural and Industrial Maintenance Coatings

This federal measure requires reformulation of architectural and industrial maintenance coatings.

Description of Source Category

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. The different types of coatings include flat, non-flat coatings, and numerous specialty coatings. VOC emissions result from the evaporation of solvents from the coatings during application and drying.

Control Strategy for Source Category

The users of these coatings are small and widespread, making the use of add-on control devices is technically and economically infeasible. Reductions in VOC emissions must therefore be obtained through product reformulation.

Product reformulation is the process of modifying the current formulation of the coating, in this case to obtain a lower VOC content. Product reformulation can involve one or several of the following approaches:

- Replacing VOC solvents with non-VOC solvents;
- Increasing the solids content of the coating;
- Altering the chemistry of the resin so that less solvent is needed for the required viscosity;
- Switching to a waterborne latex or water-soluble resin system.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Estimated Emissions Reductions, Methodology and Sample Calculation

On March 22, 1995, the EPA issued a guidance memorandum on credit for reductions from the Architectural and Industrial Maintenance (AIM) Coating Rule. The memorandum stated that the federal AIM coating rule resulted in an overall reduction estimate of 20 percent.

> The AIM rule is applicable to the following source categories: Architectural Surface Coating, Traffic Marking, Industrial Maintenance Coatings, and Other Coatings. The 2005 emission reductions for

Cecil County were calculated as follows:

{[1990 Emissions from the Architectural Surface Coating * Respective BEA Growth Factor] + [1990 Emissions from the Traffic Paint Categories * Respective BEA Growth Factor] + [1990 Emissions from the Industrial Maintenance Coatings * Respective BEA Growth Factor] + [1990 Emissions from the Other Coatings Categories * Respective BEA Growth Factor]} * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

{(0.58 * 1.128) + (0.03 * 1.128) + (0.110 * 0.744) + (0.110 * 0.744)} * 0.20 = 0.170 Tons per day

The 1999 and 2002 emission reductions were calculated in a similar fashion with their respective growth factors.

	2005 VOC	**2005 NOx**
Cecil	0.170	0.0

6.2.4 Commercial and Consumer Products

This measure requires the reformulation of certain consumer products to reduce their VOC content.

Description of Source Category

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.

Control Strategy for Source Category

Control strategies to reduce emissions from consumer products include reformulation of the product, modified and alternative dispensing or delivery systems, and product substitution or elimination.

Product reformulation can be accomplished by substituting water, other non-VOC ingredients, or low-VOC solvents for VOCs in the product.

Alternative application techniques modify the product delivery system and include traditional as well as innovative ways to reduce VOC emissions. This option applies primarily to aerosol products, which produce the majority of the VOC emissions from this category. Methods include the substitution of a hand pump in replacement of the traditional propellants to deliver the product or changing the delivery system from an aerosol to a liquid, solid or powder form.

Product substitution or elimination involves replacing high-VOC products with low or non-VOC emitting products.

The Department used VOC emissions reductions required through the implementation of federal regulations that would establish VOC content standards for various consumer product categories.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology and Sample Calculation

The EPA issued a memorandum on June 22, 1995, which provided the regulatory schedule and guidance on the expected emission reduction for the federal consumer products rule.

According to the memorandum, the baseline emission factor from the regulated subset resulting from the federal rule is 3.9 pounds per person annually. The emissions reductions are 20% of this subset. The calculation is as follows:

Control Efficiency from regulated subset = (3.9 lb/yr/person regulated subset) x (0.2 percent reduction from subset) / (7.84 lb/yr/person original factor)

= 0.099489796

2005 Emission Reductions = 1990 Emissions x Growth factor x Control Efficiency

= 0.620 x 1.128 x 0.99489796

= 0.07 tons/day

The expected emission reductions in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	0.07	0.0

6.2.5 Automobile Refinishing

This measure based on state regulation requires large and small autobody refinishing operations to use low VOC content materials in the refinishing process and cleanup and to use spray guns to control application.

Description of Source Type

Automobile refinishing is the repainting of worn or damaged automobiles, light trucks and other vehicles. The different types of coatings include primers, surfacers, sealers, topcoats and some specialty coatings. Volatile organic compound emissions result from the evaporation of solvents from the coatings during application, drying and clean up techniques.

Control Strategy for Source Type

The Department adopted regulations requiring the use of reformulated coatings that would reflect standards similar to those in EPA's CTGs for Automobile Refinishing (1991c,e). In addition, the regulation requires the use of equipment with greater transfer efficiency in the application of the coatings, and regulates the use of solvents to clean application equipment.

The reductions do not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation results in a 60 percent reduction in VOC emissions.

The 2005 emissions reductions for Cecil County were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2002 (Tons per day)

0.370 Tons per day * 1.294 * 0.60 = 0.215 Tons per day

The 1999 and 2005 emissions reductions were calculated in a similar fashion with their respective growth factors.

The expected emission reductions in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	0.287	0.0

6.2.6 Graphic Arts - Screen Printing

This measure would require certain small printing operations to install RACT.

Description of Source Category

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. The printed substrate is then placed on a drying rack or in a drying unit. After the screen is used, it is transferred to a screen reclamation process to be cleaned for reuse. During this process the ink residue is removed with solvents. Sometimes stencil material and hardened ink appears as a "ghost image" from previous stencil applications. Separate solvent material is used to remove this image.

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.

Control Strategy for Source Category

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 will be obtained through the use of ink reformulation, process printing modification, and material substitution for cleaning operations.

Ink reformulation is the process of modifying the current formulation of the ink to a lower VOC content. Ink reformulation can involve one or several of the following approaches:

Replacing the VOC solvents with non-VOC solvents;

Increasing the solids content of the coating;

Altering the chemistry of the resin;

In a printing process modification, a typical VOC solvent based printing operation may be replaced with an ultraviolet (UV) ink operation. The UV inks are cured by exposing the printed substrate to an ultraviolet light source. Ultraviolet inks do not contain VOC nor is VOC added to the inks during the operation. For a high production facility, a cost saving can be attributed to using an ultraviolet system over a conventional ink system. For the screen cleaning process there are a number of cleaning systems which contain lower amounts of VOC.

The Department expects to promulgate a regulation with ink standards that would be dependent upon the printed substrate. The cleaning solvents would also be required to have a lower VOC content. The regulation would reflect standards similar to the South Coast Air Quality Management District's (SCAQMD) regulation for screen printing.

The 15% RPP did not include rule effectiveness in the calculation because the control requirement involved the use of reformulation. Therefore, the emissions are calculated by means of a direct determination. EPA guidance on rule effectiveness states that it is not required for sources for which emissions are calculated by means of a direct determination (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

This regulation became effective on June 5, 1995 and submitted to the EPA on July 12, 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

The Department approximately 3 to 5 percent of the graphic arts area source inventory can be attributed to screen printing sources.

Based upon the SCAQMD rule, the Department expects to obtain a 35% emissions reductions from the implementation of this rule (SCAQMD, 1991b). Using this emissions reduction percentage the expected emissions reductions for this category is 0.5 tons per day. The 2002 emissions reductions were calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) * Rule Effectiveness (Percentage) * Penetration (Percentage) = Expected Emissions Reduction (Tons per day)

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) = Expected Emissions Reduction (Tons per day)

0.178 Tons per day * 1.19 (1.24 in 2005) * 0.35 * 0.8 * 0.05 = 0.003 Tons per day

The expected emission reductions by 2002 and 2005 in tons per day are as follows:

	2002 VOC	**2002 NOx**	**2005 VOC**	**2005 NOx**
Cecil	0.003	0.0	0.0031	0.0

6.2.7 Graphic Arts – Lithographic Printing

This measure would require smaller printers to use control devices and/or low VOC materials to reduce VOC emissions.

Description of Source Type

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 to the air are caused by evaporation of the ink solvents, alcohol in the fountain or dampening solution, and equipment wash solvents. Emissions from sheet fed presses are minimal because most of the VOC from the inks are absorbed in the printed matter. About one third of the VOC from web printing ink is absorbed in the printed matter. Higher VOC emissions are caused by heat-set inks because of the elevated temperatures. These VOC discharges may also cause visible emissions and nuisance odors.

Historically, lithographic web printers have used up to 35 percent isopropyl alcohol (IPA) in the fountain solutions. The volatile alcohol evaporated relatively quickly causing significant VOC emissions. The industry eventually found non-volatile substitutes for the isopropyl alcohol. Web printers are able to utilize 100 percent substitution, however, sheet fed printers with older design printing presses may require a limited amount of alcohol to achieve the required dampening.

Control Strategy for Source Type

Although several control devices were evaluated over the years for web printers, a catalytic oxidizer has proven to be most successful. For heat-set web printers, the dryer emissions are ducted directly into the oxidizer yielding a 100 percent capture of emissions. A typical oxidizer yields 96-98 percent destruction of VOC.

The proposed measure would require that:

- Web printers use no alcohol in the fountain solutions;
- Heat-set web printers install an afterburner on the oven exhaust if plant wide emissions exceed 20 pounds per day; and
- Sheet fed printers use no more than 8.5 percent isopropyl alcohol in the fountain solution and the solution must be refrigerated to 55^{o}F or less.

The CTG included the following controls:

Emission Source	**CTG Recommended Control**
Inks	90% control (condenser filters) for heatset plants

Fountain Solution	1.6% isopropyl alcohol (IPA) for heatset plants (90% reduction) alcohol substitution for non-heatset (99% reduction) 5% IPA for sheet-fed (50% reduction)
Cleaning Solutions	30% VOC content limit (70% reduction)

The emission reductions described in the 15% RPP for this control measure takes into consideration only one type of printer, lithographic printing. The Department adopted a regulation (COMAR 26.11.19.11 C & D) that limits the amount of isopropyl alcohol in the fountain solutions. Web printers are prohibited from using IPA (100 percent control) while sheet-fed printers are limited to no more than 8.5 percent IPA in the fountain solution. Previously, fountain solutions typically contained 16 percent IPA in the fountain solution (46.88 percent reduction). The regulations were adopted in 1989 and the IPA requirements became effective on January 1, 1992.

The 15% RPP did not include rule effectiveness in the calculation for point sources because this measure constitutes an irreversible process change for the web printers. EPA guidance on rule effectiveness states that it is not required for sources for which an irreversible process change has been applied (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology, and Sample Calculations

Based on the CTG (based on employment), it was assumed that offset lithographic printing accounts for 64% of total graphic arts emissions. This percentage contribution was applied to total graphic arts area source emissions to estimate total emissions from offset lithography.

The CTG estimated overall reduction for four model plants: heatset web, non-heatset web, non-heatset sheet-fed, and newspaper non-heated web. Since the CTG did not classify the population of sources into these model plants, the numerical average of the overall sources was used for the nonattainment area reductions.

The average control efficiency of 75% (from the CTG) and the 64 % penetration were applied to area source graphic art emissions to determine total reductions.

The expected area source emission reductions for 2002 are calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) * Rule Effectiveness (Percentage) * Penetration (Percentage) = Expected Emissions Reduction (Tons per day)

0.178 Tons per day * 1.166 (1.194 in 2005) * 0.75 * 0.8 * 0.64 = 0.0797 Tons per day

The total expected emission reductions for the Graphic Arts – Lithographic category in tons per day are the following:

	2005 VOC	2005 NOx
Cecil	0.0816	0.0

6.2.8 Graphic Arts – Flexographic and Rotogravure Printing

This measure would require smaller printers to use control devices and/or low VOC materials to reduce VOC emissions.

Description of Source Type

This source category consists of numerous small flexographic or rotogravure printers that perform non-continuous sheet fed printing and continuous web or roll printing.

Flexographic printing employs plates with raised images and only the raised image comes in contact with the substrate during printing. Typically, flexographic plates are made of plastic, rubber, or some other flexible material, which is attached to a roller or cylinder for ink application. Modern presses are now equipped with enclosed doctor blade systems which eliminate the fountain roller and fountain, thereby reducing evaporation loss. In a typical flexographic printing operation, the cylinder plate is removed from the press and is cleaned in a separate area.

Gravure printing uses almost exclusively electro-mechanically engraved copper image carriers to separate the image area from the non-image area. Typically, the gravure image carrier is a cyclinder. In gravure printing, ink is applied to the engraved cylinder, then wiped from the surface by the doctor blade, leaving ink only on the engraved image area. The printing substrate is brought into contact with the cylinder with sufficient pressure so that it picks up the ink left in the depressions on the cylinder. In a typical gravure printing operation, the cylinder is removed from the press and is re-plated for the new process.

VOC emissions to the air are caused almost entirely by evaporation of the ink solvents.

Control Strategy for Source Type

Although several control devices were evaluated over the years for rotogravure and flexographic web printers, a catalytic oxidizer has proven to be most successful. For heat set web printers, the dryer emissions are ducted directly into the oxidizer yielding nearly a 100 percent capture of emissions. A typical oxidizer yields 96-98 percent destruction of VOC.

The proposed measure would require that:

- Printers reduce emissions by using water-based inks that contain less that 25 percent VOC by volume of the volatile portion of the ink, or high solids inks that contain not less than 60 percent nonvolatiles; or

- If compliance with these requirements cannot be achieved, reduce the VOC content of each ink, or reduce the average VOC content of inks used at each press as follows;

- 60 percent reduction for flexographic presses,
- 65 percent reduction for packaging rotogravure presses, and
- 75 percent reduction for publication rotogravure presses.

Maryland adopted a printing regulation in 1987 that required any person who causes or permits the discharge of any emissions of VOC from any roll-printing utilizing flexography, packaging rotogravure, or publication rotogravure in excess of 550 pounds per day to reduce the discharge by the following percentage indicated:

Roll Printing Method	Reduction
Flexography	60%
Packaging Rotogravure	65%
Publication Rotogravure	75%

This regulation is applicable only to sources emitting over 550 pounds per day and thus only addresses certain point sources. Some web printers were in compliance with this requirement in 1990. Also many printers installed stack afterburners or oxidizers because they were cited for visible emission or nuisance odor violations. Most sources were in compliance with all requirements by early 1992.

The Maryland regulation was amended at the end of 1993 to change the trigger level for installing a control device to 100 pounds per day. In addition, the regulation now addresses all flexographic, packaging rotogravure and publication rotogravure printers who apply a clear protective coating over the printed matter. The provisions of the regulation do not apply to printing on fabric, metal or plastic.

Therefore, the expected point source emission reduction from this control measure are included in the base year uncontrolled emission inventory. However, area source controls have not been reflected in the base year emission inventory.

The 15% RPP did not include rule effectiveness in the calculation for point sources because this measure constitutes an irreversible process change for the web printers. EPA guidance on rule effectiveness states that it is not required for sources for which an irreversible process change has been applied to (Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO SIP Base Year Inventories, EPA-454/R-92-010).

Expected Emissions Reductions, Methodology, and Sample Calculations

Based on a November 1996 EIIP document entitled Graphic Arts, the estimated percentage of product market share for rotogravure printing is 18 percent and the estimated percentage of market share for flexographic printing is 18 percent. This percentage contribution was applied to total graphic arts area source emissions, to estimate total emissions from either flexographic or rotogravure printing.

The average control efficiency for flexographic printers is assumed to be 60% (from COMAR 26.11.19.10)

* 90% (estimated percent of emisssions attibutable to evaporation of ink solvent).

The average control efficiency for rotogravure printers is assumed to be 70% (from COMAR 26.11.19.10) * 90% (estimated percent of emisssions attibutable to evaporation of ink solvent).

The average control efficiency for each type of printing operation and the 18 % penetration were applied to area source graphic art emissions to determine total reductions.

The expected area source emission reductions for 2002 are calculated as follows:

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) * Rule Effectiveness (Percentage) * Penetration (Percentage) = Expected Emissions Reduction (Tons per day)

Flexographic Printing
0.178 Tons per day * 1.166 (1.194 in 2005) * (0.6 * 0.9) * 0.8 * 0.18 = 0. 161 Tons per day

Rotogravure Printing
0.178 Tons per day * 1.166 (1.194 in 2005) * (0.7 * 0.9) * 0.8 * 0.18 = 0.019 Tons per day

The total expected emission reductions in tons per day are the following:

	2005 VOC	**2005 NOx**
Cecil	0.0358	0.0

The total expected emission reductions in tons per day from all printing operations are the following:

	2005 VOC	**2005 NOx**
Cecil	0.1205	0.0

6.3 Non-Road Measures

6.3.1 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.

Description of Source Category

Small gasoline-powered engine equipment includes lawn mowers, trimmers, generators, compressors, etc. 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.

Control Strategy

EPA promulgated regulations for this type of equipment in two phases. In the first phase, EPA developed regulations similar to California's regulation for 1995 and later utility and lawn and garden equipment engines through the normal regulatory process. The second phase of regulation used a consultative approach of negotiated rulemaking to develop consensus on important issues, such as useful life, in-use emissions, evaporative emissions, test procedures, and market based incentive programs.

Expected Emissions Reductions, Methodology and Sample Calculation

The regulation results in a 32 percent reduction in VOC emissions for Phase I. Phase II will produce an additional 4.38% for handheld spark ignition engines and 8.67% reduction for non-handheld spark ignition engines by 2002. Phase II with produce an additional 43.18% for handheld spark ignition engines and 23.88% reduction for non-handheld spark ignition engines by 2005.

The following is a sample calculation of 2005 emissions reductions for Cecil County for trimmers/edgers/brush cutters:

Phase I Emission Reductions:
1990 Emissions (Tons per day) * BEA Growth Factor * Expected Phase I Emissions Reduction (Percentage) = Expected Phase I Emissions Reduction in 2002 (Tons per day)

(0.054 Tons per day * 1.2117 * 0.32) = 0.021ons per day

Phase II Emission Reductions:
{[1990 Emissions (Tons per day) * BEA Growth Factor] – Phase I Emission Reductions} * Expected Additional Phase II Emissions Reductions (Percentage) = Expected Phase II Emissions Reduction in 2002 (Tons per day)

[(0.054 Tons per day * 1.2117) – 0.021] * 0.4318 = 0.019 Tons per day

Total Phase I and Phase II Emission Reductions:
Phase I Emission Reductions + Phase II Emission Reductions = Total Emission Reductions

0.021 + 0.019 = 0.04 Tons per day

The emissions reductions for all involved categories were calculated in a similar fashion with their respective growth factors. A spreadsheet with calculations for this category follow this description.

The expected emission reductions by 2005 in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	0.7374	-0.0119

2005 VOC Emission Credits

Equipment Type	Equip Cat	Cat Type	Diesel VOC tpsd	4-Stroke VOC tpsd	2-Stroke VOC tpsd	Small Gas Engine Emission PH 1 Reduction	Emission After PH 1	Small Gas Engine Emission PH 2 Reduction	Small Gas Engine Emission Total PH 1 & PH 2 Reduction
Trimmers/Edgers/Brush Cutters	1	1	0.000	0.000	0.066	0.0211	0.0449	0.0194	0.0405
Lawn Mowers	1	2	0.000	0.219	0.118	0.1079	0.2293	0.0990	0.2070
Leaf Blowers/Vacuums	1	3	0.000	0.000	0.019	0.0059	0.0126	0.0055	0.0114
Rear Engine Riding Mowers	1	4	0.000	0.004	0.000	0.0012	0.0025	0.0011	0.0023
Front Mowers	1	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Chainsaws <4HP	1	6	0.000	0.000	0.248	0.0793	0.1686	0.0728	0.1521
Shredders <5HP	1	7	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tillers <5HP	1	8	0.000	0.015	0.000	0.0048	0.0101	0.0044	0.0091
Lawn & Garden Tractors	1	9	0.000	0.062	0.000	0.0199	0.0423	0.0182	0.0381
Wood Splitters	1	10	0.000	0.004	0.000	0.0012	0.0025	0.0011	0.0023
Snowblowers	1	11	0.000	0.003	0.000	0.0009	0.0019	0.0008	0.0017
Chippers/Stump Grinders	1	12	0.000	0.015	0.000	0.0000	0.0149	0.0000	0.0000
Commercial Turf Equip.	1	13	0.000	0.058	0.000	0.0184	0.0392	0.0169	0.0353
Other Lawn & Garden Equip.	1	14	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Aircraft Support Equip.	2	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Terminal Tractors	2	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
All Terrain Vehicles	3	1	0.000	0.062	0.022	0.0000	0.0843	0.0000	0.0000
Minibikes	3	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.000	0.000	0.027	0.0000	0.0272	0.0000	0.0000
Golf Carts	3	4	0.000	0.065	0.071	0.0436	0.0926	0.0221	0.0657
Snowmobiles	3	5	0.000	0.000	0.008	0.0000	0.0079	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.000	0.005	0.027	0.0105	0.0222	0.0053	0.0158
Vessels w/Inboard Engines	4	1	0.004	0.006	0.000	0.0000	0.0107	0.0000	0.0000
Vessels w/Outboard Engines	4	2	0.000	0.000	0.650	0.1690	0.4811	0.0000	0.1690
Vessels w/Sternboard Engines	4	3	0.000	0.006	0.000	0.0000	0.0064	0.0000	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Generator Sets <50 HP	5	1	0.000	0.088	0.031	0.0382	0.0812	0.0351	0.0733
Pumps <50 HP	5	2	0.000	0.019	0.000	0.0060	0.0127	0.0055	0.0114
Air Compressors <50 HP	5	3	0.000	0.008	0.000	0.0025	0.0053	0.0023	0.0048
Gas Compressors <50 HP	5	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Welders <50 HP	5	5	0.000	0.016	0.000	0.0050	0.0107	0.0046	0.0096
Pressure Washers <50 HP	5	6	0.000	0.004	0.000	0.0013	0.0027	0.0012	0.0024
Aerial Lifts	6	1	0.000	0.008	0.000	0.0000	0.0076	0.0000	0.0000
Forklifts	6	2	0.004	0.026	0.011	0.0000	0.0416	0.0000	0.0000
Sweepers/Scrubbers	6	3	0.004	0.004	0.000	0.0000	0.0076	0.0000	0.0000
Other Industrial Equip.	6	4	0.000	0.004	0.004	0.0024	0.0051	0.0022	0.0046
Other Material Handling Equip.	6	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Asphalt Pavers	7	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tampers/Rammers	7	2	0.000	0.000	0.006	0.0018	0.0039	0.0017	0.0035
Plate Compactors	7	3	0.000	0.000	0.006	0.0018	0.0039	0.0017	0.0035
Concrete Pavers	7	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Rollers	7	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Scrapers	7	6	0.006	0.000	0.000	0.0000	0.0058	0.0000	0.0000
Paving Equipment	7	7	0.000	0.006	0.006	0.0037	0.0078	0.0019	0.0056
Surfacing Equipment	7	8	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Signal Boards	7	9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Bore/Drill Rigs	7	11	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Excavators	7	12	0.006	0.000	0.000	0.0000	0.0058	0.0000	0.0000
Concrete/Industrial Saws	7	13	0.000	0.006	0.000	0.0018	0.0039	0.0017	0.0035
Cement and Mortar Mixers	7	14	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Cranes	7	15	0.012	0.000	0.000	0.0000	0.0115	0.0000	0.0000
Graders	7	16	0.006	0.000	0.000	0.0000	0.0058	0.0000	0.0000
Off-Highway Trucks	7	17	0.012	0.000	0.000	0.0000	0.0115	0.0000	0.0000
Crushing/Proc. Equip.	7	18	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Rough Terrain Forklifts	7	19	0.006	0.000	0.000	0.0000	0.0058	0.0000	0.0000
Rubber Tired Loaders	7	20	0.012	0.000	0.000	0.0000	0.0115	0.0000	0.0000
Rubber Tired Dozers	7	21	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tractors/Loaders/Backhoes	7	22	0.017	0.000	0.000	0.0000	0.0173	0.0000	0.0000
Crawler Tractors	7	23	0.040	0.000	0.000	0.0000	0.0403	0.0000	0.0000
Skid Steer Loaders	7	24	0.006	0.000	0.000	0.0000	0.0058	0.0000	0.0000
Off-Highway Tractors	7	25	0.017	0.000	0.000	0.0000	0.0173	0.0000	0.0000
Dumpers/Tenders	7	26	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Other Construction Equip.	7	27	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
2-Wheel Tractors	8	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	0.193	0.004	0.000	0.0000	0.1973	0.0000	0.0000
Agricultural Mowers	8	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.004	0.000	0.000	0.0000	0.0044	0.0000	0.0000
Sprayers	8	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Balers	8	6	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tillers >5HP	8	7	0.000	0.031	0.000	0.0098	0.0209	0.0050	0.0148
Swathers	8	8	0.000	0.007	0.000	0.0000	0.0065	0.0000	0.0000
Hydro Power Units	8	9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Other Agricultural Equip.	8	10	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Chainsaws >4HP	9	1	0.000	0.000	0.026	0.0084	0.0179	0.0077	0.0161

Shredders >5HP	9	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
					Total	0.5666			0.9037
		Marine Vessels Reduction Total				0.1690			0.1690
		Total SI Engines minus Marine Vessels				0.3976			0.7347

Projected Phase 2 Annual Nationwide Exhaust HC and NOx Emissions in Tons/Yr
for Nonroad SI Handheld Engines

Year	HC + NOx	HC	NOx
2000	421,420	418,362	3,058
2001	430,254	427,124	3,130
2002	420,785	417,470	3,315
2003	397,428	393,849	3,579
2004	339,542	335,935	3,607
2005	269,251	265,647	3,604

Projected Phase 1 Annual Nationwide Exhaust HC and NOx Emissions in Tons/Yr
for Nonroad SI Handheld Engines

Year	HC + NOx	HC	NOx
2000	421,420	418,362	3,058
2001	430,254	427,124	3,130
2002	439,799	436,587	3,212
2003	449,879	446,584	3,295
2004	460,340	456,961	3,379
2005	470,970	467,505	3,465

Projected Phase 2 Annual Nationwide Exhaust HC and NOx Emissions in Tons/Yr
for Nonroad SI Non-Handheld Engines

Year	HC + NOx	HC	NOx
2000	427,063	356,085	70,978
2001	410,793	339,093	71,700
2002	394,179	322,915	71,264
2003	377,267	307,224	70,043
2004	362,159	293,424	68,735
2005	347,065	279,888	67,177

Projected Phase 1 Annual Nationwide Exhaust HC and NOx Emissions in Tons/Yr
for Nonroad SI Non-Handheld Engines

Year	HC + NOx	HC	NOx
2000	427,063	356,085	70,978
2001	428,442	353,121	75,321
2002	432,010	353,582	78,428
2003	437,973	357,032	80,941
2004	445,141	361,881	83,260
2005	453,129	367,710	85,419

6.3.2 Non-Road Diesel Engines Tier I and Tier II

This measure takes credit for NOx emissions reductions attributable to emissions standards promulgated by the EPA for non-road, compression-ignition (i.e., diesel-powered) utility engines, as authorized under 42 U.S.C. § 7547. 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).

Description of Source Category

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 at or above 37 kW (50 horsepower) 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.

Control Strategy

Federal emissions standards applicable to compression-ignition non-road utility engines were promulgated under §7547 (a). The Federal emissions standard are part of a 3-tiered progression to low emission standards. Each tier involves a phase in (by horsepower rating) over several years. EPA has the authority to require emission standards for nonroad mobile sources under section 213(a)(3) of the Act.

The EPA's initial final rule on the Tier 1 emissions standards was published in 59 *Federal Register* 31306 (June 17, 1994), and was effective on July 18, 1994. These Tier 1 standards were adopted in 1994 for engines over 50 hp (such as bulldozers) and were phased in from 1996 to 2000. EPA has promulgated regulations for NOx emissions and smoke standards for new heavy-duty farm and construction equipment with gross maximum power output measured at or above 37 kW (50 horsepower). The NOx emissions standard is 9.2 grams per kilowatt-hour (6.9 grams per brake horsepower hour). NOx standards will be phased in depending upon the horsepower of the engine, beginning with the 1996 model year. The first standards to take effect will be for engines at or above 175 hp and at or below 750 hp.

The EPA's second rule which promulgated the second and third tier of standards was published in 64 *Federal Register* 56968 (October 23, 1998), and was effective on December 22, 1998. This final rule set Tier 1 standards for engines under 50 hp (such as lawn tractors), phasing in from 1999 to 2000. It also phases in more stringent Tier 2 standards for *all* engine sizes from 2001 to 2006, and yet more stringent Tier 3 standards for engines rated over 50 hp from 2006 to 2008.

Projected reductions are technically achievable within a short time period because the emissions control technologies necessary to meet the proposed standards are known to be effective on similar on-highway engines.

Expected Emissions Reductions, Methodology and Sample Calculation

The Tier I regulation results in NOx emissions reductions of 16.2% by 2002 and 23.5% by 2005. Tier II regulations apply an additional 9.7% reduction to specific equipment types.

The following is a sample calculation of 2005 emissions reductions for Cecil County for agricultural tractors:

Tier 1 Benefits

1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage) = Expected Emissions Reduction in 2005 (Tons per day)

0.942 Tons per day * 1.0 * 0.235 = 0.2215 Tons per day

Tier 2 Benefits

{[1990 Emission (Tons per day) * BEA Growth Factor] – [1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reduction (Percentage)]} * = Expected Emissions Reduction in 2005 (Tons per day)

{[0.942 Tons per day * 1.0] – [0.942 Tons per day * 1.0 * 0.235]} * 0.097 = .0699 Tons per day

Total Benefits = Tier 1 Benefits + Tier 2 Benefits

Total Benefits = 0.2215 + 0.0699
Total Benefits = 0.2914

All of the 2005 emissions reductions were calculated in a similar fashion with their respective growth factors and control efficiencies. A spreadsheet with calculations for this category follows this description.

The expected emission reductions for all equipment types for 2005 in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	0.0	0.6769

2005 NOx Emission HD Diesel Reductions

Equipment Type	Equip Cat	Cat Type	Diesel NOx tpsd	4-Stroke NOx tpsd	2-Stroke NOx tpsd	Tier 1 HD Diesel NOx Reductions	Small Engine Emission Increases	Tier 2 HD Diesel NOx Reductions	Tier 1+2 HD Diesel NOx Reductions
Trimmers/Edgers/Brush Cutters	1	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Lawn Mowers	1	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Leaf Blowers/Vacuums	1	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Rear Engine Riding Mowers	1	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Front Mowers	1	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Chainsaws <4HP	1	6	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Shredders <5HP	1	7	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tillers <5HP	1	8	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Lawn & Garden Tractors	1	9	0.004	0.000	0.000	0.0000	0.0000	0.0008	0.0008
Wood Splitters	1	10	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Snowblowers	1	11	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Chippers/Stump Grinders	1	12	0.004	0.000	0.000	0.0009	0.0000	0.0003	0.0011
Commercial Turf Equip.	1	13	0.000	0.004	0.000	0.0000	-0.0036	0.0000	0.0000
Other Lawn & Garden Equip.	1	14	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Aircraft Support Equip.	2	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Terminal Tractors	2	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
All Terrain Vehicles	3	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Minibikes	3	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Off-Road Motorcycles	3	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Golf Carts	3	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Snowmobiles	3	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Specialty Vehicle Carts	3	6	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Vessels w/Inboard Engines	4	1	0.017	0.017	0.000	0.0000	0.0000	n/a	0.0000
Vessels w/Outboard Engines	4	2	0.000	0.000	0.008	0.0000	-0.0083	n/a	0.0000
Vessels w/Sternboard Engines	4	3	0.000	0.046	0.000	0.0000	0.0000	n/a	0.0000
Sailboat Auxiliary Inboard Engines	4	4	0.000	0.000	0.000	0.0000	0.0000	n/a	0.0000
Sailboat Auxiliary Outboard Engines	4	5	0.000	0.000	0.000	0.0000	0.0000	n/a	0.0000
Generator Sets <50 HP	5	1	0.004	0.000	0.000	0.0000	0.0000	0.0008	0.0008
Pumps <50 HP	5	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Air Compressors <50 HP	5	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Gas Compressors <50 HP	5	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Welders <50 HP	5	5	0.003	0.000	0.000	0.0000	0.0000	0.0006	0.0006
Pressure Washers <50 HP	5	6	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Aerial Lifts	6	1	0.004	0.000	0.000	0.0000	0.0000	0.0008	0.0008
Forklifts	6	2	0.030	0.008	0.030	0.0071	0.0000	0.0022	0.0093
Sweepers/Scrubbers	6	3	0.023	0.000	0.000	0.0053	0.0000	0.0017	0.0070
Other Industrial Equip.	6	4	0.008	0.000	0.000	0.0018	0.0000	0.0006	0.0023
Other Material Handling Equip.	6	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Asphalt Pavers	7	1	0.006	0.000	0.000	0.0014	0.0000	0.0004	0.0018
Tampers/Rammers	7	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Plate Compactors	7	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Concrete Pavers	7	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Rollers	7	5	0.011	0.000	0.000	0.0027	0.0000	0.0009	0.0036
Scrapers	7	6	0.046	0.000	0.000	0.0108	0.0000	0.0034	0.0142
Paving Equipment	7	7	0.017	0.000	0.000	0.0041	0.0000	0.0013	0.0053
Surfacing Equipment	7	8	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Signal Boards	7	9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Trenchers	7	10	0.011	0.000	0.000	0.0027	0.0000	0.0023	0.0050
Bore/Drill Rigs	7	11	0.006	0.000	0.000	0.0014	0.0000	0.0004	0.0018
Excavators	7	12	0.069	0.000	0.000	0.0162	0.0000	0.0051	0.0213
Concrete/Industrial Saws	7	13	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Cement and Mortar Mixers	7	14	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Cranes	7	15	0.080	0.000	0.000	0.0189	0.0000	0.0060	0.0249
Graders	7	16	0.040	0.000	0.000	0.0095	0.0000	0.0030	0.0124
Off-Highway Trucks	7	17	0.109	0.000	0.000	0.0257	0.0000	0.0081	0.0338
Crushing/Proc. Equip.	7	18	0.011	0.000	0.000	0.0027	0.0000	0.0009	0.0036
Rough Terrain Forklifts	7	19	0.017	0.000	0.000	0.0041	0.0000	0.0013	0.0053
Rubber Tired Loaders	7	20	0.121	0.000	0.000	0.0284	0.0000	0.0090	0.0373
Rubber Tired Dozers	7	21	0.023	0.000	0.000	0.0054	0.0000	0.0017	0.0071
Tractors/Loaders/Backhoes	7	22	0.126	0.000	0.000	0.0297	0.0000	0.0094	0.0391
Crawler Tractors	7	23	0.310	0.000	0.000	0.0729	0.0000	0.0230	0.0960
Skid Steer Loaders	7	24	0.023	0.000	0.000	0.0000	0.0000	0.0047	0.0047
Off-Highway Tractors	7	25	0.075	0.000	0.000	0.0176	0.0000	0.0055	0.0231
Dumpers/Tenders	7	26	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Other Construction Equip.	7	27	0.011	0.000	0.000	0.0027	0.0000	0.0009	0.0036
2-Wheel Tractors	8	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Agricultural Tractors	8	2	0.942	0.000	0.000	0.2215	0.0000	0.0699	0.2914
Agricultural Mowers	8	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Combines	8	4	0.053	0.000	0.000	0.0124	0.0000	0.0039	0.0163
Sprayers	8	5	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Balers	8	6	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Tillers >5HP	8	7	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000

Swathers	8	8	0.009	0.000	0.000	0.0021	0.0000	0.0007	0.0027
Hydro Power Units	8	9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Other Agricultural Equip.	8	10	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Chainsaws >4HP	9	1	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Shredders >5HP	9	2	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Skidders	9	3	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Fellers/Bunchers	9	4	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000
Total						0.5076	-0.0036	0.1693	0.6769

6.3.3 Marine Engine Standards

This measure controls exhaust emissions from new spark-ignition (SI) gasoline marine engines, including outboard engines, personal watercraft engines, and jet boat engines. Of 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).

Control Strategy for Source Type

Once the program is fully implemented, manufacturers of these engines must demonstrate to EPA that hydrocarbon emissions are reduced by 75 percent from present levels, by testing engines representative of the product line before sale and after use. EPA is imposing emission standards for 2 – stroke technology, outboard and personal watercraft engines. This will involve increasingly stringent HC control over the course of a nine-year phase-in period beginning in model year 1998. By the end of the phase-in, each manufacturer must meet an HC and NOx emission standard that represents a 75% reduction in HC compared to unregulated levels.

Each manufacturer is allowed to decide the type of control technologies to be applied to each engine type. However, there will be a pre-production certification program that requires all gasoline marine engine families to be certified by EPA as meeting applicable emissions standards before they are introduced into commerce. Manufacturers will comply by testing engines as they leave the production line, at appropriate sampling rates. Manufacturers will also have to test a portion of their fleet each year to determine if their engines are meeting emission standards while in use. These standards do not apply to any currently owned engines or boats.

Expected Emissions Reductions

The Code of Federal Register (40 CFR Parts 89, 90 and 91) rule entitled Control of Air Pollution; Final Rule for New Gasoline Spark-Ignition Marine Engines; Exemptions for New Nonroad Compression-Ignition Engines at or Above 37 Kilowatts and New Nonroad Spark-Ignition Engines at or Below 19 Kilowatts lists the projected inventory reductions for outboard/personal watercraft (OB/PWC) engines. These reduction percentages are listed in Table 3 of the document and are reproduced below.

TABLE 3. – PROJECTED INVENTORY REDUCTIONS

Year	Percent reduction in OB/PWC HC inventory
2000	4
2005	26
2010	52
2015	68
2020	73
2030	75

Linearly extrapolating the data between 2000 and 2005 yields a 2002 percent reduction in HC inventory of 12.8 percent. The expected emissions reductions by 2005 in tons per day are as follows:

	2005 VOC	**2005 NOx**
Cecil	0.1690	-0.0083

6.3.4 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.

Description of Source Category

The new EPA requirements vary depending on the kind of engine or vehicle, taking into account environmental impacts, usage rates, the need for high performance models, costs and other factors. 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. Controls on the other engine categories are required beginning in years after 2005. 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.

EPA adopted two tiers of emission standards for Large SI engines. The first tier of standards, scheduled to start in 2004, are based on a simple laboratory measurement using steady-state procedures. The Tier 1 standards are the same as those adopted earlier by the California Air Resources Board for engines used in California. The Tier 2 standards starting in 2007

This program will be implemented by the EPA under 42 U.S.C. § 7547 (a).

Projected Reductions

Expected Emissions Reductions, Methodology and Sample Calculation

EPA's "Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," (EPA420-R-02-022, September 2002), presents the emission reductions to be expected from the large industrial spark-ignition engine category in 2005. HC emissions will be reduced 24% and NOx emissions reduced 21% in 2005. These reductions were applied to the appropriate category types in the nonroad inventory.

	2005 VOC	**2005 NOx**
Cecil	.018	-0.0079

References

1990 Clean Air Act Amendments, 42 U.S.C. §7547 (a).

U.S. Environmental Protection Agency, "Control of Emissions From Nonroad Large Spark-Ignition Engines, and Recreational Engines (Marine and Land-Based)," Final Rule, 67 Federal Register 68241 (November 8, 2002).

U.S. Environmental Protection Agency, Final Regulatory Support Document: Control of Emissions from Unregulated Nonroad Engines," EPA420-R-02-022, September 2002.

Large Spark Ignition Standard (LSIS) VOC Credits Calculation

LSIS Rule Coverage	Equipment Type	Equip Cat	Cat Type	2005 Emissions Diesel VOC (tpsd)	2005 Emissions 4-Stroke VOC (tpsd)	2005 Emissions 2-Stroke VOC (tpsd)	2005 Emission Reductions (tpsd)
	Trimmers/Edgers/Brush Cutters	1	1	0.000	0.000	0.066	0.0000
	Lawn Mowers	1	2	0.000	0.219	0.118	0.0000
	Leaf Blowers/Vacuums	1	3	0.000	0.000	0.019	0.0000
	Rear Engine Riding Mowers	1	4	0.000	0.004	0.000	0.0000
	Front Mowers	1	5	0.000	0.000	0.000	0.0000
	Chainsaws <4HP	1	6	0.000	0.000	0.248	0.0000
	Shredders <5HP	1	7	0.000	0.000	0.000	0.0000
	Tillers <5HP	1	8	0.000	0.015	0.000	0.0000
	Lawn & Garden Tractors	1	9	0.000	0.062	0.000	0.0000
	Wood Splitters	1	10	0.000	0.004	0.000	0.0000
	Snowblowers	1	11	0.000	0.003	0.000	0.0000
yes	Chippers/Stump Grinders	1	12	0.000	0.015	0.000	0.0036
	Commercial Turf Equip.	1	13	0.000	0.058	0.000	0.0000
	Other Lawn & Garden Equip.	1	14	0.000	0.000	0.000	0.0000
yes	Aircraft Support Equip.	2	1	0.000	0.000	0.000	0.0000
yes	Terminal Tractors	2	2	0.000	0.000	0.000	0.0000
	All Terrain Vehicles	3	1	0.000	0.062	0.022	0.0000
	Minibikes	3	2	0.000	0.000	0.000	0.0000
	Off-Road Motorcycles	3	3	0.000	0.000	0.027	0.0000
	Golf Carts	3	4	0.000	0.065	0.071	0.0000
	Snowmobiles	3	5	0.000	0.000	0.008	0.0000
	Specialty Vehicle Carts	3	6	0.000	0.005	0.027	0.0000
	Vessels w/Inboard Engines	4	1	0.004	0.006	0.000	0.0000
	Vessels w/Outboard Engines	4	2	0.000	0.000	0.650	0.0000
	Vessels w/Sternboard Engines	4	3	0.000	0.006	0.000	0.0000
	Sailboat Auxiliary Inboard Engines	4	4	0.000	0.000	0.000	0.0000
	Sailboat Auxiliary Outboard Engines	4	5	0.000	0.000	0.000	0.0000
	Generator Sets <50 HP	5	1	0.000	0.088	0.031	0.0000
	Pumps <50 HP	5	2	0.000	0.019	0.000	0.0000
	Air Compressors <50 HP	5	3	0.000	0.008	0.000	0.0000
yes	Gas Compressors <50 HP	5	4	0.000	0.000	0.000	0.0000
	Welders <50 HP	5	5	0.000	0.016	0.000	0.0000
	Pressure Washers <50 HP	5	6	0.000	0.004	0.000	0.0000
yes	Aerial Lifts	6	1	0.000	0.008	0.000	0.0018
yes	Forklifts	6	2	0.004	0.026	0.011	0.0091
yes	Sweepers/Scrubbers	6	3	0.004	0.004	0.000	0.0009
	Other Industrial Equip.	6	4	0.000	0.004	0.004	0.0000
yes	Other Material Handling Equip.	6	5	0.000	0.000	0.000	0.0000
	Asphalt Pavers	7	1	0.000	0.000	0.000	0.0000
	Tampers/Rammers	7	2	0.000	0.000	0.006	0.0000
	Plate Compactors	7	3	0.000	0.000	0.006	0.0000

Large Spark Ignition Standard (LSIS) VOC Credits Calculation

LSIS Rule Coverage	Equipment Type	Equip Cat	Cat Type	2005 Emissions Diesel VOC (tpsd)	2005 Emissions 4-Stroke VOC (tpsd)	2005 Emissions 2-Stroke VOC (tpsd)	2005 Emission Reductions (tpsd)
yes	Concrete Pavers	7	4	0.000	0.000	0.000	0.0000
	Rollers	7	5	0.000	0.000	0.000	0.0000
	Scrapers	7	6	0.006	0.000	0.000	0.0000
	Paving Equipment	7	7	0.000	0.006	0.006	0.0000
	Surfacing Equipment	7	8	0.000	0.000	0.000	0.0000
	Signal Boards	7	9	0.000	0.000	0.000	0.0000
yes	Trenchers	7	10	0.000	0.000	0.000	0.0000
yes	Bore/Drill Rigs	7	11	0.000	0.000	0.000	0.0000
	Excavators	7	12	0.006	0.000	0.000	0.0000
	Concrete/Industrial Saws	7	13	0.000	0.006	0.000	0.0000
	Cement and Mortar Mixers	7	14	0.000	0.000	0.000	0.0000
yes	Cranes	7	15	0.012	0.000	0.000	0.0000
	Graders	7	16	0.006	0.000	0.000	0.0000
	Off-Highway Trucks	7	17	0.012	0.000	0.000	0.0000
yes	Crushing/Proc. Equip.	7	18	0.000	0.000	0.000	0.0000
yes	Rough Terrain Forklifts	7	19	0.006	0.000	0.000	0.0000
yes	Rubber Tired Loaders	7	20	0.012	0.000	0.000	0.0000
	Rubber Tired Dozers	7	21	0.000	0.000	0.000	0.0000
yes	Tractors/Loaders/Backhoes	7	22	0.017	0.000	0.000	0.0000
	Crawler Tractors	7	23	0.040	0.000	0.000	0.0000
yes	Skid Steer Loaders	7	24	0.006	0.000	0.000	0.0000
	Off-Highway Tractors	7	25	0.017	0.000	0.000	0.0000
	Dumpers/Tenders	7	26	0.000	0.000	0.000	0.0000
yes	Other Construction Equip.	7	27	0.000	0.000	0.000	0.0000
	2-Wheel Tractors	8	1	0.000	0.000	0.000	0.0000
yes	Agricultural Tractors	8	2	0.193	0.004	0.000	0.0011
	Agricultural Mowers	8	3	0.000	0.000	0.000	0.0000
yes	Combines	8	4	0.004	0.000	0.000	0.0000
	Sprayers	8	5	0.000	0.000	0.000	0.0000
yes	Balers	8	6	0.000	0.000	0.000	0.0000
	Tillers >5HP	8	7	0.000	0.031	0.000	0.0000
yes	Swathers	8	8	0.000	0.007	0.000	0.0016
	Hydro Power Units	8	9	0.000	0.000	0.000	0.0000
yes	Other Agricultural Equip.	8	10	0.000	0.000	0.000	0.0000
	Chainsaws >4HP	9	1	0.000	0.000	0.026	0.0000
	Shredders >5HP	9	2	0.000	0.000	0.000	0.0000
	Skidders	9	3	0.000	0.000	0.000	0.0000
	Fellers/Bunchers	9	4	0.000	0.000	0.000	0.0000
	TOTAL						0.0180

Large Spark Ignition Standard (LSIS) NOx Credits Calculation

LSIS Rule Coverage	Equipment Type	Equip Cat	Cat Type	2005 Emissions Diesel NOx (tpsd)	2005 Emissions 4-Stroke NOx (tpsd)	2005 Emissions 2-Stroke NOx (tpsd)	2005 Emission Reductions (tpsd)
	Trimmers/Edgers/Brush Cutters	1	1	0.000	0.000	0.000	0.000
	Lawn Mowers	1	2	0.000	0.000	0.000	0.000
	Leaf Blowers/Vacuums	1	3	0.000	0.000	0.000	0.000
	Rear Engine Riding Mowers	1	4	0.000	0.000	0.000	0.000
	Front Mowers	1	5	0.000	0.000	0.000	0.000
	Chainsaws <4HP	1	6	0.000	0.000	0.000	0.000
	Shredders <5HP	1	7	0.000	0.000	0.000	0.000
	Tillers <5HP	1	8	0.000	0.000	0.000	0.000
	Lawn & Garden Tractors	1	9	0.004	0.000	0.000	0.000
	Wood Splitters	1	10	0.000	0.000	0.000	0.000
	Snowblowers	1	11	0.000	0.000	0.000	0.000
yes	Chippers/Stump Grinders	1	12	0.004	0.000	0.000	0.000
	Commercial Turf Equip.	1	13	0.000	0.004	0.000	0.000
	Other Lawn & Garden Equip.	1	14	0.000	0.000	0.000	0.000
yes	Aircraft Support Equip.	2	1	0.000	0.000	0.000	0.000
yes	Terminal Tractors	2	2	0.000	0.000	0.000	0.000
	All Terrain Vehicles	3	1	0.000	0.000	0.000	0.000
	Minibikes	3	2	0.000	0.000	0.000	0.000
	Off-Road Motorcycles	3	3	0.000	0.000	0.000	0.000
	Golf Carts	3	4	0.000	0.000	0.000	0.000
	Snowmobiles	3	5	0.000	0.000	0.000	0.000
	Specialty Vehicle Carts	3	6	0.000	0.000	0.000	0.000
	Vessels w/Inboard Engines	4	1	0.017	0.017	0.000	0.000
	Vessels w/Outboard Engines	4	2	0.000	0.000	0.008	0.000
	Vessels w/Sternboard Engines	4	3	0.000	0.046	0.000	0.000
	Sailboat Auxiliary Inboard Engines	4	4	0.000	0.000	0.000	0.000
	Sailboat Auxiliary Outboard Engines	4	5	0.000	0.000	0.000	0.000
	Generator Sets <50 HP	5	1	0.004	0.000	0.000	0.000
	Pumps <50 HP	5	2	0.000	0.000	0.000	0.000
	Air Compressors <50 HP	5	3	0.000	0.000	0.000	0.000
yes	Gas Compressors <50 HP	5	4	0.000	0.000	0.000	0.000
	Welders <50 HP	5	5	0.003	0.000	0.000	0.000
	Pressure Washers <50 HP	5	6	0.000	0.000	0.000	0.000
yes	Aerial Lifts	6	1	0.004	0.000	0.000	0.000
yes	Forklifts	6	2	0.030	0.008	0.030	0.007
yes	Sweepers/Scrubbers	6	3	0.023	0.000	0.000	0.000
	Other Industrial Equip.	6	4	0.008	0.000	0.000	0.000
yes	Other Material Handling Equip.	6	5	0.000	0.000	0.000	0.000
	Asphalt Pavers	7	1	0.006	0.000	0.000	0.000
	Tampers/Rammers	7	2	0.000	0.000	0.000	0.000
	Plate Compactors	7	3	0.000	0.000	0.000	0.000

Large Spark Ignition Standard (LSIS) NOx Credits Calculation

LSIS Rule Coverage	Equipment Type	Equip Cat	Cat Type	2005 Emissions Diesel NOx (tpsd)	2005 Emissions 4-Stroke NOx (tpsd)	2005 Emissions 2-Stroke NOx (tpsd)	2005 Emission Reductions (tpsd)
yes	Concrete Pavers	7	4	0.000	0.000	0.000	0.000
	Rollers	7	5	0.011	0.000	0.000	0.000
	Scrapers	7	6	0.046	0.000	0.000	0.000
	Paving Equipment	7	7	0.017	0.000	0.000	0.000
	Surfacing Equipment	7	8	0.000	0.000	0.000	0.000
	Signal Boards	7	9	0.000	0.000	0.000	0.000
yes	Trenchers	7	10	0.011	0.000	0.000	0.000
yes	Bore/Drill Rigs	7	11	0.006	0.000	0.000	0.000
	Excavators	7	12	0.069	0.000	0.000	0.000
	Concrete/Industrial Saws	7	13	0.000	0.000	0.000	0.000
	Cement and Mortar Mixers	7	14	0.000	0.000	0.000	0.000
yes	Cranes	7	15	0.080	0.000	0.000	0.000
	Graders	7	16	0.040	0.000	0.000	0.000
	Off-Highway Trucks	7	17	0.109	0.000	0.000	0.000
yes	Crushing/Proc. Equip.	7	18	0.011	0.000	0.000	0.000
yes	Rough Terrain Forklifts	7	19	0.017	0.000	0.000	0.000
yes	Rubber Tired Loaders	7	20	0.121	0.000	0.000	0.000
	Rubber Tired Dozers	7	21	0.023	0.000	0.000	0.000
yes	Tractors/Loaders/Backhoes	7	22	0.126	0.000	0.000	0.000
	Crawler Tractors	7	23	0.310	0.000	0.000	0.000
yes	Skid Steer Loaders	7	24	0.023	0.000	0.000	0.000
	Off-Highway Tractors	7	25	0.075	0.000	0.000	0.000
	Dumpers/Tenders	7	26	0.000	0.000	0.000	0.000
yes	Other Construction Equip.	7	27	0.011	0.000	0.000	0.000
	2-Wheel Tractors	8	1	0.000	0.000	0.000	0.000
yes	Agricultural Tractors	8	2	0.942	0.000	0.000	0.000
	Agricultural Mowers	8	3	0.000	0.000	0.000	0.000
yes	Combines	8	4	0.053	0.000	0.000	0.000
	Sprayers	8	5	0.000	0.000	0.000	0.000
yes	Balers	8	6	0.000	0.000	0.000	0.000
	Tillers >5HP	8	7	0.000	0.000	0.000	0.000
yes	Swathers	8	8	0.009	0.000	0.000	0.000
	Hydro Power Units	8	9	0.000	0.000	0.000	0.000
yes	Other Agricultural Equip.	8	10	0.000	0.000	0.000	0.000
	Chainsaws >4HP	9	1	0.000	0.000	0.000	0.000
	Shredders >5HP	9	2	0.000	0.000	0.000	0.000
	Skidders	9	3	0.000	0.000	0.000	0.000
	Fellers/Bunchers	9	4	0.000	0.000	0.000	0.000
	TOTAL			0.000	0.000	0.000	0.007

6.3.5 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 reductions due to 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. Reformulated gasoline has been available in the Baltimore, MD ozone nonattainment area since 1995.

Description of Source Category

This measure affects the various non-road mobile sources that burn gasoline, such as small gasoline-powered engine equipment includes lawn mowers, trimmers, generators, compressors, etc. VOC emissions result from combustion and evaporation of gasoline used to power this equipment.

Control Strategy

Federal reformulated gasoline has been sold in the Baltimore Nonattainment Area since 1995.

Expected Emissions Reductions, Methodology and Sample Calculation

Refueling emissions for on-road sources are already calculated in the Baltimore, MD ozone nonattainment area's mobile source inventory.

In an August 18, 1993, memorandum, EPA’s Office of Mobile Sources lists several factors for use in computing reduction credits for the use of reformulated gasoline in non-road equipment. Using the EPA memorandum, the emissions reduction factor is 3.324%, and the calculated emissions reductions therefore are as follows:

$$\text{2005 Expected VOC Emissions Reductions (tons/day)} = \text{Uncontrolled 2005 non-road mobile source VOC emissions inventory} \times \text{0.03324 reduction factor} \times \text{Gasoline component of the non-road mobile sources VOC inventory}$$

$$\text{2005 Expected VOC Emissions Reductions (tons/day)} = 2.447 \times 0.03324 \times \frac{2.1}{2.447}$$

$$\text{2005 Expected VOC Emissions Reductions (tons/day)} = 0.698$$

The 1999 and 2002 emissions reductions were calculated in a similar fashion.

The expected emission reductions by 1999, 2002 and 2005 in tons per day are:

	2005 VOC	**2005 NOx**
Cecil	0.698	0.0

2005 Nonroad Mobile VOC Emission

Equipment Type	Equip Cat	Cat Type	Diesel VOC (tpsd)	4 –Stroke VOC (tpsd)	2-Stroke VOC (tpsd)
Trimmers/Edgers/Brush Cutters	1	1	0.000	0.000	0.066
Lawn Mowers	1	2	0.000	0.219	0.118
Leaf Blowers/Vacuums	1	3	0.000	0.000	0.019
Rear Engine Riding Mowers	1	4	0.000	0.004	0.000
Front Mowers	1	5	0.000	0.000	0.000
Chainsaws <4HP	1	6	0.000	0.000	0.248
Shredders <5HP	1	7	0.000	0.000	0.000
Tillers <5HP	1	8	0.000	0.015	0.000
Lawn & Garden Tractors	1	9	0.000	0.062	0.000
Wood Splitters	1	10	0.000	0.004	0.000
Snowblowers	1	11	0.000	0.003	0.000
Chippers/Stump Grinders	1	12	0.000	0.015	0.000
Commercial Turf Equip.	1	13	0.000	0.058	0.000
Other Lawn & Garden Equip.	1	14	0.000	0.000	0.000
Aircraft Support Equip.	2	1	0.000	0.000	0.000
Terminal Tractors	2	2	0.000	0.000	0.000
All Terrain Vehicles	3	1	0.000	0.062	0.022
Minibikes	3	2	0.000	0.000	0.000
Off-Road Motorcycles	3	3	0.000	0.000	0.027
Golf Carts	3	4	0.000	0.065	0.071
Snowmobiles	3	5	0.000	0.000	0.008
Specialty Vehicle Carts	3	6	0.000	0.005	0.027
Vessels w/Inboard Engines	4	1	0.004	0.006	0.000
Vessels w/Outboard Engines	4	2	0.000	0.000	0.650
Vessels w/Sternboard Engines	4	3	0.000	0.006	0.000
Sailboat Auxiliary Inboard Engines	4	4	0.000	0.000	0.000
Sailboat Auxiliary Outboard Engines	4	5	0.000	0.000	0.000
Generator Sets <50 HP	5	1	0.000	0.088	0.031
Pumps <50 HP	5	2	0.000	0.019	0.000
Air Compressors <50 HP	5	3	0.000	0.008	0.000
Gas Compressors <50 HP	5	4	0.000	0.000	0.000
Welders <50 HP	5	5	0.000	0.016	0.000
Pressure Washers <50 HP	5	6	0.000	0.004	0.000
Aerial Lifts	6	1	0.000	0.008	0.000
Forklifts	6	2	0.004	0.026	0.011
Sweepers/Scrubbers	6	3	0.004	0.004	0.000
Other Industrial Equip.	6	4	0.000	0.004	0.004
Other Material Handling Equip.	6	5	0.000	0.000	0.000
Asphalt Pavers	7	1	0.000	0.000	0.000
Tampers/Rammers	7	2	0.000	0.000	0.006
Plate Compactors	7	3	0.000	0.000	0.006
Concrete Pavers	7	4	0.000	0.000	0.000
Rollers	7	5	0.000	0.000	0.000
Scrapers	7	6	0.006	0.000	0.000
Paving Equipment	7	7	0.000	0.006	0.006
Surfacing Equipment	7	8	0.000	0.000	0.000
Signal Boards	7	9	0.000	0.000	0.000
Trenchers	7	10	0.000	0.000	0.000
Bore/Drill Rigs	7	11	0.000	0.000	0.000
Excavators	7	12	0.006	0.000	0.000
Concrete/Industrial Saws	7	13	0.000	0.006	0.000
Cement and Mortar Mixers	7	14	0.000	0.000	0.000
Cranes	7	15	0.012	0.000	0.000
Graders	7	16	0.006	0.000	0.000
Off-Highway Trucks	7	17	0.012	0.000	0.000
Crushing/Proc. Equip.	7	18	0.000	0.000	0.000
Rough Terrain Forklifts	7	19	0.006	0.000	0.000
Rubber Tired Loaders	7	20	0.012	0.000	0.000
Rubber Tired Dozers	7	21	0.000	0.000	0.000
Tractors/Loaders/Backhoes	7	22	0.017	0.000	0.000
Crawler Tractors	7	23	0.040	0.000	0.000
Skid Steer Loaders	7	24	0.006	0.000	0.000
Off-Highway Tractors	7	25	0.017	0.000	0.000
Dumpers/Tenders	7	26	0.000	0.000	0.000
Other Construction Equip.	7	27	0.000	0.000	0.000
2-Wheel Tractors	8	1	0.000	0.000	0.000
Agricultural Tractors	8	2	0.193	0.004	0.000
Agricultural Mowers	8	3	0.000	0.000	0.000
Combines	8	4	0.004	0.000	0.000
Sprayers	8	5	0.000	0.000	0.000
Balers	8	6	0.000	0.000	0.000
Tillers >5HP	8	7	0.000	0.031	0.000
Swathers	8	8	0.000	0.007	0.000
Hydro Power Units	8	9	0.000	0.000	0.000
Other Agricultural Equip.	8	10	0.000	0.000	0.000
Chainsaws >4HP	9	1	0.000	0.000	0.026
Shredders >5HP	9	2	0.000	0.000	0.000

Skidders	9	3	0.000	0.000	0.000
Fellers/Bunchers	9	4	0.000	0.000	0.000
TOTAL			0.347	0.754	1.346

References

U.S. Environmental Protection Agency, "Regulation of Fuels and Fuel Additives: Standards for Reformulated Gasoline", Proposed Rule, 58 *Federal Register* 11722, February 26, 1993.

"VOC Emission Benefits for Non-Road Equipment with the Use of Federal Phase I Reformulated Gasoline", memorandum from Phil Lorang, U.S. EPA Office of Mobile Sources to Air Directors, EPA Regions 1-10, August 18, 1993.

6.3.6 Railroad Engine Standards

This measure establishes emission standards for oxides of nitrogen (NOx), hydrocarbons (HC), carbon monoxide (CO), particulate matter (PM) and smoke for newly manufactured and remanufactured diesel-powered locomotives and locomotive engines, which have previously been unregulated.

Control Strategy for Source Type

This regulation will take effect in 2000 and will affect railroad manufacturers and locomotive re-manufacturers. It involves adoption of three separate sets of emission standards with applicability dependent on the date a locomotive is first manufactured. The first set of standards (Tier 0) applies to locomotives originally manufactured from 1973 through 2000. The second set of standards (Tier 1) applies to locomotives and locomotive engines manufactured from 2002 through 2004. The final set of standards (Tier 2) apply to locomotives and locomotive engines originally manufactured in 2005 and later. Locomotives and locomotive engines will be required to meet the Tier 1 standards at original manufacture and at each subsequent remanufacture.

EPA has adopted a production line testing (PLT) program that requires manufacturers, and in some cases, re-manufacturers of locomotives to perform production line testing of newly manufactured and remanufactured locomotives as they leave the point where the manufacture or remanufacture is completed. EPA is also planning to adopt an in-use-testing program to ensure that locomotives continue to meet emission standards during actual operation. EPA has also adopted averaging, banking and trading (ABT) provisions to allow manufacturers and re-manufacturers the flexibility to meet overall emissions goals at the lowest cost, while allowing EPA to set emissions standards at levels more stringent than they would be if each and every engine family had to comply with the standards.

Expected Emissions Reductions, Methodology and Sample Calculation

According to the EPA[4], the regulation should result in NOx emissions reductions of 23.9 % by 2002 and 41.8 % by 2005.

> The following is a sample calculation of 2005 emissions reductions for the Baltimore nonattainment area for railroad locomotives:
>
> 1990 Emissions (Tons per day) * BEA Growth Factor * Expected Emissions Reductions (Percentage) = Expected Emissions Reduction in 2005 (Tons per day)
>
> 0.52 Tons per day * 0.9592 * 0.418 = 0.2085 Tons per day

The 1999 and 2005 emissions reductions were calculated in a similar fashion with their respective growth factors. The expected emissions reductions by 1999, 2002 and 2005 in tons per day are:

---

4 Memorandum from Philip A. Lorang, Director Emission Planning and Strategies Division, dated January 12, 1995

	2005 VOC	2005 NOx
Cecil	0.00	0.2085

7.0 CONTINGENCY MEASURES

The Act requires the State to adopt specific contingency measures that will take effect without further action by the State or the EPA if the State fails to reduce VOC/NOx emissions by an additional 3% per year from 1997 through 2005.

The contingency measures identified by the State must be sufficient to secure an additional 3 percent reduction in ozone precursor emissions in the year following the year in which the failure has been identified. If the shortfall is less than 3 percent, a contingency measure need only cover that smaller percentage. If the shortfall is greater than 3 percent, the State, in an annual tracking report to EPA, must either identify the additional actions it will take to cure the shortfall before the next milestone or maintain a reserve of contingency measures capable of covering a shortfall greater than 3 percent. Early implementation of an emission reduction measure to be implemented in the future is acceptable as a contingency measure.

Table 7.1: Contingency Measure Calculation

Contingency Measure Calculation Cecil County Emissions in Tons per Day		
[A]	1990 Base Year Inventory	52.87
[B]	Biogenic Emissions	32.96
[C=A-B]	1990 Rate-of Progress Base Year Inventory	19.91
[D]	FMVCP/RVP Reductions Between 1990 and 2005	3.20
[E=C-D]	1990 Adjusted Base Year Inventory Calculated Relative to 2005	16.71
[R]	Percent Contingency Measure Reduction Requirement (3%)	0.03
[(Contingency)=C*R]	Contingency Measure Reduction Requirements	0.5013

The following contingency plan has been developed.

7.1 Surplus Reductions from Existing Measures

Some emission control strategies listed to meet the 2005 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:

? Open Burning Ban

VOC and NOx emission reductions from the open burning ban rule included in this ROP demonstration result in surplus emission reductions required to meet the 2005 target level. EPA guidance allows the use of NOx substitution for required VOC contingency reductions if NOx is needed to attain the federal ozone standard. Attainment demonstration modeling has shown that NOx reductions are needed in Cecil County.

Therefore, for 2005, Maryland will use NOx substitution to meet the VOC contingency requirement remaining after the VOC surplus has been utilized.

	2005 VOC Surplus	**2005 NOx Substitution – Open Burning**
Cecil [5]	0.32	0.74

5 Emissions available for contingency measures.

Appendix A: MOBILE6 Documentation for Cecil County

The Cecil County Ozone Non-Attainment Area

An Explanation of Methodology For Developing Mobile Source Emissions Budgets Using MOBILE6

Prepared for:

Mobile Sources Control Program
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, MD 21230

Prepared by:
Michael Baker, Jr., Inc.

April 2003

The Cecil County Ozone Non-Attainment Area
State Implementation Plan Revision Using MOBILE6
An Explanation of Methodology
April 2003

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Appendix B **1990 Cecil County mobile6 input scripts**

OVERVIEW

This document reflects the highway mobile sources emission estimations for the Cecil County 2005 ozone non-attainment area using EPA's recently approved MOBILE6 emission model that will revise the interim MOBILE5-based (Tier 2) motor vehicle emissions budget. The latest version of MOBILE is a major revision based on new test data and accounts for changes in vehicle technology and regulations. In addition, the model includes an improved understanding of in-use emission levels and the factors that influence them resulting in significantly more detailed input data. The revised motor vehicle emissions budgets using MOBILE6 are presented in the following table.

Table 1 Cecil County MOBILE6 Motor Vehicle Emissions Summary

Year	VOC (tons per day)	NO_x (tons per day)
2005	3.0	11.3

As compared to previous MOBILE versions, MOBILE6 has a significant impact on the emission factors, benefits of available control strategies, effects of new regulations and corrections to basic emission rates. As a result, the emissions rates are different and it is difficult to compare the results directly to previous runs conducted with MOBILE5. For this reason, 1990 emission totals are reanalyzed using MOBILE6 and its available input parameters.

Guidance documents from EPA were used to develop the inventory for the Cecil County Non-Attainment area. They include:

? *Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity,* US EPA Office of Air and Radiation, dated January 18, 2002.
? *Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation,* US EPA Office of Air and Radiation, and Office of Transportation and Air Quality, dated January 2002.
? *User's Guide to MOBILE6.0, Mobile Source Emission Factor Model,* EPA420-R-02-001, dated January 2002.

The methodologies used to produce the MOBILE6 emission results conform to the recommendations provided in EPA's Technical Guidance. A mix of local data and national default input data (internal to MOBILE6) has been used for this submission. Local data has been used for the primary data items that have a significant impact on emissions. This includes VMT, speeds, vehicle mixes, age distributions, diesel sales fractions, hourly distributions, temperatures, and inspection/maintenance and fuel program characteristics.

Some of the planning assumptions and modeling tools have been updated for this inventory effort. The key elements to the modeling protocol which have been updated are outlined below:

Cecil County Travel Demand Model

The roadway data input to the emissions calculations for the Cecil County non-attainment region is based on a travel demand model developed by the Maryland Department of Transportation. The model, which was developed using the MINUTP software platform, incorporates the following:

- ? Produces daily traffic volumes.
- ? Follows traditional “4-step” process – Trip generation, Trip Distribution, Mode Split, and Traffic Assignment.
- ? Calibrated/validated to year 1999 traffic count data.
- ? Utilizes socioeconomic projections, including employment, households, and population as recommended by the Technical Advisory Committee (TAC) and adopted by the WILMAPCO Council on May 3rd, 2001.
- ? Networks include the major capacity improvement projects that will be in place and open to service in the year 2005.

PPSUITE Post Processor

PPSUITE was used for the first time for Cecil County inventory submissions. PPSUITE represents an enhanced version of the Post Processor for Air Quality (PPAQ) software system that has been used for previous inventory and conformity submissions in Pennsylvania, Virginia, New Jersey, and the New York City Metropolitan Area. The software has gone through a significant revision to ensure consistency with the MOBILE6 emissions model. PPSUITE is used to process the outputs from the regional travel demand model runs for 1990 and 2005 including the development of roadway speed estimates, which are supplied as input to the MOBILE6 model. The software is also used to prepare and run the MOBILE6 input files and to process the MOBILE6 outputs.

Cecil County Inspection/Maintenance Program

The 1990 analysis run assumes no inspection/maintenance program for the region. The 2005 analysis run assumes an inspection program with the following key elements:

- ? An OBDII computer check for 1996 and newer model year gas vehicles up to 8,500 pounds.
- ? An IM240 tail pipe test for 1984 to 1995 gas vehicles and trucks up to 10,000 pounds.
- ? An Idle test for 1977 to 1983 vehicles up to 10,000 pounds and all gas trucks 10,000 to 26,000 pounds.
- ? A gas cap test for all vehicles tested.
- ? An anti-tampering program with 3 inspections for all vehicles receiving an idle test.

Regional Fuel Program

For 2005, the Cecil County ozone non-attainment region is required to have federal reformulated gasoline (RFG). Like conventional gasoline, RFG must meet fuel volatility requirements that vary by geographic region. Cecil County was modeled using the RFG requirements of the Northern region in summer time. Based on EPA’s guidance and using the monthly fuel laboratory data (Source: Motor Fuel Tax Division, Office of the Comptroller), the 1990 analysis year runs for Cecil County utilized a computed Reid Vapor Pressure (RVP) value of 8.2.

Vehicle Age/Diesel Sales Distributions

Vehicle age distributions are input to MOBILE for the region based on registered vehicles that reflect July 1 summer conditions. These distributions reflect the percentage of vehicles in the fleet up to 25 years old and are listed by the 16 MOBILE6 vehicle types. As in previous SIP submissions, 1990 information is used in the development of the data input for the 1990 analysis year based on Maryland Motor Vehicle Administration's (MVA's) vehicle registration database download. Updated 2002 vehicle age distributions have been downloaded from the registration database and are used for the 2005 analysis year run. The analysis utilizes light-duty diesel sales fraction data acquired from state registration data for both 1990 and 2002.

Vehicle Mix Patterns

Vehicle mix patterns were developed from a combination of sources. Regional vehicle mix patterns, developed by facility type from SHA 1999-2002 local count data, were used to split the link travel volumes into 4 categories: auto, truck, bus, and motorcycle. 1990 estimates were adjusted to reflect regional toll data from the Maryland Transportation Authority (MDTA). MOBILE6 defaults were then used to split the above 4 vehicle categories into the required 16 MOBILE6 vehicle classes. Defaults were used specific to the year being analyzed (1990, 2005). Thus, more sport utility vehicles are assumed in the year 2005 as compared to 1990.

Weather Data

Minimum and maximum daily temperatures were developed following USEPA guidance using information collected from the National Weather's Service BWI monitoring station. The 1990 temperatures used are the same that were used and documented in the official 1990 inventory for the Baltimore area. The 2005 temperatures are those used and documented in the 1999 inventory for the Baltimore area.

Federal Program: Low Emission Vehicle (NLEV), Tier 2/Low Sulfur Fuel, and 2004 Heavy Duty Engine (HDE) Rule

Federal new vehicle emissions control and fuel programs that were modeled separately using MOBILE5 are now incorporated into MOBILE6. The NLEV program had a three-year phase-in starting with 1999 model years. The Tier 2 / Low Sulfur Fuel Program takes effect in 2004 and provides benefit for subsequent years.

Other Changes incorporated into MOBILE6

In addition to the new regulations, a number of improvements (corrections) were incorporated into MOBILE6 that have a significant impact on emission calculations, in particular NO_x emissions. These changes may increase or decrease emissions depending on the pollutant, calendar year, fuel program and locally specified speeds and facility class driving activities. As a result, a MOBILE6 comparison to MOBILE5 emission estimates will be significantly different.

Below is a list of the most important quantitative changes to emissions incorporated into MOBILE6:

? Basic Emission Rates (BER) for light-duty cars and trucks are lower from late 1980s and early 1990 model year vehicles due to new data that shows pollution control devices are more durable than expected. This change generally lowers emissions from vehicles of model years in the late 1980's and early 1990's.
? Real world driving factors that influence emissions like air conditioning and high acceleration effects.
? Fuel content corrections to account for damage inflicted by high levels of sulfur in gasoline in vehicles with advanced catalysts. This leads to increased emissions in the late 1990s and early 2000s. This effect declines as the Tier 2 regulations phase in lower sulfur fuel.
? Speed data shows that vehicle emissions are generally less sensitive to speed changes than previously thought. This has a variable effect on emissions.
? For heavy-duty trucks, MOBILE6 includes lower base-rate emissions, but excess NO_x emissions under steady state driving conditions can occur due to pollution control defeat devices included in these vehicles in the 1990's. MOBILE6 includes, though, a reduction in these NO_x emissions expected in future years as the result of a consent decree with engine manufacturers. Thus, MOBILE6 heavy-duty truck emissions are significantly higher than MOBILE5 for some model years and pollutants and significantly lower for others.
? Heavy-duty diesel vehicle NO_x off-cycle emissions effects are incorporated into MOBILE6. These effects include the Defeat Device, NO_x Pull Ahead, Rebuild Mitigation Program, and Rebuild program effectiveness.
? MOBILE6 includes new data for evaporative emissions because this data has indicated a small fraction of older vehicles with leaks in their fuel systems contribute a large quantity of evaporative emissions. MOBILE6 also accounts for the new tests and new regulations that require lower emissions and more durable fuel systems. This has a variable effect on emissions.

INTRODUCTION

The purpose of this document is to explain how Cecil County estimates emissions from highway vehicles for inclusion in its emission inventories and State Implementation Plan.

Highway vehicles contribute significantly to air pollution, particularly to ground-level ozone. Ozone is not created directly but formed in sunlight from VOCs and NO_x. Both VOCs and NO_x are emitted from highway vehicles. Cecil County's ozone-related emission inventory efforts have been focused on these pollutants.

In order to estimate both the rate at which emissions are being generated and to calculate vehicle miles traveled (activity level), Cecil County examines its road network and fleet to estimate vehicle activity. For ozone-related inventories, this is done for a typical summer (July) weekday. Not only must this be done for a baseline year, but it must also be projected into the future. This process involves a large quantity of data and is extremely complex.

Computer models have been developed to perform these calculations by simulating the travel of vehicles on the region's roadway system. These models then generate emission rates (also called emission factors) for different vehicle types for area-specific conditions and then combine them in summary form. The "area-specific conditions" include vehicle and highway data, plus control measure characteristics and future year projections of all variables.

MOBILE. The heart of the highway vehicle emission calculation procedure is EPA's highway vehicle emission factor model, MOBILE. This is a FORTRAN program that calculates **average** in-use fleet emission factors for ozone precursors for each of twenty-eight categories of vehicles under various conditions affecting in-use emission levels (e.g., ambient temperatures, average traffic speeds, gasoline volatility) as specified by the model user. MOBILE produces the "emission rates" referred to in the previous section.

The model was first developed as MOBILE1 in the late 1970s, and has been periodically updated to reflect the collection and analysis of additional emission factor data over the years, as well as changes in vehicle, engine and emission control system technologies, changes in applicable regulations, emission standards and test procedures, and improved understanding of in-use emission levels and the factors that influence them. For this inventory effort, Cecil County utilizes MOBILE6 as approved by EPA.

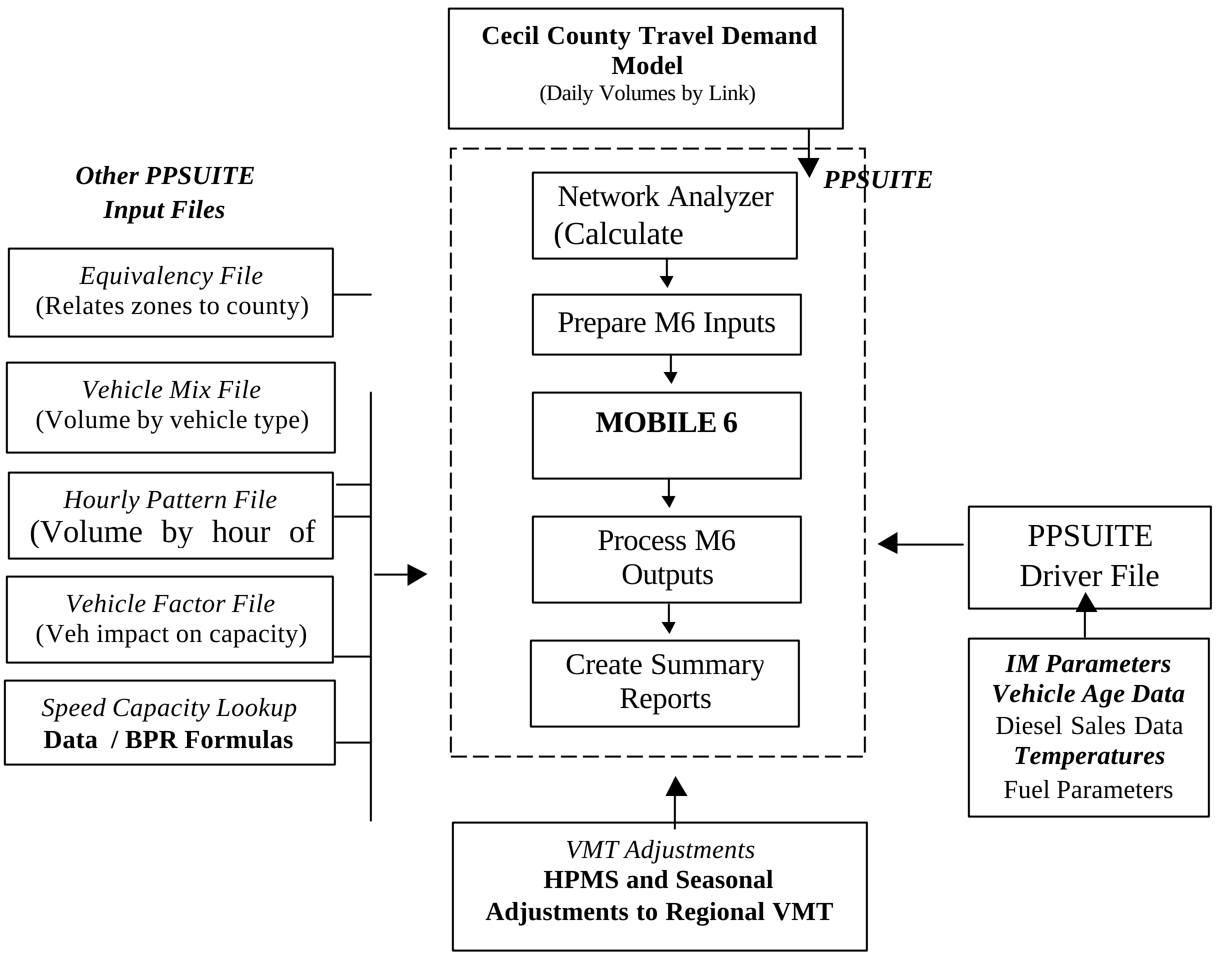
PPSUITE. Cecil County is now using a post processor named PPSUITE (formerly named PPAQ - Post Processor for Air Quality), which consists of a set of programs that perform the following functions:

? Analyzes highway operating conditions
? Calculates highway speeds
? Compiles vehicle miles of travel (VMT) and vehicle type mix data
? Prepares MOBILE6 runs
? Calculates emissions from output MOBILE6 emission rates and accumulated highway VMT.

PPSUITE has become a widely used and accepted tool for estimating speeds and processing MOBILE emission rates. It is currently being used throughout Pennsylvania, for the New York City region, for the north and south New Jersey regions, and in other states including Louisiana, Virginia, and Indiana. The software is based upon accepted transportation engineering methodologies. For example, PPSUITE utilizes speed and delay estimation procedures based on planning methods provided in the 2000 Highway Capacity Manual, a report prepared by the Transportation Research Board (TRB) summarizing current knowledge and analysis techniques for capacity and level-of-service analyses of the transportation system.

These two computer programs interact as shown in Exhibit 1. PPSUITE replaces the prior MDE-developed post processor, which could not accommodate MOBILE6 requirements without significant revision. In addition, PPSUITE enhances and adds new capabilities regarding the calculation of speed, the preparation of those speeds for input to MOBILE6, and allows for an organized input data storage format.

Exhibit 1 Emission Calculation Process for Cecil County

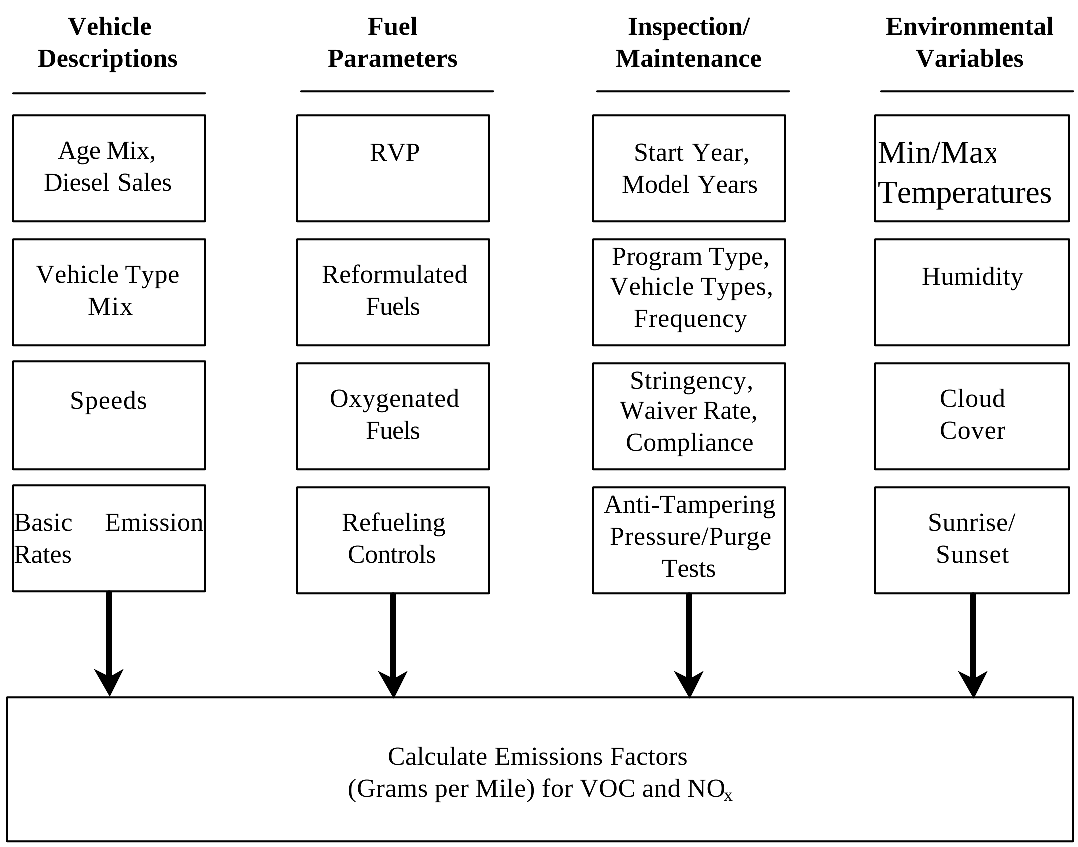


OVERVIEW OF INPUT DATA

Data Inputs to MOBILE

A large number of inputs to MOBILE are needed to fully account for the numerous vehicle and environmental parameters that affect emissions including traffic flow characteristics, vehicle descriptions, fuel parameters, inspection/maintenance program parameters, and environmental variables as shown in Exhibit 2. With some input parameters, MOBILE allows the user to choose default values, while others require area-specific inputs.

Exhibit 2 MOBILE Inputs



For an emissions inventory, area specific inputs are used for all of the items shown in Exhibit 2 except for the basic emission rates, humidity and cloud cover, which are MOBILE defaults. In addition, Cecil County uses the MOBILE6 default starts-per-day data and soak distributions that are used to calculate the number of starts in cold and hot start modes. EPA requires that the number of starts occurring per vehicle be determined from instrumented vehicle counts. Since such local data is not available, the MOBILE6 national defaults are used for the Cecil County analyses. A vehicle will generate more emissions when it is first operated (cold start). It generates emissions at a different rate when it is stopped and then started again within a short period of time (hot start). Soak distributions are used to determine the time between when an engine is turned off to the next time it is restarted.

Vehicle Descriptions. Vehicle age distributions are input to MOBILE representing the distribution for the MOBILE6 16-vehicle types in Cecil County. This data is based on registered vehicles from the Maryland Motor Vehicle Administration's vehicle registration database reflecting July 1 summer conditions. As in previous SIP submissions, 1990 information is used in the development of the data input for the 1990 analysis year for non-trucks. Updated 2002 age data has been prepared and used for the forecast 2005 analysis year.

Vehicle Type Mix is calculated from algorithms using a combination of collected 1999-2002 State Highway Administration vehicle class counts, and MOBILE6 default percentages. (See also the discussion of Vehicle Type Pattern Data in the next section.) Speeds are discussed extensively in the next section.

Significant changes have occurred in the MOBILE6 model as compared to previous releases. Some of the information previously applied by post processor routines can now be input directly to the MOBILE6 model run. This includes information on the hourly distribution of VMT and the hourly speeds that occur during the day. Another important change in MOBILE6 is the influence of facility type on output emission factors. For example, MOBILE6 assumes that an average speed on a freeway results in a different emission factor than the same speed on an arterial roadway. Thus MOBILE6 is indirectly accounting for the accelerations and decelerations that typically occur on such roadways. MOBILE6 has four distinct facility types: Freeway, Arterial, Local, and Ramp. For any emission run, the input functional classes analyzed must be mapped to the above facility types. The following mapping scheme is used for the Cecil County runs:

Cecil Model Facility Types	***MOBILE6 Facility Type***
1,5,6 (Interstate/Freeways)	Freeway
2,3,4 (Major-Minor Arterial/Collector)	Arterial
7 (Locals)	Local

Since ramps are not directly represented within the travel demand model, they are assumed to be 8% of the total interstate/freeway VMT. The above assumptions are consistent with the recommendations provided in EPA's Technical Guidance on the Use of MOBILE6 for Emissions Inventory Preparation.

Fuel Parameters. The same vehicle will produce different emissions using a different type of gasoline. Fuel control strategies can be powerful emission reduction mechanisms. An important variable in fuels for VOC emissions is its evaporability, measured by Reid Vapor Pressure.

MOBILE allows the user to choose among conventional, federal reformulated (used in Cecil County), oxygenated and low Reid Vapor Pressure (RVP) gasoline. Cecil County chooses the MOBILE inputs appropriate to the year and control strategy for the area being modeled. For 2005, Cecil County uses Northern region summertime reformulated gasoline, and for 1990, conventional gasoline with an RVP of 8.2.

MOBILE also allows users to calculate refueling emissions - the emissions created when vehicles are refueled at service stations. Cecil County includes refueling emissions in its area source inventory and not in its highway vehicle inventory.

Vehicle Emission Inspection/Maintenance (I/M) Parameters. MOBILE allows users to vary inputs depending on the I/M program in place for the particular analysis year. For Cecil County, the following tables describe the I/M program and anti-tampering program in place for the 1990 and 2005 analysis years.

Table 2 Cecil County I/M Program Parameters

Program Parameters	**1990**	**2005**						
Program Name	NO IM	Idle older LDGV, LDGT	Idle HDGT	IM240	OBD	Gas Cap for older LDGV, LDGT	Gas Cap for HDGT	Gas Cap for OBD Vehicles
Test Type		Test Only	Test Only	Test Only	Test Only	Test Only	Test Only	Test Only
I/M Program Start Year		1984	1984	1984	2003	2003	2003	2003
Test Frequency		Biennial	Biennial	Biennial	Biennial	Biennial	Biennial	Biennial
Program Type		Idle	Idle	IM240	OBD I/M	GC	GC	EVAP OBD & GC
Model Years		77-83	77-83	84-95	96-50	77-95	77-50	96-50
Stringency Rate (%)		20	20	20	20	N/A	N/A	N/A
Compliance Rate (%)		96	96	96	96	96	96	96
Waiver Rate (%)		3	3	3	3	3	3	3
Grace Period		2	2	2	2	2	2	2
Vehicle Types								
LDGV		Yes	No	Yes	Yes	Yes	No	Yes
LDGT1		Yes	No	Yes	Yes	Yes	No	Yes
LDGT2		Yes	No	Yes	Yes	Yes	No	Yes
LDGT3		Yes	No	Yes	Yes	Yes	No	Yes
LDGT4		Yes	No	Yes	Yes	Yes	No	Yes
HDGV2B		No	Yes	No	No	No	Yes	No
HDGV3		No	Yes	No	No	No	Yes	No
HDGV4		No	Yes	No	No	No	Yes	No
HDGV5		No	Yes	No	No	No	Yes	No
HDGV6		No	Yes	No	No	No	Yes	No
HDGV7		No	No	No	No	No	No	No
HDGV8A		No	No	No	No	No	No	No
HDGV8B		No	No	No	No	No	No	No
GAS BUS		No	No	No	No	No	No	No

Table 3 Cecil County Anti-tampering Program Parameters

Program Element	Cecil County	
Analysis Year	**1990**	**2005**
Program Start Year	No ATP	1989
First Model Year		1977
Last Model Year		2050
LDGV		Yes
LDGT1		Yes
LDGT2		Yes
LDGT3		Yes
LDGT4		Yes
HDGV2B		Yes
HDGV3		No
HDGV4		No
HDGV5		No
HDGV6		No
HDGV7		No
HDGV8A		No
HDGV8B		No
GAS BUS		No
Program Type		Test Only
Inspection Frequency		Biennial
Compliance Rate (%)		96
Air pump system disablement		No
Catalyst removal		Yes
Fuel inlet restrictor disablement		Yes
Tailpipe lead deposit test		No
EGR disablement		No
Evaporative system disablement		No
PCV system disablement		No
Missing gas cap		Yes

Weather Data. Minimum and maximum daily temperatures were developed following USEPA guidance using information collected from the National Weather's Service BWI monitoring station. The 1990 temperatures used are the same that were used and documented in the official 1990 inventory for the Baltimore area. The 2005 temperatures are those used and documented in the 1999 inventory for the Baltimore area.

Emission and Speed Relationships

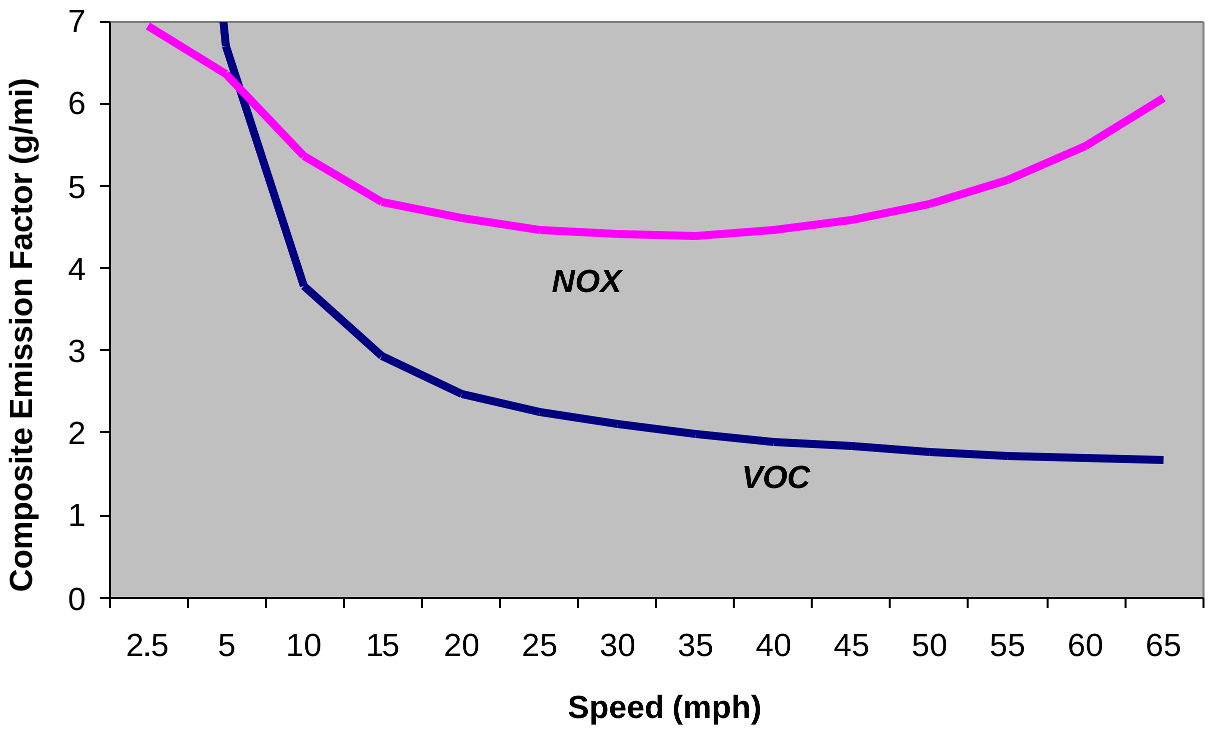
Of all the user-supplied input parameters, perhaps the most important is vehicle speed (except for local and ramp roadway types where a constant MOBILE6 speed is assumed).

To obtain the best estimate of vehicle speeds, Cecil County uses the PPSUITE set of programs, whose primary function is to calculate speeds and to organize and simplify the handling of large amounts of data needed for calculating speeds and for preparing MOBILE input files. MOBILE6 uses hourly speeds that are grouped into 14 speed bins. The shares are calculated from accumulating hourly link VMT for speeds estimated using an update to the BPR curve. Equations, consistent with previous conformity efforts, are used for the analyses. The equation is as follows:

$$traveltime = speed * \left[1 + 0.15 * \left(\frac{v}{c}\right)^4\right] \text{ for all roadway types}$$

Emissions of both VOC and NO_x vary significantly with speed, but the relationships are not linear, as shown in Exhibit 3. While VOCs generally decrease as speed increases, NO_x decreases only at the low speed range and increases steeply at higher speeds.

Exhibit 3 MOBILE6 VOC and NO_x Speed vs. Emissions



Roadway Data

The roadway data input to the emissions calculations for the Cecil County non-attainment region is based on a travel demand model developed by the Maryland Department of Transportation. The model, which was developed using the MINUTP software platform, incorporates the following:

- Produces daily traffic volumes.
- Follows traditional "4-step" process – Trip generation, Trip Distribution, Mode Split, and Traffic Assignment.
- Calibrated/validated to year 1999 traffic count data.

- ? Utilizes socioeconomic projections, including employment, households, and population as recommended by the Technical Advisory Committee (TAC) and adopted by the WILMAPCO Council on May 3rd, 2001.
- ? Networks include the major capacity improvement projects that will be in place and open to service in the year 2005.

The travel model contains all state highways and arterials, most of the major collectors, and some minor collector and local roadways divided into links of varying lengths. Each of these link segments contains descriptive data that is used in the calculation of the congested speeds input to the MOBILE emissions model. The PPSUITE post processor calculates the congested speeds based on the following model network fields:

- ? Number of Lanes
- ? Distances
- ? Daily Traffic Volumes
- ? Facility Type
- ? Area Type (Urban/Rural)
- ? Link capacity which includes impact of signals and other intersection controls
- ? Link free-flow speeds
- ? Zones to relate each link to the county in which it belongs

The model volumes and distances are used in calculating highway VMT totals for each county. As discussed in the next section, adjustments are needed to convert the volumes to an average July weekday. Lane and capacity values are an important input for determining the congestion and speeds for individual highway segments.

The travel demand model classifies its road segments by function, in addition to whether it is located in an urban or rural area, as indicated below in Exhibit 4. The facility types are important indicators of the type and function of each roadway segment. The variables provide insights into other characteristics not contained in the model network fields that are used for speed and emission calculations. In addition, VMT and emission quantities are aggregated and reported using both urban/rural codes and 5 groupings of the listed facility types.

Exhibit 4 Cecil County Model Classification Scheme: Urban/Rural and Facility Type Codes

Urban/Rural Code	1 = Urban 2 = Rural
Facility Type Class	1 = Interstate 2 = Principal Arterial 3 = Minor Arterial 4 = Collector 5 = Interstate 6 = Interstate 7 = Local

Additions and Adjustments to Roadway Data

Before the travel model data can be used by PPSUITE for speed and emission calculations, several adjustments and additions must be made to the roadway data.

HPMS Adjustments. According to EPA guidance, baseline inventory VMT computed from the travel demand model must be adjusted to be consistent with Highway Performance Monitoring System (HPMS) VMT totals. Although it has some limitations, the HPMS system is currently in use in all 50 states and is being improved under FHWA direction.

A transportation model must be validated against real world observations to be an accurate predictor of total area VMT. Since the USEPA has designated HPMS as the "official" VMT estimation methodology for air quality purposes, the Cecil County regional travel model outputs were compared to 1990 and 1999 HPMS totals.

Adjustment factors are calculated which adjust the 1990 Model VMT to be consistent with 1990 July VMT totals as documented in the 1990 Maryland inventory submission prepared in 1993. In addition, the 2005 travel model run is factored to correspond with more recent 1999 HPMS VMT totals. The factor value of 1.03362 is used for all future year run HPMS adjustments. These factors are applied to all county, urban/rural code, and facility group combinations.

Seasonal Adjustments to Volumes. The Cecil County travel demand model produces volumes that represent an average day. An ozone emission analysis, however, is based on a typical July weekday. Therefore, those volumes must be seasonally adjusted. A seasonal factor of 1.10, consistent with recent conformity analysis runs, is applied to all link volumes in the network before the calculation of speeds for 2005. The 1990 seasonal factor is represented as part of the HPMS adjustments as described above.

24-hour Pattern Data. Speeds and emissions vary considerably depending on the time of day (because of temperature) and congestion. Therefore, it is important to estimate the pattern by which roadway volume varies by hour of the day. The 24-hour pattern data provides PPSUITE with information used to split the daily roadway segment volumes to each of the 24 hours in a day. Pattern data is in the form of a percentage of the daily volumes for each hour. Distributions are provided for each county and facility type grouping. This data was developed from SHA 24-hour count data between 1999 and 2002.

Vehicle Type Pattern Data. Basic emission rates may differ by vehicle type. These types are listed below in Exhibit 5.

Exhibit 5 MOBILE6 Input Composite Vehicle Classes

VI.	LDV	- Light-Duty Vehicles (Passenger Cars)
VII.	LDT1	- Light-Duty Trucks 1 (<6,000 lbs)
VIII.	LDT2	- Light-Duty Trucks 2 (<6,000 lbs, LVW=3,751-5,750)
IX.	LDT3	- Light-Duty Trucks 3 (6,001-8,500 lbs)
X.	LDT4	- Light-Duty Trucks 4 (6,001-8,500 lbs, LVW>5,751)
XI.	HDV2B	- Class 2b Heavy Duty Vehicles
XII.	HDV3	- Class 3 Heavy Duty Vehicles
XIII.	HDV4	- Class 4 Heavy Duty Vehicles
XIV.	HDV5	- Class 5 Heavy Duty Vehicles
XV.	HDV6	- Class 6 Heavy Duty Vehicles
XVI.	HDV7	- Class 7 Heavy Duty Vehicles
XVII.	HDV8A	- Class 8a Heavy Duty Vehicles
XVIII.	HDV8B	- Class 8b Heavy Duty Vehicles
XIX.	HDBS	- School Buses
XX.	HDBT	- Transit and Urban Buses
XXI.	MC	- Motorcycles

MOBILE summary reports by vehicle type are also useful in knowing what kinds of vehicles generate emissions. The vehicle type pattern data is supplied to MOBILE for each run (county, urban/rural combination) and scenario (facility type) within the MOBILE6 input file. The data is generated by PPSUITE based on the following sources:

? Vehicle Mix Patterns for light-duty vehicles, heavy-duty vehicles, buses, and motorcycles based on SHA vehicle class counts taken between 1999 and 2002.

? MOBILE6 default vehicle type breakdowns for the analysis year

? MDTA Statement of Annual Traffic Volume and Toll Income and Resulting Percentages for 1990 through 2000.

The vehicle type pattern percentages are developed for each county and facility type combination and are input to MOBILE using the VMT FRACTIONS keyword. First, PPSUITE uses the input vehicle mix pattern data based on SHA counts to calculate the number of autos, trucks, buses, and motorcycles. Then, MOBILE6 defaults, specific to the analysis year being run, are used to divide the 4 vehicle groupings into the 16 MOBILE6 vehicle types. PPSUITE then aggregates this link specific information to the area, facility scenario groupings input to the MOBILE model. Note that the MOBILE6 defaults used vary by analysis year; as a result, each forecast year utilizes a unique vehicle mix distribution. The VMT mixes used for 1990 and 2005 are provided in Tables 4 and 5.

Table 4 2005 Vehicle Mix Inputs to MOBILE6

Run Area	Facility Grouping Scenario	*MOBILE6 VEHICLE TYPES* LDV	LDT1	LDT2	LDT3	LDT4	HDV2B	HDV3	HDV4	HDV5	HDV6	HDV7	HDV8A	HDV8B	HDBS	HDBT	MC
Cecil County (Urban)	Interstate	35.49%	6.49%	21.61%	6.66%	3.06%	8.07%	0.79%	0.64%	0.48%	1.79%	2.13%	2.31%	8.24%	1.37%	0.61%	0.27%
	Principal Arterial	45.05%	8.23%	27.43%	8.45%	3.89%	2.07%	0.20%	0.17%	0.12%	0.46%	0.54%	0.59%	2.11%	0.41%	0.18%	0.09%
	Minor Arterial	45.78%	8.37%	27.88%	8.59%	3.95%	1.48%	0.15%	0.12%	0.09%	0.33%	0.39%	0.42%	1.51%	0.37%	0.17%	0.40%
	Collector	44.45%	8.13%	27.06%	8.34%	3.84%	2.48%	0.24%	0.20%	0.15%	0.55%	0.65%	0.71%	2.54%	0.15%	0.06%	0.45%
	Local	46.22%	8.45%	28.15%	8.67%	3.99%	1.20%	0.12%	0.10%	0.07%	0.27%	0.32%	0.35%	1.23%	0.29%	0.13%	0.45%
Cecil County (Rural)	Interstate	36.34%	6.64%	22.13%	6.82%	3.14%	7.43%	0.73%	0.59%	0.44%	1.65%	1.96%	2.13%	7.59%	1.44%	0.65%	0.31%
	Principal Arterial	37.06%	6.77%	22.57%	6.95%	3.20%	7.29%	0.72%	0.58%	0.43%	1.62%	1.92%	2.09%	7.45%	0.60%	0.27%	0.48%
	Minor Arterial	43.30%	7.92%	26.37%	8.12%	3.74%	3.15%	0.31%	0.25%	0.19%	0.70%	0.83%	0.90%	3.22%	0.48%	0.22%	0.31%
	Collector	44.18%	8.08%	26.91%	8.29%	3.81%	2.55%	0.25%	0.20%	0.15%	0.57%	0.67%	0.73%	2.60%	0.50%	0.22%	0.29%
	Local	46.23%	8.45%	28.16%	8.67%	3.99%	1.19%	0.12%	0.10%	0.07%	0.26%	0.31%	0.34%	1.21%	0.29%	0.13%	0.47%

Table 5 1990 Vehicle Mix Inputs to MOBILE6

Run Area	Facility Grouping Scenario	*MOBILE6 VEHICLE TYPES* LDV	LDT1	LDT2	LDT3	LDT4	HDV2B	HDV3	HDV4	HDV5	HDV6	HDV7	HDV8A	HDV8B	HDBS	HDBT	MC
Cecil County (Urban)	Interstate	50.19%	3.36%	11.16%	4.52%	2.07%	9.00%	0.92%	0.54%	0.43%	1.74%	2.14%	2.55%	9.14%	1.35%	0.63%	0.27%
	Principal Arterial	65.50%	4.38%	14.56%	5.90%	2.71%	2.13%	0.22%	0.13%	0.10%	0.41%	0.51%	0.60%	2.16%	0.40%	0.19%	0.11%
	Minor Arterial	66.58%	4.46%	14.80%	6.00%	2.75%	1.52%	0.16%	0.09%	0.07%	0.29%	0.36%	0.43%	1.54%	0.36%	0.17%	0.41%
	Collector	64.63%	4.32%	14.37%	5.82%	2.67%	2.56%	0.26%	0.15%	0.12%	0.49%	0.61%	0.72%	2.60%	0.12%	0.06%	0.48%
	Local	67.20%	4.50%	14.94%	6.05%	2.78%	1.24%	0.13%	0.08%	0.06%	0.24%	0.29%	0.35%	1.26%	0.27%	0.13%	0.49%
Cecil County (Rural)	Interstate	51.43%	3.44%	11.43%	4.63%	2.13%	8.35%	0.85%	0.50%	0.40%	1.61%	1.98%	2.36%	8.47%	1.42%	0.67%	0.31%
	Principal Arterial	53.91%	3.61%	11.99%	4.86%	2.23%	7.52%	0.77%	0.45%	0.36%	1.45%	1.79%	2.13%	7.63%	0.58%	0.27%	0.47%
	Minor Arterial	62.95%	4.21%	13.99%	5.67%	2.60%	3.25%	0.33%	0.20%	0.16%	0.63%	0.77%	0.92%	3.30%	0.48%	0.22%	0.32%
	Collector	64.22%	4.30%	14.28%	5.78%	2.65%	2.63%	0.27%	0.16%	0.13%	0.51%	0.63%	0.75%	2.67%	0.46%	0.21%	0.36%
	Local	67.21%	4.50%	14.94%	6.05%	2.78%	1.22%	0.13%	0.07%	0.06%	0.24%	0.29%	0.35%	1.24%	0.28%	0.13%	0.51%

SPEED/EMISSION ESTIMATION PROCEDURE

The previous sections have summarized the input data used for computing speeds and emission rates for the Cecil County Non-Attainment region. This section explains how PPSUITE and MOBILE use that input data to produce emission estimates. Exhibit 6 on the following page summarizes PPSUITE's analysis procedure used for each of the 705 roadway links contained in the travel demand model.

Producing an emissions inventory with PPSUITE requires a process of disaggregation and aggregation. Data is available and used on a very small scale - individual ½ mile roadway segments 24 hours of the day. This data needs to first be aggregated into categories so that a reasonable number of MOBILE scenarios can be run, and then further aggregated and/or re-sorted into summary information that is useful for emission inventory reporting.

One of the major enhancements of MOBILE6 is the increased detail of traffic speed data that can be input to the emissions model. The PPSUITE post processor calculates hourly speeds for each roadway segment. Since previous versions of MOBILE only allowed one average speed as input for each scenario, a lookup table was created for speeds from 2.5 to 65 MPH in 0.1 MPH increments. MOBILE6 allows for direct input of the 24 hourly speeds as well as options to account for each link's speed separately. These added features utilize the full extent of the information output from the speed processing programs and provide for more accurate emission estimates of the available traffic data.

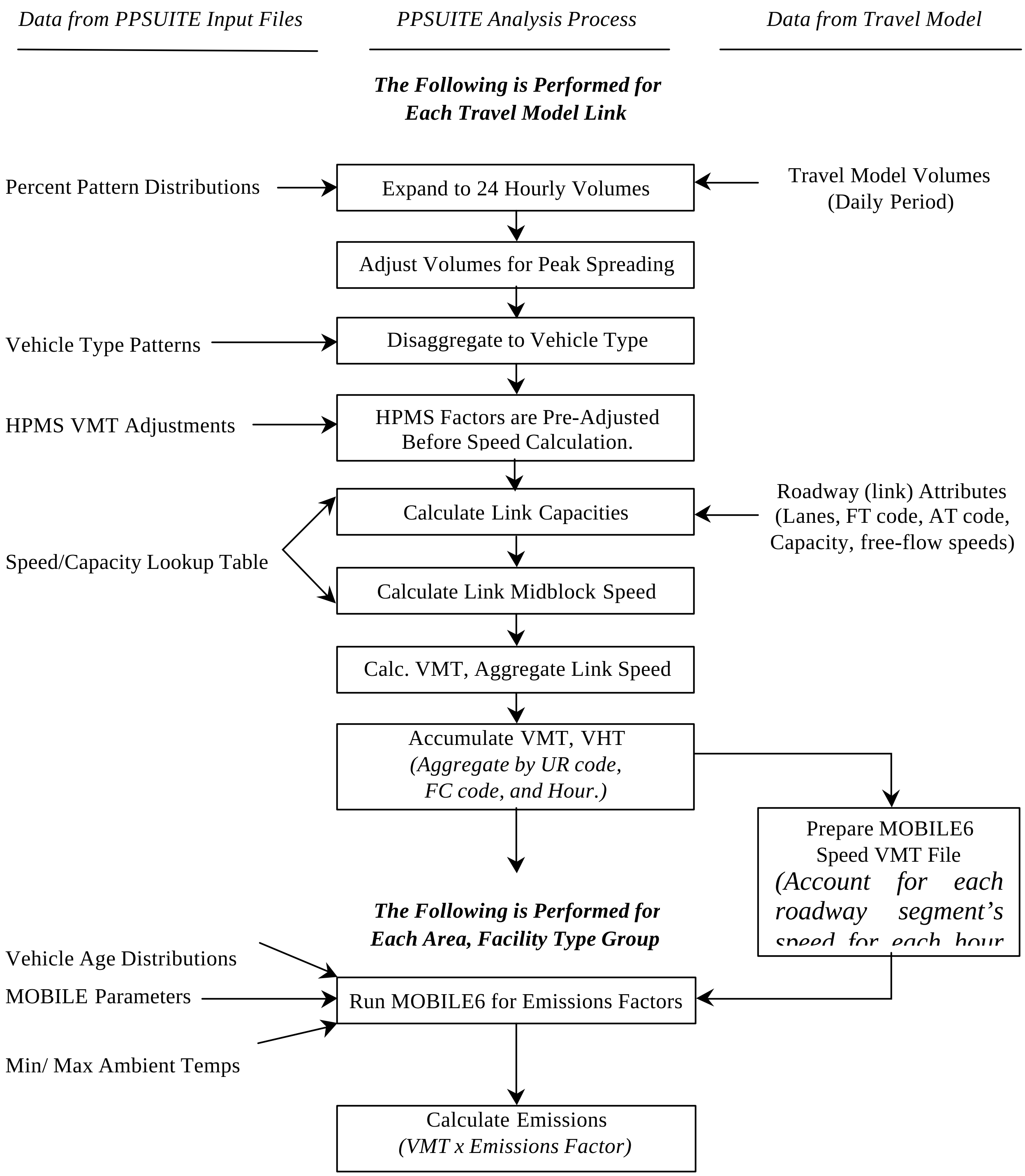
Volume/VMT Development

Before speeds can be calculated and MOBILE run, volumes acquired from the travel demand model must be adjusted and disaggregated. Such adjustments include factoring to HPMS VMT, seasonal adjustments, and disaggregating daily volumes to each hour of the day and to each of the sixteen MOBILE6 vehicle types.

Future Year Volumes

Future year volumes are based on projected land use files that the Technical Advisory Committee (TAC) and WILMAPCO Council endorse and expected changes to the future transportation network. The model is run using the future year inputs and assigned volumes are produced for each roadway link contained within the model network.

Exhibit 6 PPSUITE Speed/Emission Estimation Procedure



Seasonal Adjustments. PPSUITE takes the 24 hr model volumes from the travel demand model, which represents an average annual day. A comprehensive adjustment factor of 1.10 is applied to the entire region. Using the adjusted weekday volumes, VMT is calculated for each model link.

Example:

Assume a sample Cecil County Arterial link: The average annual weekday traffic for this link in 2005 is 12,626 vehicles/day.

A seasonal factor of 1.10 is then applied.
Average Weekday summer Volume = 12,626 x 1.10 = 13,889 vehicles/day

Total VMT (daily) for this link is calculated as volume x distance. The distance of this link as obtained from the model is 0.296 miles.

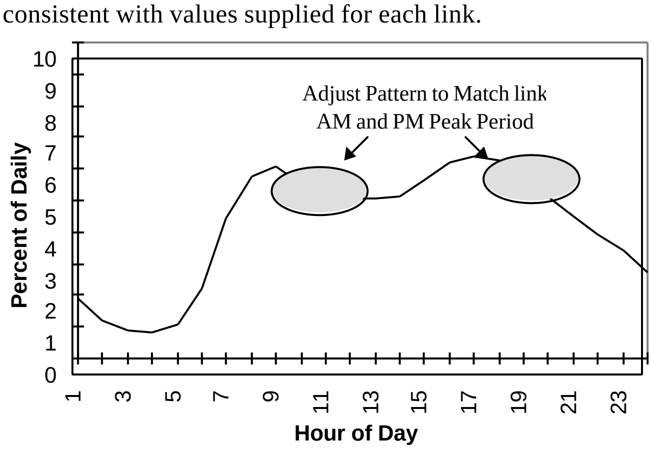
2005 VMT = 13,889 vehicles/day x 0.296 miles = 4,111 vehicle-miles / day

---

Disaggregation to 24 Hours. After seasonally adjusting the link volume, the volume is split to each hour of the day. This allows for more accurate speed calculations (effects of congested hours) and allows PPSUITE to prepare the hourly VMT and speeds for input to the MOBILE6 model.

Example:

To support speed calculations and emission estimates by time of day, the summer weekday volume is disaggregated to 24 hourly volumes. Temporal patterns by facility type were previously developed from SHA 1999-2002 count data and input to PPSUITE. A sample distribution is illustrated below and can be applied to the daily link volume to produce hourly volumes. Additional features within PPSUITE allow for the input pattern to be adjusted ensuring peak period volumes for the AM and PM are consistent with values supplied for each link.



Using the sample link, the resulting typical hourly volumes include:
8-9 a.m. 6.0 % x (4,111 vehicle miles/ 0.296mi.) = 833 vehicles/hour (vph)
12-1 p.m. 5.0 % x (4,111 vehicle miles/ 0.296mi.) = 694 vph
5-6 p.m. 6.3 % x (4,111 vehicle miles/ 0.296mi.) = 875 vph

After dividing the daily volumes to each hour of the day, PPSUITE identifies hours that are unreasonably congested. For those hours, PPSUITE then spreads a portion of the volume to other hours within the same peak period, thereby approximating the "peak spreading" that normally occurs in such over-capacity conditions.

Disaggregation to Vehicle Type. EPA requires VMT estimates to be prepared by vehicle type, reflecting specific local characteristics. As a result, for Cecil County's emission inventory runs, the hourly volumes are disaggregated to the sixteen MOBILE6 vehicle types based on a combination of SHA count pattern data and MOBILE6 defaults.

Example:

Disaggregation of the total sample link volume (by hour) to the various vehicle types would include the following:

Total Model Volume 8-9 am = 833 vph;

From the SHA counts for hour 8-9am (Based on Facility Type):

Light-duty vehicles (LDV)	= 89.52%
Motorcycles (MC)	= 00.17%
Heavy-duty vehicles (HDV)	= 09.52%
Bus	= 00.79%

Using the above information, the following vehicle type volumes are calculated for 8-9 am:

LDV	=	833 x 89.5%	=	746	vph
MC	=	833 x 00.2%	=	1	vph
HDV	=	833 x 09.5%	=	79	vph
BUS	=	833 x 00.8%	=	7	vph

Finally, MOBILE6 defaults are used to break the above categories into the 16 input vehicle types. Defaults vary by the analysis year being run. For example, the following factors have been developed from 2005 MOBILE6 defaults:

LDV	0.4840 of LDV Group	=	361	vph
LDT1	0.0885 of LDV Group	=	66	vph
LDT2	0.2948 of LDV Group	=	220	vph
LDT3	0.0908 of LDV Group	=	68	vph
LDT4	0.0418 of LDV Group	=	31	vph
HDV2B	0.3299 of HDV Group	=	26	vph
HDV3	0.0324 of HDV Group	=	3	vph
HDV4	0.0264 of HDV Group	=	2	vph
HDV5	0.0196 of HDV Group	=	2	vph
HDV6	0.0733 of HDV Group	=	6	vph
HDV7	0.0870 of HDV Group	=	7	vph
HDV8A	0.0946 of HDV Group	=	7	vph
HDV8B	0.3367 of HDV Group	=	26	vph
HDBS	0.6897 of BUS Group	=	5	vph
HDBT	0.3103 of BUS Group	=	2	vph
MC	1.0000 of MC Group	=	1	vph

Speed/Delay Determination

EPA recognizes that the estimation of vehicle speeds is a difficult and complex process. Because emissions are so sensitive to speeds, it recommends special attention be given to developing reasonable and consistent speed estimates; it also recommends that VMT be disaggregated into subsets that have roughly equal speed, with separate emission factors for each subset. At a minimum, speeds should be estimated separately according to roadway facility class.

The computational framework used for this analysis meets and **exceeds** that recommendation. Speeds are individually calculated for each roadway segment and hour based on the physical characteristics of the roadway and the assigned capacities to each model link. Rather than accumulating the roadway segments into area/functional groupings and calculating an average speed, each individual link hourly speed is represented in the MOBILE6 speed VMT file. This represents a significant enhancement in the MOBILE model since past versions only allowed input of one average speed for each scenario. MOBILE6 allows the input of a distribution of hourly speeds. For example, if 5% of a county's arterial VMT operate at 5 mph during the AM peak hour and the remaining 95% operate at 65mph, this can be represented in the MOBILE6 speed input file. For the Cecil County runs, distributions of speeds are input to MOBILE6 for separate scenarios representing county/area and facility type groupings; VMT is accumulated by the same groupings for the application of the emission factors to produce resulting emission totals.

To calculate speeds, PPSUITE first obtains initial capacities (how much volume the roadway can serve before heavy congestion) and free-flow speeds (speeds assuming no congestion) from the travel demand model data. Other data needed for the speed calculations including the BPR parameters (speed – congestion relationships) are obtained from a lookup table input to PPSUITE. This lookup data contains default roadway information indexed by the urban/rural code and facility type.

Example:

For the sample arterial link, the free-flow speeds and capacity is obtained from the travel demand model:

free flow speed = 65 mph
capacity = 1800 vph per lane

This information is used along with the physical characteristics of the roadway to calculate the delay (including congestion) to travel this link during each hour of the day:

For example: The sample link is calculated to have a travel time, including delay of 17.76 seconds for the 8-9am hour

Total travel time, in vehicle hours, for the 8-9am hour is calculated as:

VHT (8-9am) = 17.76 seconds x 833vph / 3600 sec/hr = 4.12 vehicle hours

---

The result of this process is an estimated average travel time for each hour of the day for each highway segment. The average time multiplied by the volume produces vehicle hours of travel (VHT).

HPMS and VMT Adjustments

Link volumes from the traffic model assignment must also be adjusted to account for differences with the HPMS VMT totals, as described previously. VMT adjustment factors are provided as input to PPSUITE, and are applied to each of the roadway segment volumes. These factors were developed from 1990 and 1999 HPMS data; however, the 1999 factors are also applied to any future year runs. The VMT added or subtracted to the travel model links are applied before the calculation of speeds. Therefore, the final congested speed that is used by MOBILE6 accounts for the HPMS VMT adjustments. However, for "local" facility, a constant speed is assumed within MOBILE6 for the calculation of emission factors and the HPMS adjustments will not impact its speeds.

Example:

Assuming the sample arterial link in Cecil County, the daily assigned volume is adjusted to account for reconciliation with the HPMS VMT. A factor of 1.03362 has been developed in the past to account for HPMS differences for all future years.

This factor is applied in the 2005 run.

Thus for the sample link:

VMT (8-9am) = 833 vph x 0.296 miles x 1.03362 = 255 vehicle miles

VMT and Speed Aggregation

As discussed in previous sections, MOBILE6's ability to handle input distributions of hourly speeds has eliminated the need to aggregate speed data. For the Cecil County runs, PPSUITE has been set up to automatically accumulate VMT and VHT by geographic areas and 5 highway facility type groupings. The speed files input to MOBILE6 for each scenario contain the actual distribution of roadway speeds for that aggregation group. Exhibit 7 illustrates the scenario aggregation scheme used with MOBILE6.

Exhibit 7 VMT/VHT Aggregation Scheme

Urban/Rural Code -	1=Urban 2=Rural	2 entries
Facility Type Group -	1 = Interstate 2 = Principal Arterial 3 = Minor Arterial 4 = Collector 5 = Local	5 entries
		10 potential combinations

Geographic aggregation is performed according to urban and rural areas within the county. Facility class aggregation is based on 5 groupings of the facility types contained in the travel demand model. This creates a potential for 10 possible combinations, each of which becomes an input MOBILE6 scenario. This allows each MOBILE6 scenario to represent the actual VMT mix and speed for that geographic/highway combination.

MOBILE Emissions Run

After computing speeds and aggregating VMT and VHT, PPSUITE prepares input files to be run in EPA's MOBILE6 program, which is used to produce VOC and NO_x emission factors in grams of pollutant per vehicle mile.

The MOBILE input file prepared by PPSUITE contains the following:

? MOBILE template containing appropriate parameters and program flags
? Temperature data specific to Cecil County (based on Baltimore data).
? Vehicle age and diesel sales fraction data for Cecil County.
? Scenario data - contains VMT mix, speed distributions specific to scenario as produced by PPSUITE

Example:

A MOBILE input file is created by PPSUITE for Cecil County. This file contains separate scenarios for each urban/rural code, facility type grouping. A scenario represents a separate MOBILE run with different emission factors calculated and output for each run.

For this example, Cecil County arterials will be run as a scenario with a specific VMT mix file and a speed distribution file accounting for all the roadway speeds within the grouping.

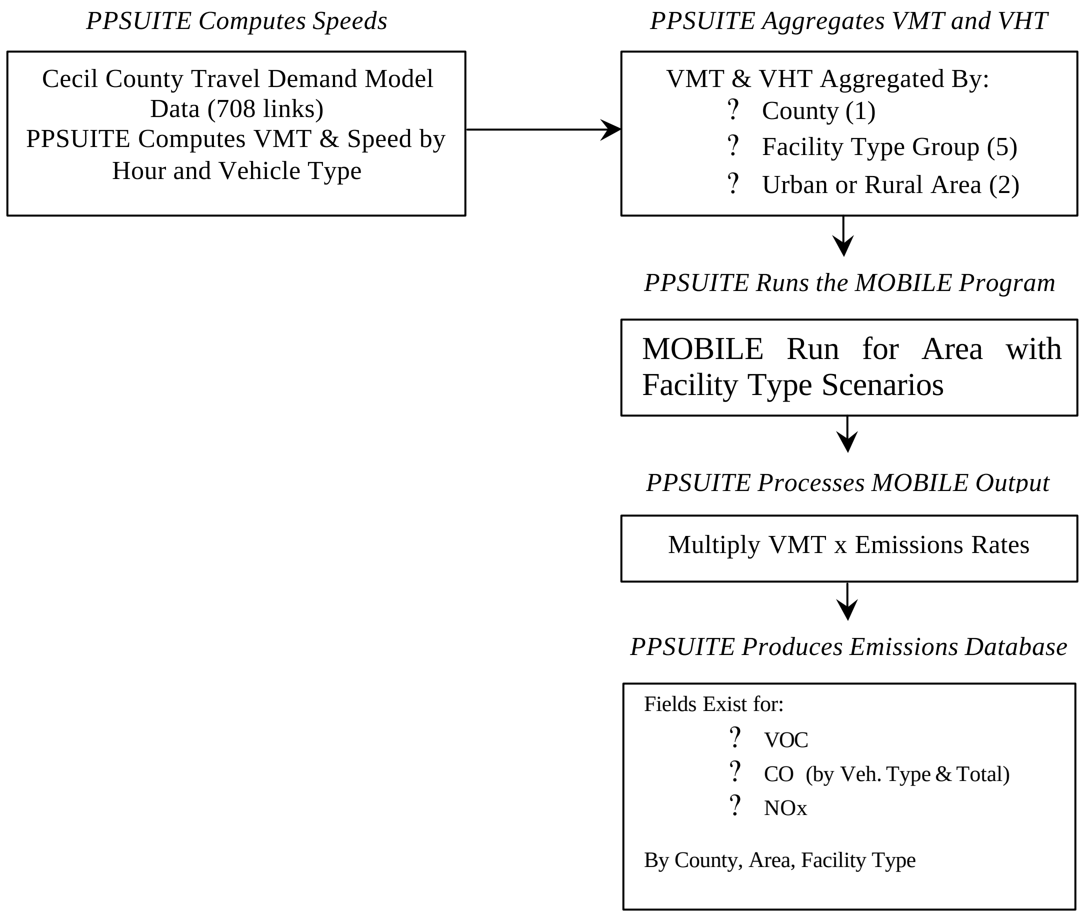
Time of Day Emissions

Unlike in the past using MOBILE5, VMT and speeds are no longer aggregated as separate scenarios representing time periods. This was done in the past to account for the unique speeds encountered during each time period in the day. Diurnal emissions were estimated on a daily period. Since MOBILE6 allows for hourly roadway speeds to be represented in the speed VMT file, such a process is no longer needed. MOBILE6 will internally account for the emissions during each hour in the day and make the necessary calculations.

MOBILE Output Post Processing

After MOBILE has been run, PPSUITE processes the MOBILE output files and compiles the emission factors for each scenario. Using the MOBILE emission factors, PPSUITE calculates emission quantities by multiplying the emission factors by the aggregated VMT totals. PPSUITE then produces an emissions database summarizing VMT, VHT, VOC, and NO_x emissions as shown in Exhibit 8.

Exhibit 8 Summary of PPSUITE's Methodology in Producing Emissions Summary



Example:

Cecil County urban arterials were run as a scenario in MOBILE. Based on the input information, MOBILE6 outputs emission factors by vehicle type for this scenario as shown below:

Composite Emission Factors (grams/mile) from MOBILE6 output

Vehicle Type:	LDGV	LDGT1	LDGT2	LDGT3	LDGT4	HDDV	For all 28 M6 types
VOC:	1.22	1.86	2.42	3.68	0.36	1.13	
NO_X:	2.41	3.16	3.66	7.14	1.84	5.84	

PPSUITE reads these emission factors from the MOBILE6 output file and multiplies them by the Cecil County urban arterial VMT to obtain emission totals for this scenario. (Note: emissions shown in kg/day, which is converted to tons/day in SIP narratives)

PPSUITE computes emissions as follows for this scenario:

			Emission Factors (g/mi)			**Emissions (kg/day)**	
Veh Type	**VMT**		**VOC**	**NOX**		**VOC**	**NOX**
LDGV	84,344	x	1.22	2.41	=	102.9	203.3
LDGT1	30,713	x	1.86	3.16	=	57.1	97.1
LDGT2	21,515	x	2.42	3.66	=	52.1	78.7
LDGT3	4,209	x	3.68	7.14	=	15.5	30.1
LDGT4	3,586	x	0.36	1.84	=	1.3	6.6
HDDV7	7,483	x	1.13	5.84	=	8.5	43.7
….. Repeated for all 28 MOBILE6 vehicle types							
Total	155,903					244.6	482.0

The emissions for this scenario are reported and stored in an output database file that contains a record for each scenario with fields containing VMT, VHT, VOC emissions, and NO_x emissions. Fields exist for each vehicle type and for the total of all vehicle types as shown below.

Reported by Vehicle Type 1-28 and Total --- Repeated for VHT,HC,NOX

Cnty	**UR**	**FC**	**VMT1**	**VMT2**	**VMT3**	**VMT4**	**VMT5**	**VMT6**	**VMT7**	**VMT8**	**VMT28**
Harf	1	3	84,344	30,713	21,515	4,209	3,586	2,806	7,483	1,248	
			VHT1	**VHT2**	**VHT3**	**VHT4**	**VHT5**	**VHT6**	**VHT7**	**VHT8**	**VHT28**
			1,298	473	331	65	55	43	115	19	
			VOC1	**VOC2**	**VOC3**	**VOC4**	**VOC5**	**VOC6**	**VOC7**	**VOC8**	**VOC28**
			102.9	57.1	52.1	15.5	1.3	1.5	8.5	5.7	
			NO_x1	**NO_x2**	**NO_x3**	**NO_x4**	**NO_x5**	**NO_x6**	**NO_x7**	**NO_x8**	**NO_x28**
			203.3	97.1	78.7	30.1	6.6	11.6	43.7	10.9	

RESOURCES

MOBILE Model

EPA – OTAQ - Modeling and Inventories. Feb. 12, 2003. U. S. Environmental Protection Agency. April 3, 2003. <http://www.epa.gov/omswww/models.htm>

This site contains a downloadable model, MOBILE users guide, and other information.

U.S. Environmental Protection Agency. *User's Guide to MOBILE6.0 (Mobile Source Emission Factor Model)*. Office of Mobile Sources. January 2002.

U.S. Environmental Protection Agency. *Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation.* Office of Transportation and Air Quality. January 2002.

U.S. Environmental Protection Agency. *Policy Guidance on the Use of MOBILE6 for Emission Inventory Preparation.* Office of Air and Radiation. January 18, 2002.

Traffic Engineering

Transportation Research Board. *2000 Highway Capacity Manual.* Committee on Highway Capacity and Quality of Service. 2000.

This manual presents current knowledge and techniques for analyzing the transportation system.

Appendix A – Baker – Cecil County Mobile6 Input Files

```
2005 MOBILE6 INPUT File Script for Cecil County

MOBILE6 INPUT FILE

REPORT FILE         :  m6output.out    REPLACE
DATABASE OUTPUT     :
WITH FIELDNAMES     :
EMISSIONS TABLE     :  M6OUTPUT.TB1    REPLACE
POLLUTANTS          :  HC CO NOX
AGGREGATED OUTPUT   :
RUN DATA            : 0001

MIN/MAX TEMPERATURE: 67.9 96.5
FUEL RVP            : 7.0
EXPRESS HC AS VOC   :
EXPAND EXHAUST      :
EXPAND EVAPORATIVE  :
NO REFUELING        :
ANTI-TAMP PROGRAM   :
89 77 50 22222 22222111 1 12  96. 12211112
I/M DESC FILE       : IM2005.D
94+ LDG IMP         : nlevne.d
REG DISTRIBUTION    : Reg2002.TRK
DIESEL FRACTIONS    :
0.0013 0.0004 0.0011 0.0029 0.0032 0.0004 0.0018 0.0012 0.0005 0.0005
0.0012 0.0044 0.0014 0.0014 0.0000 0.0086 0.0112 0.0282 0.0203 0.0479
0.1200 0.0918 0.0805 0.0200 0.0047
0.0086 0.0123 0.0112 0.0305 0.0126 0.0355 0.0298 0.0261 0.0105 0.0129
0.0166 0.0184 0.0237 0.0229 0.0164 0.0031 0.0457 0.0390 0.0636 0.0789
0.2143 0.2727 0.1923 0.0233 0.0144
0.0086 0.0123 0.0112 0.0305 0.0126 0.0355 0.0298 0.0261 0.0105 0.0129
0.0166 0.0184 0.0237 0.0229 0.0164 0.0031 0.0457 0.0390 0.0636 0.0789
0.2143 0.2727 0.1923 0.0233 0.0144
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0115 0.0111 0.0145
0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209
0.0256 0.0013 0.0006 0.0011 0.0001
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.2578 0.2515 0.3263
0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918
0.2859 0.0138 0.0000 0.0000 0.0000
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.7715 0.7910 0.8105
0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032
0.4277 0.0079 0.0000 0.0000 0.0001
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8473 0.8048 0.8331
0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738
0.0341 0.0414 0.0003 0.0000 0.0000
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4384 0.3670 0.4125
0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111
0.0049 0.0060 0.0000 0.0000 0.0000
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6078 0.5246 0.5767
0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569
0.3690 0.4413 0.3094 0.1679 0.1390
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8443 0.7943 0.8266
0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602
0.6717 0.7344 0.6107 0.4140 0.3610
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9989 0.9987 0.9989
0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969
0.9978 0.9982 0.9974 0.9965 0.9964
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.8857 0.8525 0.8795
0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238
0.3260 0.2639 0.0594 0.0460 0.0291
```

```
SCENARIO RECORD    :[01 0001]  1

CALENDAR YEAR      :2005
EVALUATION MONTH   : 7
SEASON             : 1
ALTITUDE           : 1
CLOUD COVER        : 0.35
SUNRISE/SUNSET     : 6 8
FUEL PROGRAM       : 2 N
VMT FRACTIONS      :
                     .354851 .064873 .216078 .066555 .030646 .080681 .007915 .006448
                     .004788 .017922 .021265 .023141 .082364 .013673 .006147 .002653
VMT BY FACILITY    :V000101F.def
VMT BY HOUR        :V000101H.def
SPEED VMT          :V000101S.def


SCENARIO RECORD    :[02 0001]  2

CALENDAR YEAR      :2005
EVALUATION MONTH   : 7
SEASON             : 1
ALTITUDE           : 1
CLOUD COVER        : 0.35
SUNRISE/SUNSET     : 6 8
FUEL PROGRAM       : 2 N
VMT FRACTIONS      :
                     .450464 .082348 .274308 .084487 .038892 .020661 .002030 .001653
                     .001228 .004589 .005448 .005925 .021095 .004095 .001844 .000933
VMT BY FACILITY    :V000102F.def
VMT BY HOUR        :V000102H.def
SPEED VMT          :V000102S.def
```

INPUT RUN/SCENARIOS CONTINUE FOR AREA, Facility Group COMBINATION………

Attachment 1 to Appendix B

2005 I/M Input File to MOBILE6 for Cecil County

```
*IM Program 2005.  Idle, IM240, and OBD.
*IM240  Final Cutpoints.
*HDGT1 receives IM240, but is modeled as idle test to allow single run.
*Describes IM emissions program beginning Summer 2004.
*Includes gas cap testing, which will be advisory until summer 2003, and
*should become pass/fail then.
*Waiver rates are based on the assumption that a $450 waiver expenditure will
*result in a  3% waiver rate.
*Gas Cap for OBD Vehicles
*
I/M PROGRAM        : 7 2003 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 7 1996 2050
I/M VEHICLES       : 7 22222 11111111 1
I/M COMPLIANCE     : 7 96.0
I/M WAIVER RATES   : 7  3.0  3.0
I/M GRACE PERIOD   : 7 2
*Gas Cap for HDGT
I/M PROGRAM        : 6 2003 2050 2 T/O GC
I/M MODEL YEARS    : 6 1977 2050
I/M VEHICLES       : 6 11111 22222111 1
I/M COMPLIANCE     : 6 96.0
I/M WAIVER RATES   : 6  3.0  3.0
I/M GRACE PERIOD   : 6 2
*Gas Cap for older LDGV, LDGT
```

```
I/M PROGRAM        : 5 2003 2050 2 T/O GC
I/M MODEL YEARS    : 5 1977 1995
I/M VEHICLES       : 5 22222 11111111 1
I/M COMPLIANCE     : 5 96.0
I/M WAIVER RATES   : 5  3.0  3.0
I/M GRACE PERIOD   : 5 2
*OBD
I/M PROGRAM        : 4 2003 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 20.0
I/M COMPLIANCE     : 4 96.0
I/M WAIVER RATES   : 4  3.0  3.0
I/M GRACE PERIOD   : 4 2
*IM240
I/M PROGRAM        : 3 1984 2050 2 T/O IM240
I/M MODEL YEARS    : 3 1984 1995
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 20.0
I/M COMPLIANCE     : 3 96.0
I/M WAIVER RATES   : 3  3.0  3.0
I/M CUTPOINTS      : 3 d:\BALTAQ\M6_Data\cutpnt05.d
I/M GRACE PERIOD   : 3 2
*Idle HDGT
I/M PROGRAM        : 2 1984 2050 2 T/O Idle
I/M MODEL YEARS    : 2 1977 2050
I/M VEHICLES       : 2 11111 22222111 1
I/M STRINGENCY     : 2 20.0
I/M COMPLIANCE     : 2 96.0
I/M WAIVER RATES   : 2  3.0  3.0
I/M GRACE PERIOD   : 2 2
*Idle older LDGV, LDGT
I/M PROGRAM        : 1 1984 2050 2 T/O Idle
I/M MODEL YEARS    : 1 1977 1983
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 20.0
I/M COMPLIANCE     : 1 96.0
I/M WAIVER RATES   : 1  3.0  3.0
I/M GRACE PERIOD   : 1 2
```

Attachment 2 to Appendix B

2002 Vehicle Age Distribution Inputs to MOBILE6 for Cecil County

```
REG DIST
*
*   2002 Registration Mix for the Cecil County of MD
*
* This file contains the default MOBILE6 values for the distribution of
* vehicles by age for July of any calendar year.  There are sixteeen (16)
* sets of values representing 16 combined gasoline/diesel vehicle class
* distributions.  These distributions are split for gasoline and diesel
* using the separate input (or default) values for diesel sales fractions.
* Each distribution contains 25 values which represent the fraction of
* all vehicles in that class (gasoline and diesel) of that age in July.
* The first number is for age 1 (calendar year minus model year plus one)
* and the last number is for age 25.  The last age includes all vehicles
* of age 25 or older.  The first number in each distribution is an integer
* which indicates which of the 16 vehicle classes are represented by the
* distribution.  The sixteen vehicle classes are:
*
*  1  LDV    Light-Duty Vehicles (Passenger Cars)
*  2  LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2   Light Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6  HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
```

```
* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
* The 25 age values are arranged in two rows of 10 values followed by a row
* with the last 5 values.  Comments (such as this one) are indicated by
* an asterisk in the first column. Empty rows are ignored.  Values are
* read "free format," meaning any number may appear in any row with as
* many characters as needed (including a decimal) as long as 25 values
* follow the initial integer value separated by a space.
*
* If all 28 vehicle classes do not need to be altered from the default
* values, then only the vehicle classes that need to be changed need to
* be included in this file.  The order in which the vehicle classes are
* read does not matter, however each vehicle class set must contain 25
* values and be in the proper age order.
*
* Based on the 2002 MVA Data received during July 2002
* Assume Defaults for Trucks
*
* LDV
 1 0.0432 0.0704 0.0795 0.0664 0.0688 0.0724 0.0612 0.0707 0.0604 0.0563
   0.0477 0.0447 0.0399 0.0398 0.0332 0.0259 0.0198 0.0128 0.0110 0.0052
   0.0028 0.0027 0.0024 0.0028 0.0599
* LDT1
 2 0.0736 0.0924 0.0964 0.0955 0.0852 0.0819 0.0765 0.0701 0.0600 0.0442
   0.0342 0.0309 0.0294 0.0304 0.0269 0.0204 0.0139 0.0097 0.0070 0.0048
   0.0027 0.0007 0.0016 0.0027 0.0088
* LDT2
 3 0.0736 0.0924 0.0964 0.0955 0.0852 0.0819 0.0765 0.0701 0.0600 0.0442
   0.0342 0.0309 0.0294 0.0304 0.0269 0.0204 0.0139 0.0097 0.0070 0.0048
   0.0027 0.0007 0.0016 0.0027 0.0088
* LDT3
 4 0.0526 0.0762 0.0708 0.0666 0.0632 0.0691 0.0565 0.0653 0.0624 0.0448
   0.0411 0.0373 0.0422 0.0455 0.0464 0.0367 0.0362 0.0217 0.0163 0.0100
   0.0050 0.0050 0.0039 0.0064 0.0187
* LDT4
 5 0.0526 0.0762 0.0708 0.0666 0.0632 0.0691 0.0565 0.0653 0.0624 0.0448
   0.0411 0.0373 0.0422 0.0455 0.0464 0.0367 0.0362 0.0217 0.0163 0.0100
   0.0050 0.0050 0.0039 0.0064 0.0187
* Motorcycles
16 0.0786 0.1063 0.0772 0.0592 0.0536 0.0407 0.0421 0.0379 0.0282 0.0277
   0.0250 0.4235 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
   0.0000 0.0000 0.0000 0.0000 0.0000
```

Appendix B – Baker – 1990 Cecil County Mobile6 Input Files

```
1990 MOBILE6 INPUT File Script for Cecil County

MOBILE6 INPUT FILE

REPORT FILE         :  m6output.out    REPLACE
DATABASE OUTPUT     :
WITH FIELDNAMES     :
EMISSIONS TABLE     :  M6OUTPUT.TB1    REPLACE
POLLUTANTS          :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA            : 0001

MIN/MAX TEMPERATURE: 69.1 98.4
FUEL RVP            : 8.2
EXPRESS HC AS VOC  :
EXPAND EXHAUST      :
EXPAND EVAPORATIVE :
NO REFUELING        :
REG DISTRIBUTION   : Reg1990.CEC
DIESEL FRACTIONS   :
0.0012 0.0007 0.0000 0.0000 0.0048 0.0049 0.0092 0.0065 0.0163 0.0283
0.0188 0.0060 0.0089 0.0045 0.0035 0.0000 0.0105 0.0040 0.0039 0.0053
0.0060 0.0000 0.0075 0.0088 0.0014
0.0050 0.0000 0.0029 0.0033 0.0177 0.0176 0.0348 0.0419 0.1122 0.1940
0.0513 0.0174 0.0313 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.1000
0.0050 0.0000 0.0029 0.0033 0.0177 0.0176 0.0348 0.0419 0.1122 0.1940
0.0513 0.0174 0.0313 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.1000
0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256 0.0013
0.0006 0.0011 0.0001 0.0000 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001
0.0001 0.0001 0.0001 0.0001 0.0001
0.0096 0.0083 0.0072 0.0082 0.0124 0.0135 0.0169 0.0209 0.0256 0.0013
0.0006 0.0011 0.0001 0.0000 0.0000 0.0000 0.0001 0.0001 0.0001 0.0001
0.0001 0.0001 0.0001 0.0001 0.0001
0.2384 0.2058 0.1756 0.1958 0.2726 0.2743 0.3004 0.2918 0.2859 0.0138
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.8477 0.7940 0.7488 0.7789 0.7842 0.6145 0.5139 0.5032 0.4277 0.0079
0.0000 0.0000 0.0001 0.0003 0.0010 0.0028 0.0248 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000
0.7275 0.7158 0.5647 0.3178 0.2207 0.1968 0.1570 0.0738 0.0341 0.0414
0.0003 0.0000 0.0000 0.0000 0.0259 0.0078 0.0004 0.0090 0.0112 0.0112
0.0112 0.0112 0.0112 0.0112 0.0112
0.2730 0.2616 0.1543 0.0615 0.0383 0.0333 0.0255 0.0111 0.0049 0.0060
0.0000 0.0000 0.0000 0.0000 0.0037 0.0011 0.0001 0.0013 0.0016 0.0016
0.0016 0.0016 0.0016 0.0016 0.0016
0.5617 0.4537 0.4216 0.4734 0.4705 0.4525 0.4310 0.3569 0.3690 0.4413
0.3094 0.1679 0.1390 0.0808 0.0476 0.0365 0.0288 0.0274 0.0297 0.0297
0.0297 0.0297 0.0297 0.0297 0.0297
0.8177 0.7440 0.7184 0.7588 0.7567 0.7431 0.7261 0.6602 0.6717 0.7344
0.6107 0.4140 0.3610 0.2353 0.1489 0.1170 0.0940 0.0897 0.0966 0.0966
0.0966 0.0966 0.0966 0.0966 0.0966
0.9982 0.9979 0.9969 0.9978 0.9980 0.9979 0.9976 0.9969 0.9978 0.9982
0.9974 0.9965 0.9964 0.9949 0.9920 0.9936 0.9819 0.9812 0.9720 0.9720
0.9720 0.9720 0.9720 0.9720 0.9720
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.8760 0.7710 0.7502 0.7345 0.6733 0.5155 0.3845 0.3238 0.3260 0.2639
0.0594 0.0460 0.0291 0.0240 0.0086 0.0087 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000


SCENARIO RECORD     :[01 0001]  1

CALENDAR YEAR       :1990
EVALUATION MONTH   : 7
```

```
SEASON              : 1
ALTITUDE            : 1
FUEL PROGRAM        : 1
VMT FRACTIONS       :
                      .501874 .033589 .111564 .045186 .020736 .090000 .009197 .005427
                      .004341 .017366 .021393 .025478 .091371 .013453 .006312 .002713
VMT BY FACILITY    :V000101F.def
VMT BY HOUR        :V000101H.def
SPEED VMT          :V000101S.def


SCENARIO RECORD    :[02 0001]  2

CALENDAR YEAR      :1990
EVALUATION MONTH   : 7
SEASON             : 1
ALTITUDE           : 1
FUEL PROGRAM       : 1
VMT FRACTIONS      :
                      .654981 .043827 .145622 .058991 .027077 .021310 .002177 .001287
                      .001028 .004107 .005066 .006031 .021626 .003952 .001861 .001057
VMT BY FACILITY    :V000102F.def
VMT BY HOUR        :V000102H.def
SPEED VMT          :V000102S.def
```

INPUT RUN/SCENARIOS CONTINUE FOR AREA, Facility Group COMBINATION………

Attachment 1 to Appendix C

1990 Vehicle Age Distribution Inputs to MOBILE6 for Cecil County

```
REG DIST
*
* 1990 Registration Mix for the Cecil County of MD
* This file contains the default MOBILE6 values for the distribution of
* vehicles by age for July of any calendar year.  There are sixteeen (16)
* sets of values representing 16 combined gasoline/diesel vehicle class
* distributions.  These distributions are split for gasoline and diesel
* using the separate input (or default) values for diesel sales fractions.
* Each distribution contains 25 values which represent the fraction of
* all vehicles in that class (gasoline and diesel) of that age in July.
* The first number is for age 1 (calendar year minus model year plus one)
* and the last number is for age 25.  The last age includes all vehicles
* of age 25 or older.  The first number in each distribution is an integer
* which indicates which of the 16 vehicle classes are represented by the
* distribution.  The sixteen vehicle classes are:
*
*  1  LDV    Light-Duty Vehicles (Passenger Cars)
*  2  LDT1   Light-Duty Trucks 1 (0-6,000 lbs. GVWR, 0-3750 lbs. LVW)
*  3  LDT2   Light Duty Trucks 2 (0-6,001 lbs. GVWR, 3751-5750 lbs. LVW)
*  4  LDT3   Light Duty Trucks 3 (6,001-8500 lbs. GVWR, 0-3750 lbs. LVW)
*  5  LDT4   Light Duty Trucks 4 (6,001-8500 lbs. GVWR, 3751-5750 lbs. LVW)
*  6  HDV2B  Class 2b Heavy Duty Vehicles (8501-10,000 lbs. GVWR)
*  7  HDV3   Class 3 Heavy Duty Vehicles (10,001-14,000 lbs. GVWR)
*  8  HDV4   Class 4 Heavy Duty Vehicles (14,001-16,000 lbs. GVWR)
*  9  HDV5   Class 5 Heavy Duty Vehicles (16,001-19,500 lbs. GVWR)
* 10  HDV6   Class 6 Heavy Duty Vehicles (19,501-26,000 lbs. GVWR)
* 11  HDV7   Class 7 Heavy Duty Vehicles (26,001-33,000 lbs. GVWR)
* 12  HDV8A  Class 8a Heavy Duty Vehicles (33,001-60,000 lbs. GVWR)
* 13  HDV8B  Class 8b Heavy Duty Vehicles (>60,000 lbs. GVWR)
* 14  HDBS   School Busses
* 15  HDBT   Transit and Urban Busses
* 16  MC     Motorcycles (All)
*
* The 25 age values are arranged in two rows of 10 values followed by a row
```

```
* with the last 5 values.  Comments (such as this one) are indicated by
* an asterisk in the first column. Empty rows are ignored.  Values are
* read "free format," meaning any number may appear in any row with as
* many characters as needed (including a decimal) as long as 25 values
* follow the initial integer value separated by a space.
*
* If all 28 vehicle classes do not need to be altered from the default
* values, then only the vehicle classes that need to be changed need to
* be included in this file.  The order in which the vehicle classes are
* read does not matter, however each vehicle class set must contain 25
* values and be in the proper age order.
*
* Based on the 1990 MVA Data received during July 1990
*
* LDV
 1 0.0501 0.0884 0.0966 0.0978 0.0964 0.0874 0.0834 0.0564 0.0472 0.0468
   0.0424 0.0459 0.0379 0.0274 0.0178 0.0088 0.0088 0.0077 0.0080 0.0058
   0.0051 0.0047 0.0041 0.0035 0.0216
* LDT1
 2 0.0862 0.1455 0.1468 0.1276 0.1086 0.0849 0.0674 0.0356 0.0209 0.0143
   0.0166 0.0367 0.0273 0.0235 0.0162 0.0092 0.0060 0.0090 0.0053 0.0047
   0.0019 0.0023 0.0006 0.0004 0.0021
* LDT2
 3 0.0862 0.1455 0.1468 0.1276 0.1086 0.0849 0.0674 0.0356 0.0209 0.0143
   0.0166 0.0367 0.0273 0.0235 0.0162 0.0092 0.0060 0.0090 0.0053 0.0047
   0.0019 0.0023 0.0006 0.0004 0.0021
* LDT3
 4 0.0549 0.0924 0.1011 0.0986 0.1037 0.0769 0.0696 0.0522 0.0375 0.0347
   0.0339 0.0475 0.0411 0.0321 0.0237 0.0121 0.0141 0.0124 0.0118 0.0095
   0.0074 0.0085 0.0064 0.0060 0.0117
* LDT4
 5 0.0549 0.0924 0.1011 0.0986 0.1037 0.0769 0.0696 0.0522 0.0375 0.0347
   0.0339 0.0475 0.0411 0.0321 0.0237 0.0121 0.0141 0.0124 0.0118 0.0095
   0.0074 0.0085 0.0064 0.0060 0.0117
* HDV2B
 6 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV3
 7 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV4
 8 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV5
 9 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV6
10 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV7
11 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV8a
12 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDV8b
13 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDBS
14 0.0330 0.0629 0.0748 0.0840 0.0816 0.0727 0.0504 0.0320 0.0402 0.0335
   0.0395 0.0552 0.0513 0.0314 0.0255 0.0170 0.0343 0.0351 0.0192 0.0181
   0.0179 0.0161 0.0134 0.0134 0.0475
* HDBT
```

```
15 0.0426 0.0739 0.0938 0.1165 0.1108 0.0852 0.0568 0.0284 0.0455 0.0426
   0.0625 0.0455 0.0483 0.0227 0.0085 0.0057 0.0313 0.0170 0.0170 0.0114
   0.0170 0.0057 0.0028 0.0028 0.0057
* Motorcycles
16 0.0283 0.0405 0.0489 0.0604 0.1055 0.0680 0.0474 0.0528 0.0956 0.0872
   0.0696 0.2959 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
   0.0    0.0000 0.0000 0.0000 0.0000
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MOBILE6 ELECTRONIC FILES FOR CECIL COUNTY

Electronic files related to this SIP Revision can also be obtained by contacting:

Brian J. Hug, Planner III
Air and Radiation Management Administration
Maryland Department of the Environment
1800 Washington Boulevard
Baltimore, Maryland 21230
(410) 537-4125
bhug@mde.state.md.us