PROPOSED

Revision to the Pennsylvania State Implementation Plan for Maintaining the Carbon Monoxide National Ambient Air Quality Standard for the Years 2007-2017 in Philadelphia County

Philadelphia Department of Public Health
Air Management Services
321 University Avenue, 2nd Floor
Philadelphia, PA 19104

6/30/04

EXECUTIVE SUMMARY

In 1995, a request to redesignate the Philadelphia, Pennsylvania carbon monoxide (CO) nonattainment area to attainment was submitted to the Environmental Protection Agency by the Pennsylvania Department of Environmental Protection (DEP). The Environmental Protection Agency (EPA) redesignated the area to attainment effective March 15, 1996. A maintenance plan, as required by the Federal Clean Air Act, 42 U.S.C.A. § 7401 et seq. as amended by the Clean Air Act Amendments of 1990, P.L. 101-549, November 15, 1990 (Act) Section 175A including contingency measures, was developed covering the years 1997-2007 and was approved by EPA.

The Act Section 175A, requires that eight years after redesignation of any area as an attainment area under Section 107(d), the State shall submit to the EPA an additional revision of the applicable State Implementation Plan (SIP) for maintaining the national primary ambient air quality standard for 10 years after the expiration of the initial 10-year period.

This analysis was performed in support of a second 10-year carbon monoxide (CO) maintenance plan for Philadelphia County for the years 2007-2017.

Consistency is provided between the first ten year plan and the second ten year plan by using current methodologies to recalculate 1990, 1992, and 2007 inventories for mobile and nonroad sources which have been prepared for a typical winter work day.

CO is a colorless, odorless, and tasteless gas and is a by-product of incomplete combustion. In other words, it is emitted when wood, gasoline, coal or natural gas are burned incompletely. The combination of fossil fuel consumption and meteorology can temporarily cause CO to accumulate to its highest levels during the calm, cool days of winter.

The National Ambient Air Quality Standard (NAAQS) for CO is 9 ppm averaged over 8 hours. Comparison with the NAAQS is usually done using the design value. The CO design value is the second highest 8-hour average at any monitoring site in Philadelphia County for that particular year. Philadelphia County's designation as a moderate I nonattainment area (areas with a design value greater than 9 but less than or equal to 12.7) was based on a design value of 11.6 ppm for the 8 hour standard measured at the Air Management Services Laboratory site in January 1989. Since that date, the design values, based on CO monitoring data, has had a significant downward trend. Recent design values have been between one-third to one-half of the NAAQS; 2.9 in 2002 and 3.9 in 2003.

The analysis here contains documentation demonstrating that the standard will be maintained through the year 2017.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

The Federal Clean Air Act, 42 U.S.C.A. § 7401 et seq. as amended by the Clean Air Act Amendments of 1990, P.L. 101-549, November 15, 1990 (Act) requires all areas of the nation to attain and maintain compliance with the federal ambient air quality standards. These federal standards are designed to protect the public health and welfare from specific pollutants referred to as the National Ambient Air Quality Standards (NAAQS). Carbon monoxide (CO) is a colorless and odorless gas that can exacerbate health problems such as heart and lung disease. Concern is greatest in newborn infants, the elderly, and those suffering from chronic illnesses. The NAAQS were established with protection of these "at-risk" groups in mind. Concentration of CO in the ambient air depends on many factors, including the volume of vehicle traffic and local weather. The primary source of CO emissions is vehicular traffic.

The two primary NAAQS for CO are 9 parts per million (ppm) averaged over an 8-hour period, and 35 ppm averaged over a 1-hour period. The 1-hour average standard is not a concern in Philadelphia County. Air quality levels in Philadelphia County have not exceeded the 1-hour standard since 1969 and the highest values in recent years have been a small fraction of the NAAQS 35-ppm level. The maximum 1-hour design value in recent years has been at or below 7.7 ppm. There has been only one occasion in the last 15 years when the NAAQS 8-hour standard has not been met in Philadelphia County, January 1989.

The design value for 2002 is approximately one-third (2.9 ppm) and in 2003 the design value was less than one-half (3.9 ppm) of the 8-hour CO NAAQS (9 ppm). This represents better air quality than the 4.6 ppm predicted for 2007 in the first 10-Year Plan.

This document demonstrates that Philadelphia County will continue to maintain the NAAQS for CO for the years 2007-2017.

I. Ambient Air Quality Data Analysis

A. Monitored Attainment

The air quality data for the five Philadelphia carbon monoxide (CO) monitoring sites shows that from 1990 to 2002 there were no violations measured (Figure 1a-e). A violation is when the second highest 8-hour average at any monitoring site in Philadelphia County goes above 9 ppm for CO. There has not been a violation of the 8-hour average CO standard in Philadelphia County since 1989. Air monitoring data indicates that Philadelphia County has been in continuous compliance with the CO NAAQS since the attainment year of 1992.

Figure 1 - Air Monitoring Station Eight-Hour Average Carbon Monoxide Concentration - Highest and Second Highest Values for Philadelphia County (Non-Overlapping 8-Hour Concentration)

Figure 1a.: Franklin Institute

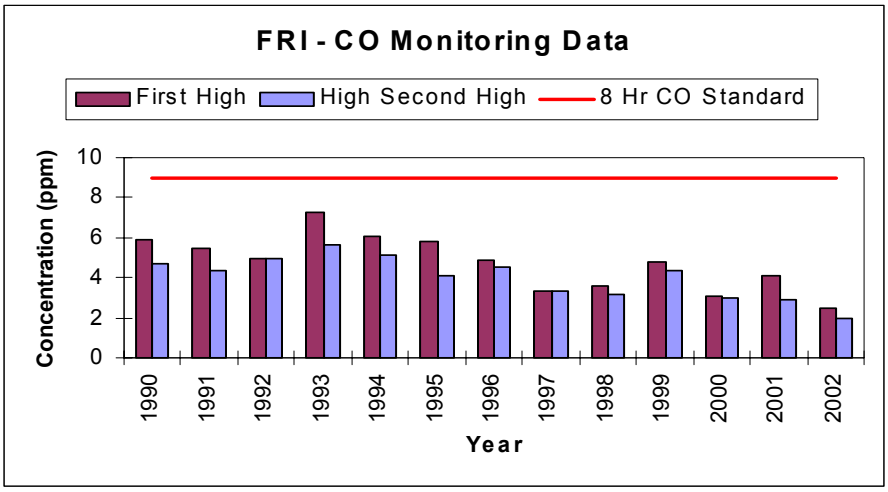


Figure 1b.: AMS Laboratory

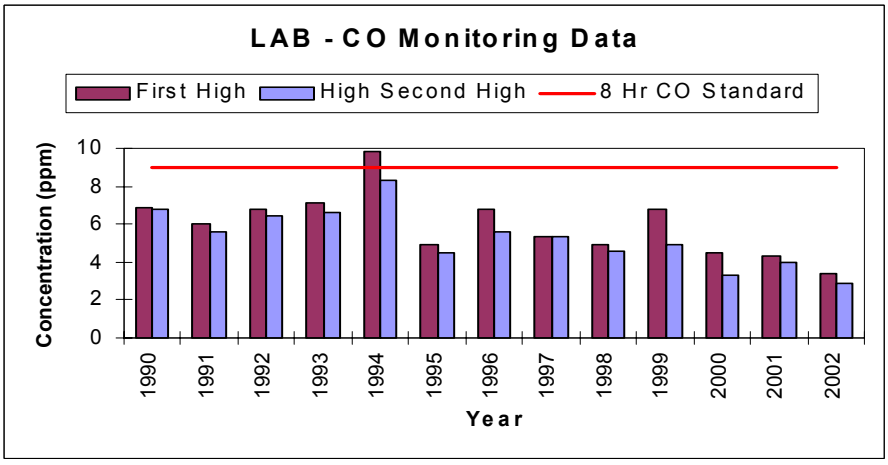


Figure 1c. 323 Race St.

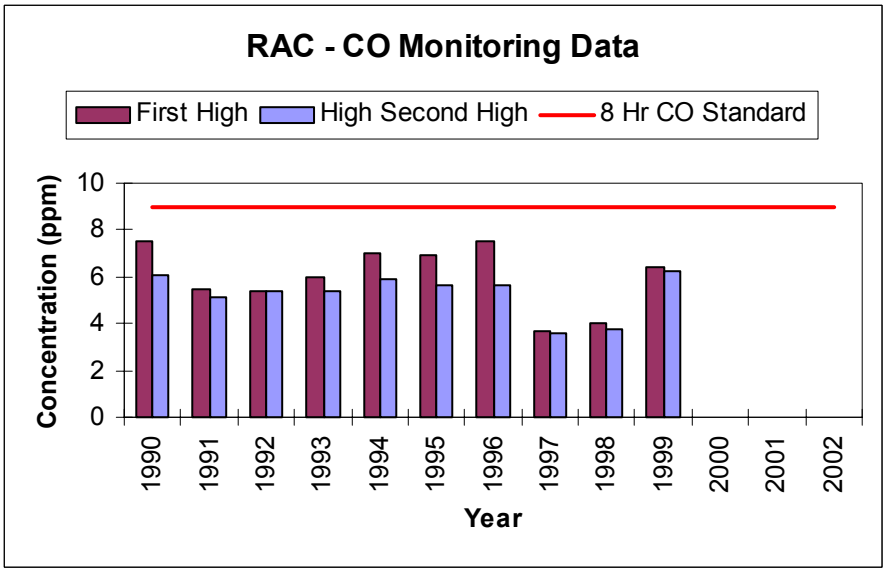


Figure 1d.: 500 South Broad St.

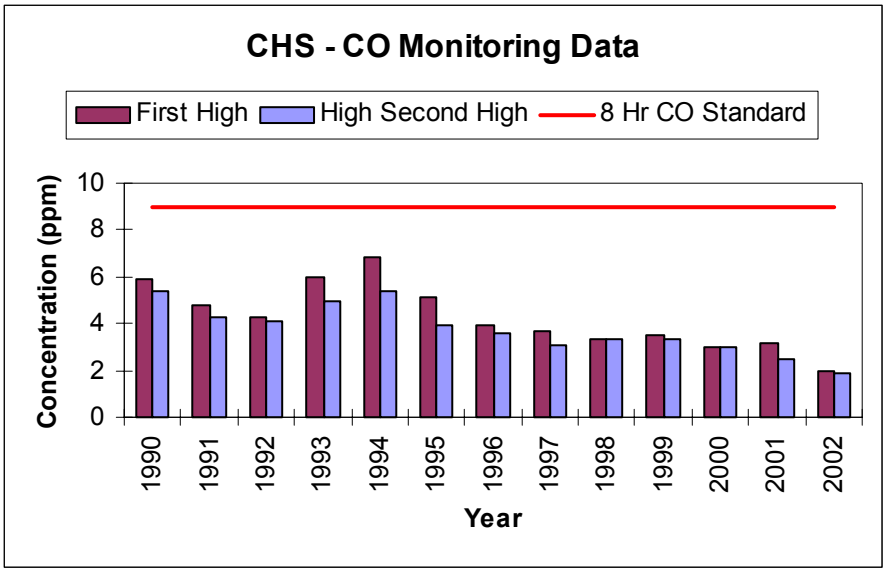
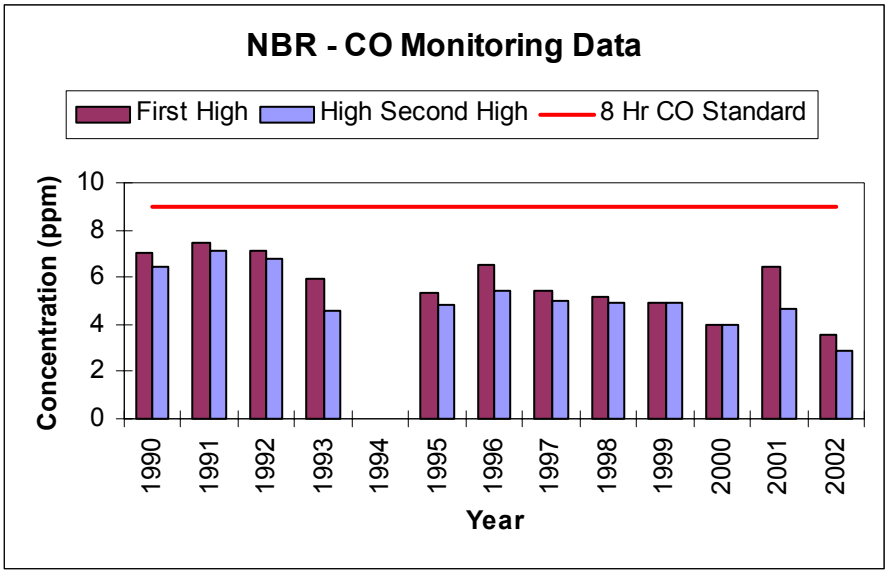
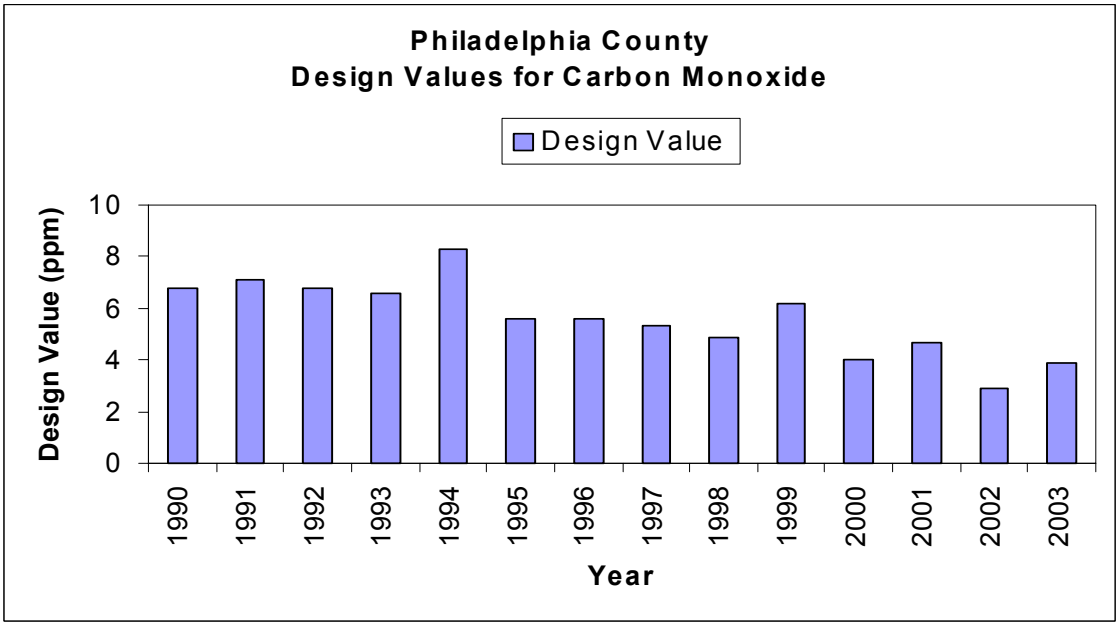


Figure 1e.: Broad and Butler St.



The CO design value is the second highest 8-hour average at any monitoring site in Philadelphia County for that particular year. Figure 2 graphs the CO design values from 1990 through 2003.

Figure 2 - Philadelphia County Design Values for Carbon Monoxide - Time Versus CO Concentration From 1990 Through 2003



B. Meteorological Analysis

Another requirement of the air quality demonstration is that the improvement in the air quality is due to emission reductions that are permanent and enforceable and not due to unusually favorable meteorological conditions.

Philadelphia County has measured attainment of the CO NAAQS since January 1989. The long time period and continued improvement in air quality indicates attainment can not be attributed to unusually favorable meteorology.

The following summary and analysis supports this conclusion and indicates that meteorological conditions during the attainment period were not unusually favorable.

The January 1989 violation of the CO NAAQS occurred during Monday, January 23, 1989, 7:00 p.m. through Tuesday, January 24, 1989, 8:00 am. This was characterized by low morning temperatures (between 0 and 5 degrees Celsius), low mixing heights (between 25 and 334 m), low wind speeds (2.5 m/s and less) and a stable atmosphere (stability classes 5 - 7).

Since January 1989 only one exceedance and no violation of the standard has occurred. This exceedance occurred within the overnight period from Friday, February 18, 1994, 6:00 p.m. to Saturday, February 19, 1994, 6:00 a.m. During this time the highest CO level - 9.8 ppm for the 8-hour average was reached at the Air Management Services (AMS) Laboratory. This event was similar to the one in 1989 where there were very low to calm wind speeds, a cold snow covered ground, and warm air in the upper 50's moving into the area. This created a low mixing height and a stable atmosphere for the pollutants to build to this higher level.

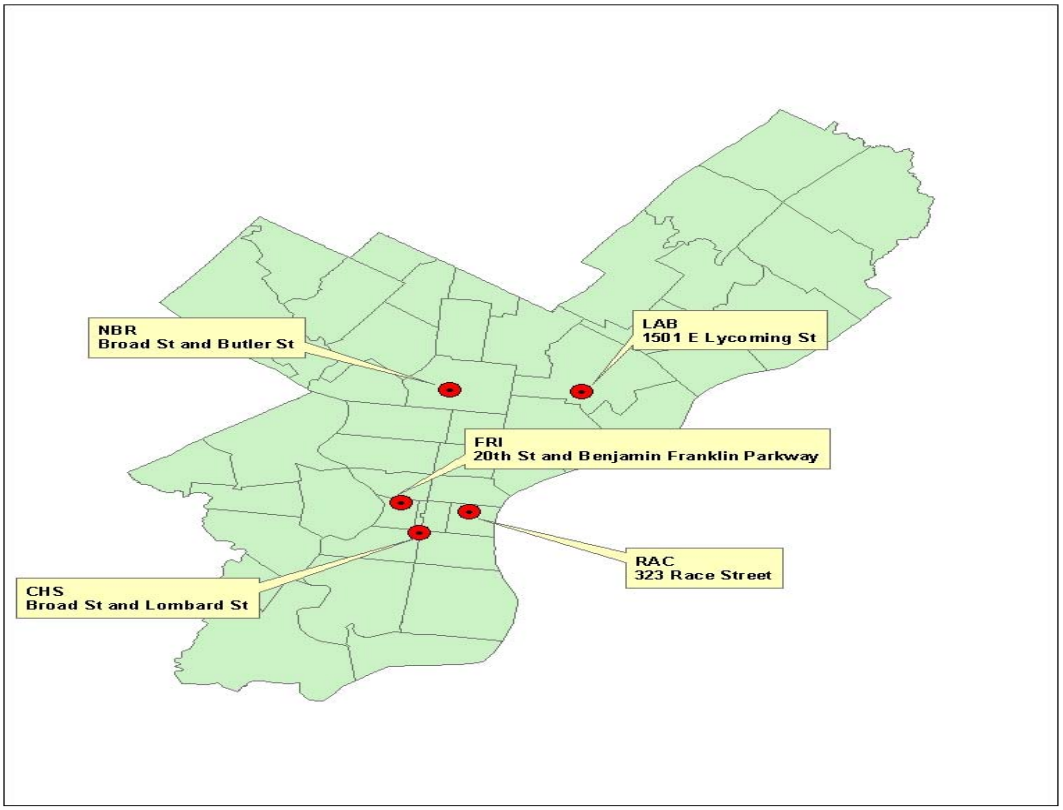
A meteorological analysis similar to that performed in the 1st 10-Year Maintenance Plan for the 1989 event was performed for the February 1994 event. A comparison with similar meteorological conditions of 2000, 2001, and 2002 was performed (Appendix I.). NOAA hourly climatological data for Philadelphia reported through http://pasc.met.psu.edu/cgi-bin/hourly.pl?id=PHL for the years 2000, 2001, and 2002 during the hours of 6:00 p.m. to 12:00 noon was reviewed. The analysis identified 227 hours in 2000, 234 hours in 2001 and 196 hours in 2002 with conditions similar to those that occurred in the February 1994 event. The similar number of hours during each year with low morning temperatures and low wind speeds indicates that meteorological conditions during the attainment period were not unusually favorable.

C. Monitoring Network

Air quality measurements used in this analysis were performed in accordance with appropriate regulations and guidance documents including adherence to EPA quality assurance requirements. Monitoring procedures were determined in accordance with 40 CFR Part 58. The CO monitoring instruments send the information to the Philadelphia Department of Public Health's computer system at the AMS laboratory located at 1501 E Lycoming Street.

Figure 3 shows the locations of the citywide network of CO monitors.

Figure 3 - Citywide Network of Carbon Monoxide Monitors



The RAC - 323 Race Street site was forced to close in 1999 because the building housing the monitoring equipment was razed.

II. 2002 Base Year CO Emissions Inventory

A. Purpose

The maintenance plan for the first 10 years contained a base year inventory of 1990. This inventory was used to develop the inventories for the attainment year (1992) and future years to 2007. The anticipated change in emission levels from the attainment year was used to estimate the future air quality levels.

The analysis in this 2nd 10-Year Plan documents a base year inventory of 2002. The 2002 emission inventory was selected because it is current and representative of the emissions in Philadelphia County during the period air quality data has shown maintenance of the NAAQS. This inventory contains emission estimates of point, area, highway, and nonroad sources of CO in Philadelphia County for the year and a typical CO season workday. The CO season is the winter months of December, January, and February. The 2002 inventory will be used to project point and area emissions to future years.

Air Management Services (AMS) compiled the point source inventory. The area inventory is based on material prepared by AMS and the Pennsylvania Department of Environmental Protection (DEP). Emissions from highway vehicles, the principal source of CO emissions in the county, were developed by an outside contractor (Michael Baker Jr. Inc.) in conjunction with DEP and AMS. AMS determined nonroad emission estimates by using EPA's draft Nonroad2002a model.

B. Emissions Summary

The inventory is comprised of four major categories:

Point – large stationary sources such as refineries, power generating stations, and other facilities with large boilers

Area – small stationary sources not included in the point inventory such as commercial and home heating; and some mobile sources such as aircraft, commercial marine vessels, and railroad locomotives;

Highway – automobiles, trucks, etc. that operate on roads and highways; and

Nonroad – equipment not otherwise counted in the inventory such as that used for light commercial, lawn & garden, construction, and airport support.

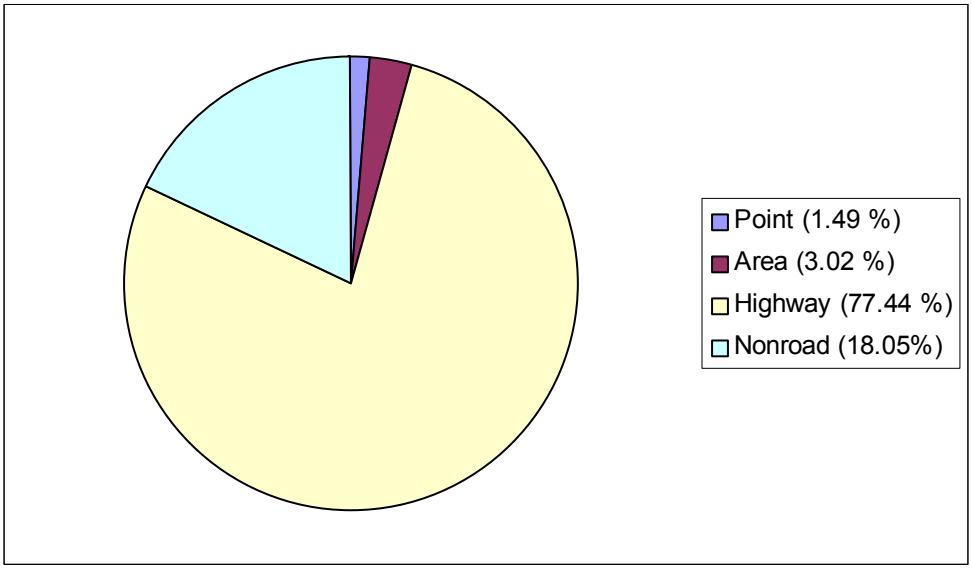
The total estimated carbon monoxide emissions for Philadelphia County are shown in Table 1:

Table 1 - 2002 CO Emissions for CO Season Day by Source Category

Category	CO Emissions in Tons/ CO Season Day
Point	8.38
Area	16.96
Highway	434.70
Nonroad	101.30
Total	**561.34**

Figure 4 graphically shows the percentage breakdown of the carbon monoxide sources in Philadelphia County.

Figure 4 - Sources of Carbon Monoxide in Philadelphia County By Category



C. Point Source Summary

The point source inventory includes all Title V and Synthetic Minor facilities. These are facilities that have the potential to emit a major source level of criteria pollutant. This

includes 25 tons of nitrogen oxides (NOx), 25 tons of volatile organic compounds (VOC), 100 tons of particulate matter less than 10 microns (PM10), 100 tons of sulfur dioxide (SO2), 100 tons of carbon monoxide (CO), 25 tons of combined hazardous air pollutants (HAP) or 10 tons of a single HAP.

The estimation methods prescribed by EPA include the consideration of "Rule Effectiveness" of control equipment. This provision accounts for control equipment breakdowns, periods of reduced control efficiency and other conditions which may cause increased emissions.

The major source of the CO point emissions is a petroleum refinery. Further details can be seen in Appendix II. A – Point Source Detail.

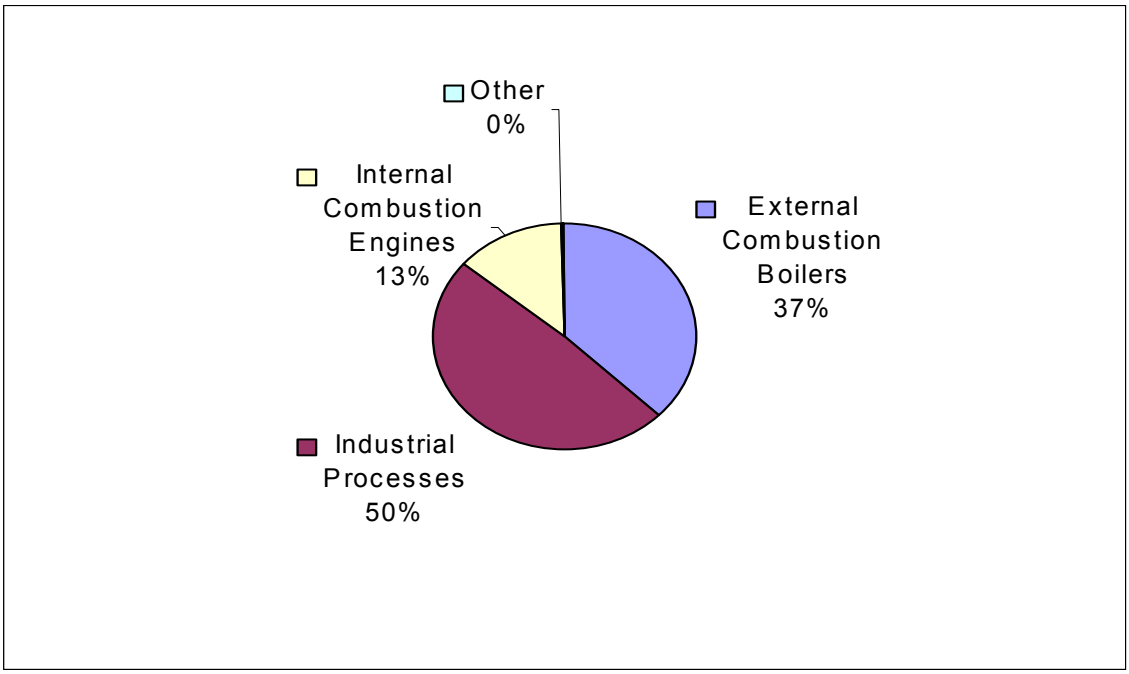
For point sources, the estimated CO emissions for Philadelphia County are shown in Table 2:

Table 2 - 2002 CO Emissions for CO Season Day by Point Source Category

Category	**CO Emissions in Tons/ CO Season Day**
External Fuel Combustion	3.11
Stationary Internal Combustion	1.12
Industrial Processes	4.11
Other	0.03
Total	**8.38**

Figure 5 graphically shows the percentage breakdown of the point sources in Philadelphia County.

Figure 5 - Point Sources of Carbon Monoxide in Philadelphia County by Category



D. Area Source Summary

The area source emission inventory is an estimate of the collective emissions of sources that are either too small or too numerous to be compiled individually in the point source inventory. Many are sources related to combustion of fossil and other fuels.

The area sources considered for this inventory are divided into ten categories and are listed in Appendix II. B – Area Source Detail.

Area source emission estimates for Philadelphia County are made in a variety of ways depending on the source being estimated. For the stationary source fuel combustion category they are typically estimated by multiplying a known activity level or known indicator by an emission factor. For example, fuel oil sale information supplied by the U.S. Department of Energy for Pennsylvania was allocated to Philadelphia County by a ratio of population to represent the fuel usage in Philadelphia County and then multiplied by the emission factor. More detailed descriptions of this procedure can be found in Appendix II B.

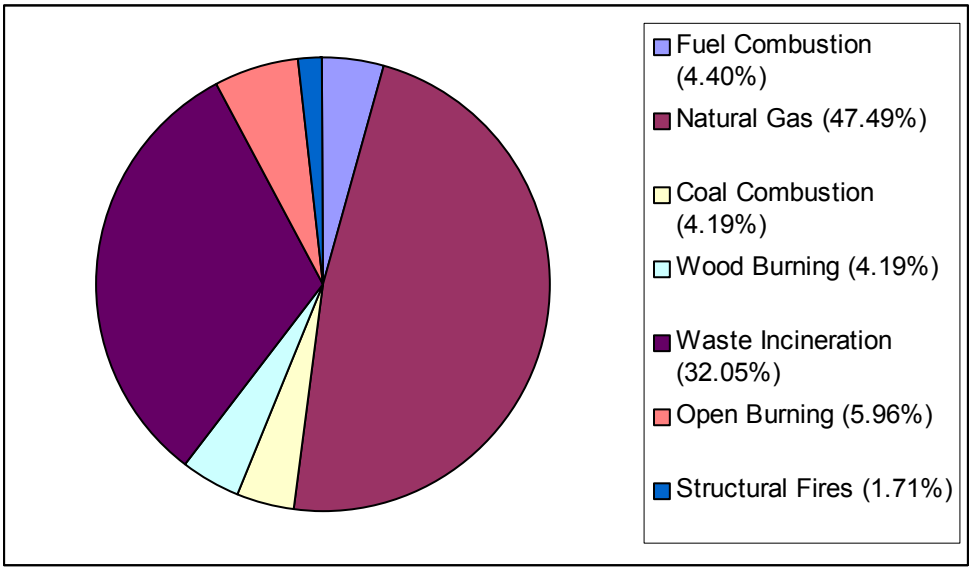
For area sources the estimated CO emissions for Philadelphia County are shown in Table 3:

Table 3 - 2002 CO Emissions for CO Season Day by Area Source Category

Category	**CO Emissions in Tons/ CO Season Day**
Fuel Combustion	0.75
Natural Gas	8.06
Coal Combustion	0.71
Wood Burning	0.71
Waste Incineration	5.44
Open Burning	1.01
Structural Fires	0.29
Total	**16.96**

Figure 6 graphically shows the percentage breakdown of the area sources in Philadelphia County.

Figure 6 - Area Sources of Carbon Monoxide in Philadelphia County by Category



E. Highway Sources Summary

This category is comprised of vehicles that operate on the city's roads and highways and includes gasoline and diesel powered automobiles, trucks, etc. Estimating highway vehicle emissions is a complex process which must account for many variables including ambient temperature, vehicle speed, vehicle type and vehicle age. To estimate the emission factors for vehicles, EPA developed the MOBILE model. These emission factors are multiplied by the vehicle miles traveled (VMT) to obtain emissions.

The version used in the First 10-Year Maintenance Plan was MOBILE 5.0a. This Second 10 Year Maintenance Plan uses MOBILE 6.2, the latest version of the MOBILE model released by EPA on February 26, 2004.

MOBILE6 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.

Vehicles are itemized into 28-subcategories of vehicle type.

Table 4 summarizes the emissions from the 16 vehicle types that contribute the most to CO.

Table 4 - Vehicle Types the Contribute Most to CO

Vehicle Type	Description
LDGV	Light duty gasoline vehicles
LDGT1	Light duty gasoline trucks 1 (0-6,000 lb GVWR, 0-3750 lbs. LVW)
LDGT2	Light duty gasoline trucks 2 (0-6,000 lb GVWR, 3751-5,750 lbs. LVW)
LDGT3	Light duty gasoline trucks 3 (6,001-8,500 lbs GVWR, 0-5,750 lbs. ALVW lb)
LDGT4	Light duty gasoline trucks 4 (6,001-8,500 lbs GVWR, greater than 5,751 lbs. ALVW lb)
HDGV2B	Class 2b Heavy-duty gasoline vehicles (8,501-10,000 lbs. GVWR)
HDGV3	Class 3 Heavy-duty gasoline vehicles (10,001-14,000 lbs. GVWR)
HDGV4	Class 4 Heavy-duty gasoline vehicles (14,001-16,000 lbs. GVWR)
HDGV5	Class 5 Heavy-duty gasoline vehicles (16001-19,500 lbs. GVWR)
HDGV6	Class 6 Heavy-duty gasoline vehicles (19,501-26,000 lbs. GVWR)
HDGV7	Class 7 Heavy-duty gasoline vehicles (26,001-33,000 lbs. GVWR)
HDGB	Gasoline busses (school, transit and urban)
HDDV7	Class 7 Heavy duty diesel vehicles (26,001-33,000 GVWR)
HDDV8A	Class 8a Heavy duty diesel vehicles (33,001-60,000 GVWR)
HDDV8B	Class 8b Heavy duty diesel vehicles (>60,000 GVWR)
MC	Motorcycles (gasoline)

Emissions from passenger vehicles(LDGV) represent the largest percentage of the CO emissions from both highway sources and all sources in the Philadelphia County.

For highway sources the estimated CO emissions for Philadelphia County are shown in Table 5:

Table 5 - 2002 CO Emissions for CO Season Day for Highway Sources

VMT	Speed	CO (tpd)
15,559,855	19.21	**434.70**

Table 6 shows the 2002 CO Winter Weekday VMT and CO Emissions for Highway Sources by Vehicle Type.

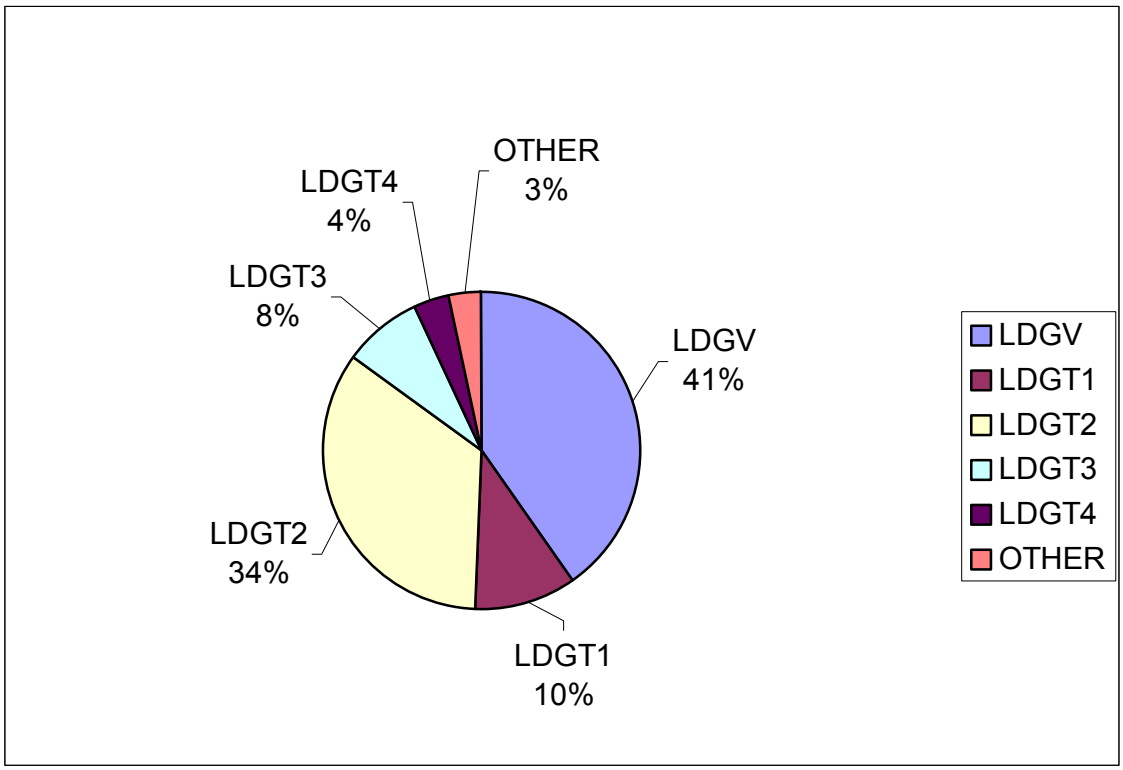
Table 6 - 2002 CO Winter Weekday VMT and CO Emissions for Highway Sources by Vehicle Type

Vehicle Type	VMT		CO		
	Miles	Pct.	T/day	Kg/day	Pct.
LDGV	7,597,343	48.8%		158939	40.3%
LDGT1	1,154,628	7.4%		40520	10.3%
LDGT2	3,840,093	24.7%		135114	34.3%
LDGT3	1,169,003	7.5%		31784	8.1%
LDGT4	538,221	3.5%		14756	3.7%
HDGV2B	273,711	1.8%		5134	1.3%
HDGV3	9,715	0.1%		411	0.1%
HDGV4	5,019	0.0%		333	0.1%
HDGV5	10,787	0.1%		380	0.1%
HDGV6	23,496	0.2%		895	0.2%
HDGV7	10,745	0.1%		640	0.2%
HDGB	4,672	0.0%		584	0.1%
HDDV7	84,000	0.5%		225	0.1%
HDDV8A	103,226	0.7%		427	0.1%
HDDV8B	369,677	2.4%		2031	0.5%
MC	96,739	0.6%		1696	0.4%
Total	15,559,847	100.0%		394352	100.0%
			434.70		

Other M6 vehicle categories are negligible.

Figure 7 graphically shows the CO percentage breakdown of highway sources in Philadelphia County by vehicle type.

Figure 7 - CO Percentage Breakdown of Highway Sources by Vehicle Type



F. Nonroad Source Summary

This category includes a diverse collection of equipment ranging from lawn mowers and chain saws to farm tractors and construction machinery. The inventory is determined using EPA's draft Nonroad2002a model. Further detail is supplied in Appendix II D.

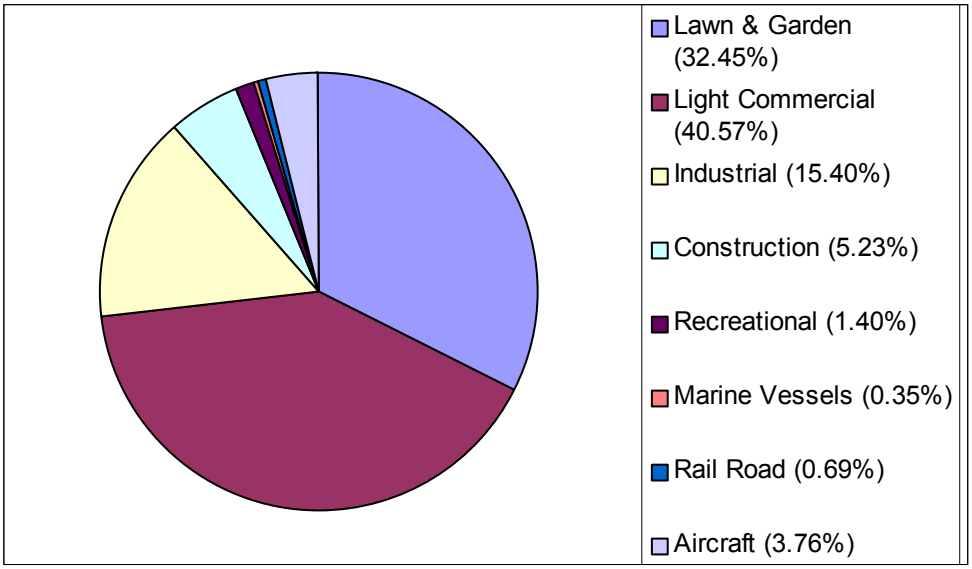
For nonroad sources, the estimated CO emissions for Philadelphia County are shown in Table 7:

Table 7 - 2002 CO Emissions for CO Season Day by NonRoad Source Category

Category	CO Emissions in Tons/CO Season Day
Lawn & Garden	32.87
Agricultural	0.00
Logging	0.00
Light Commercial	41.10
Industrial	15.60
Construction	5.30
Airport Service	0.00
Recreational	1.42
Recreational Marine	0.06
Marine Vessels	0.35
Rail Road	0.70
Aircraft	3.81
Total	**101.30**

Figure 8 graphically shows the percentage breakdown of the nonroad sources in Philadelphia County.

Figure 8 - Non-Road Sources of Carbon Monoxide in Philadelphia County by Category



III. Maintenance Plan

Per the Federal Clean Air Act, 42 U.S.C.A. § 7401 et seq. as amended by the Clean Air Act Amendments of 1990, P.L. 101-549, November 15, 1990 (Act) Section 175A, eight years after redesignation of any area as an attainment area under Section 107(d), the State shall submit to the EPA an additional revision of the applicable State Implementation Plan (SIP) for maintaining the national primary ambient air quality standard for 10 years after the expiration of the initial 10-year period. A previous SIP was made effective on March 15, 1996 in which EPA approved a CO maintenance plan for the years 1997-2007 and a request to redesignate part of Philadelphia County from nonattainment to attainment for CO. To demonstrate continued attainment of the NAAQS, this 2nd maintenance plan projects future CO emissions and air quality for the years 2007-2017. This projection analysis includes the impact of the mandatory federal motor vehicle control program (FMVCP), reformulated gasoline, and the state inspection and maintenance (I/M) program. As described below and in more detail in Appendix II. C., the impact of these programs provides for emissions to remain well below those that brought about the attainment of the NAAQS.

A. Projected Emission Inventories

The 2002 emission inventory was selected because it is current and representative of the emissions in Philadelphia County during the period air quality data has shown maintenance of the NAAQS.

Future year inventories were projected from the 2002 inventory by accounting for growth in the activity of an emission source category and any expected controls. EPA guidance indicates product output, value added, earnings, and employment can be used as indications of growth. EGAS Model Version 4 was used as it creates growth factors based on the Regional Economic Model (REMI) outputs and user inputs of regional or local controls.

EGAS provided state specific historical data for projection estimates for years 2007, 2013, and 2017.

Additional information is available in Appendix III.

This method of estimating the future emissions was made for point, area, and nonroad sources. Projections of highway emissions were made using the MOBILE6.2 as described in Appendix II C.

Summary of Projected Emissions

Table 8 provides total emission estimates from 1990 to 2007 in Tons per CO Season Day and Comparison of the 1st and 2nd 10-year Maintenance Plans

Table 8 - Total Emission Estimates 1990 to 2007 in Tons per CO Season Day and Comparison of the 1st and 2nd 10-year Maintenance Plans

CATEGORY	1990 1st Plan	1990 2nd Plan	1992 1st Plan	1992 2nd Plan	2002 2nd Plan	2007 1st Plan	2007 2nd Plan
Point	20.98	20.98	22.07	22.07	8.38	31.11	8.90
Area	13.77	13.77	13.80	13.80	16.96	13.98	17.45
Highway Mobile	608.99	920.15	561.25	868.88	434.70	334.33	331.25
Nonroad Mobile	9.62	79.97	9.69	84.12	101.30	10.11	112.29
Grand Total	**653.36**	**1034.87**	**606.81**	**988.86**	**561.34**	**389.52**	**469.89**

Table 9 summarizes the total projected emissions for the Years 2007 to 2017. Additional information on individual categories is also presented below.

Table 9 - Total Emission Projections 2007 to 2017 in Tons per CO Season Day

CATEGORY	2007	2013	2017
Point	8.90	9.42	9.55
Area	17.45	18.27	18.76
Highway Mobile	331.25	278.24	260.97
Nonroad Mobile	112.29	125.25	134.04
Grand Total	**469.89**	**431.18**	**423.32**

Point Source Growth

Table 10 lists the projected inventories for this point source category.

Table 10 - Point Source Emissions Projections 2007 to 2017 in Tons per CO Season Day

Category	2007	2013	2017
External Fuel Combustion	3.08	3.50	3.54
Stationary Internal Combustion	4.06	4.62	4.68
Industrial Processes	1.11	1.26	1.28
Other	0.03	0.03	0.03
Total	**8.28**	**9.41**	**9.54**

Area Source Growth

Table 11 lists the projected inventories for this area source category.

Table 11 - Area Source Emissions Projections 2007 to 2017 in Tons per CO Season Day

Category	2007	2013	2017
Fuel Combustion	0.70	0.68	0.66
Natural Gas	8.01	8.13	8.16
Coal Combustion	0.66	0.63	0.62
Wood Burning	0.69	0.69	0.69
Waste Incineration	6.05	6.79	7.26
Open Burning	1.03	1.06	1.08
Forest Fires	0.00	0.00	0.00
Structural Fires	0.29	0.29	0.29
Total	**17.45**	**18.27**	**18.76**

Highway Mobile Source Growth

Highway mobile emissions growth was projected based on the projected increase in Vehicle Miles Traveled (VMT). Additional information on this process is contained in Appendix II C.

As compared to previous MOBILE versions, MOBILE6.2 has a significant impact on 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, 1992 and 2007 were run so the emission estimates made in the first 10-year maintenance plan could be consistent with this second 10-year maintenance plan. Consistency is also important because the amount of change in emissions is related to how air quality is expected to change over time. Totals are reanalyzed using MOBILE6.2 and its available input parameters.

Table 12 lists the projected inventories for this highway mobile source category.

Table 12 - Highway Mobile Source Emission Projections 2007 to 2017 in Tons per Co Season Day

Winter Weekday	VMT	Speed	CO (tpd)
2007	16,904,395	16.84	**331.25**
2013	18,588,460	14.18	**278.24**
2017	19,752,618	12.56	**260.97**

Transportation Conformity

EPA regulation issued under section 176(c) of the CAA to implement "transportation conformity" provides that motor vehicle emission "budgets" cannot be exceeded by emissions produced by the planned transportation system. Transportation agencies in Pennsylvania are responsible for making timely transportation conformity determinations. The Delaware Valley Regional Planning Commission holds that responsibility for the Philadelphia area. The Federal Highway Administration approved these determinations after EPA concurred.

The following can be used to establish transportation conformity budgets. Once EPA has approved this SIP, these would supersede previous budgets and would be the applicable budgets to use for subsequent conformity determinations.

Table 13 - Inventory of VMT and Highway Mobile CO Emissions

Year	2007	2013	2017
• VMT	16,904,391	18,588,460	19,752,618
• T/winter day	331.25	278.23	260.97
• Kg/winter day	300,507	252,407	236,749

Nonroad Source Growth

The model approved by EPA for estimating nonroad sources, draft Nonroad2002a, provides for estimates of emissions beyond the timeframe of 2007 to 2017 that is spanned by the 1st and 2nd Maintenance Plans. To improve the consistency of the inventories over these years, new estimates were made for the years covered by this 2nd 10-Year Maintenance Plan - 2007 (a year common between the two plans, 2013 and 2017.)

Table 14 lists the projected inventories from this nonroad source category.

Table 14 - Nonroad Source Emission Estimates 2007 to 2017 in Tons per CO Season Day

Category	2007	2013	2017
Lawn & Garden	36.06	40.14	42.86
Agricultural	0.00	0.00	0.00
Logging	0.00	0.00	0.00
Light Commercial	48.79	57.24	62.77
Industrial	15.43	15.27	15.39
Construction	5.04	5.04	5.13
Airport Service	0.00	0.00	0.00
Recreational	1.60	1.72	1.78
Recreational Marine	0.06	0.06	0.06
Marine Vessels	0.38	0.43	0.46
Rail Road	0.55	0.43	0.32
Aircraft	4.38	4.92	5.26
Total	**112.29**	**125.25**	**134.04**

Maintenance Demonstration

The motor vehicle remains the dominant source of carbon monoxide emissions in Philadelphia County. The vast majority of the emission reductions during the time period 2007 to 2017 are attributed to motor vehicles. Over this period of time, older, poorer performing vehicles are gradually being replaced with newer vehicles, which exhibit intrinsically lower emissions.

However, growth in both vehicle miles traveled (VMT) and the use of less stringently controlled nonroad mobile sources can reduce the overall gains from improved automobile standards. Through the use of the control measures described below, Philadelphia County continues to show compliance with the NAAQS through 2017.

The Clean Air Act contains several mandatory federal programs designed to reduce motor vehicle emissions including FMVCP. Some of the measures included in this program are: the design, manufacture and certification of new vehicles to lower tailpipe emission standards, improved cold start emission standards and improved emission standards for light duty trucks and passenger vehicles for 1994 model year and thereafter (commonly referred to as Tier I vehicles). Additional federal new vehicle emissions control and fuel programs are incorporated into MOBILE6. The NLEV program became effective in 1999. The Tier 2 / Low Sulfur Fuel Program takes effect in 2004 and provides benefit for subsequent years.

In addition, MOBILE also includes the effects of the heavy-duty highway diesel engine and ultra-low sulfur fuel program which becomes effective in 2007.

The benefits of these improved standards are assessed in the MOBILE6.2 computer program in the attainment and maintenance demonstration.

The Commonwealth has an existing Inspection and Maintenance Program that also reduces carbon monoxide emissions. This program assists in controlling the increase in vehicle emissions due to aging. Without this program emissions would be significantly higher. The benefits of this program were evaluated using MOBILE6.2.

Another important federal requirement is the sale of reformulated gasoline. This is primarily an ozone and air toxics strategy, but provides significant carbon monoxide reductions. The benefits of the use of this fuel are also included in the MOBILE6.2 computer program to predict past, current and future emissions.

Projected design values derived from proportional roll back analysis demonstrate maintenance of the NAAQS through 2017. The analysis is presented in Appendix IV B. The first ten-year plan used proportional roll back methodology to estimate future design values based on the change of emissions over time.

A design value of 4.6 ppm for 2007 was estimated based on the design value for the attainment period 1990-91 (7.1 ppm) and the emission from that period and 2007.

Air quality readings in 1989 determined the nonattainment status of Philadelphia County. Additional assurance that the NAAQS for carbon monoxide would be maintained was demonstrated by using the roll back methodology on Philadelphia County's 1989 design value (11.6 ppm) to predict a 2007 design value of approximately 6.9 ppm.

This second ten-year plan projects a design value of 2.2 to 3.0 ppm in 2007 as compared to the design values of 6.9 or 4.6 ppm predicted for 2007 in the first ten-year plan.

This second ten-year plan projects a 2017 design value of 1.7 to 2.3 based on monitored design values of 2.9 ppm in 2002 or 3.9 ppm in 2003. All of these are well below the NAAQS of 9.0 ppm for the 8-hour average for carbon monoxide.

This plan includes the existing I/M program, the FMVCP and the federal reformulated gasoline program (RFG) as the emission control elements for maintaining compliance with CO NAAQS, a reduction sufficient to maintain the standard through the period. RFG is required under the Act for ozone nonattainment areas and was implemented in 1996 for that purpose in the Philadelphia CMSA. RFG furnishes additional emission reductions that assist in maintaining the CO NAAQS and provides a cushion beyond what is received from the existing I/M program and the FMVCP.

Philadelphia County – I/M Program

The Philadelphia County is included in the I/M program that inspects the emissions for light duty passenger cars and light duty trucks (<9,000#). This modeling makes the following assumptions about I/M:

Basic I/M Program (1990, 1992)

- Model years 1968 and newer receive an idle test.

PA97 with ASM Program with Phase-In Cutpoints (2002)

- Gas cap pressure check applied to model years 1975 and newer.
- Model years 1981 and newer receive the ASM 5015 program with phase-in cutpoints and 1975 to 1980 model years receive the idle test. The anti-tampering program that includes seven inspections applies to model years 1975 and newer.

OBDII and PA97 with ASM I/M Program with Final Cutpoints (2007, 2013, 2017)

- An OBDII computer check for 1996 and newer model year vehicles along with the gas cap pressure check, which is applied to all model years (1975 and newer).
- Model years 1981 to 1995 receive the ASM 5015 program with final cutpoints and 1975 to 1980 model years receive the idle test. The anti-tampering program that includes seven inspections applies to model years 1975 to 1995.

Fuels Program

The Philadelphia county area is required to have federal reformulated gasoline (RFG) for years 1996 and greater. Like conventional gasoline, RFG must meet fuel volatility requirements that vary by geographic region. Philadelphia County was modeled using the RFG requirements for winter time and in the "North" for years 2002, 2007, 2013 and 2017. Reid Vapor Pressure (RVP) of 13.47 was used for 1990 and 1992.

Summary of Emissions and Design Values

Table 15 summarizes both actual and projected emissions and design values for the Years 1990 to 2017. Emissions are in Tons per CO Season Day.

Table 15 - Summary of Design Values for the Years 1990 to 2017

Year	1990	1992	2002	2007	2013	2017
1st Maintenance Plan Emissions	653.36	606.81		389.52		
2nd Maintenance Plan Emissions	1034.87	988.86	561.34	469.76	430.60	422.57
Design Value ppm	**6.8**	**6.8**	**2.9**	**2.4**	**2.2**	**2.2**

B. Verification of Continued Attainment

The Department will continue to operate an air monitoring network as outlined in Part I, Section C of this document. If ambient levels rise and threaten to exceed the NAAQS the Department commits to investigate the reasons for these occurrences and take appropriate action as warranted.

DEP is required to submit statewide emissions information to EPA periodically under the Consolidated Emission Reporting Rule (CERR). DEP and AMS have made this submission for annual carbon monoxide emissions for the year 2002. If levels of emissions submitted to EPA under CERR for carbon monoxide in Philadelphia County exceed those in future milestone years in this SIP, DEP and AMS commit to investigate the reasons for those occurrences and take appropriate action if warranted.

C. Trigger and Contingency Measures

Triggering Indicator

Pennsylvania and Philadelphia County will rely primarily on air monitoring data to track future compliance with the CO NAAQS and to determine the need to implement contingency measures in response to any future violation of the CO NAAQS. Quality

assured air monitoring data from traditional traffic-related monitoring sites, i. e., 500 South Broad Street (CHS), North Broad and Butler Streets (NBR), will serve as the primary indicators in determining the need to "trigger" contingency measures.

Any future validated violation of the CO NAAQS must be fully evaluated for consistency with traffic parameters and other pertinent factors to assure that activation of contingency measures is warranted and appropriate to the cause of the violation. Accordingly, violations that may occur at monitoring sites less impacted by motor vehicles, e.g., 1501 East Lycoming Avenue (LAB) and 20th Street and Benjamin Franklin Parkway (FRI), will require specific analysis to resolve the cause(s) of the violation.

The Department and the DEP reserve the right to petition the EPA Administrator with a show of cause as to why a measured violation of the CO NAAQS should not trigger a prescribed contingency measure, as set forth in this maintenance plan. Such showing must provide demonstration, to the satisfaction of the Administrator, that the imposition of the prescribed contingency measure would not be effective to addressing the cause of the violation in question, and must include a proposed plan and schedule for implementation of alternative remedial measures to address the identified cause of the violation.

Contingency Measures

Section 175A of the Act requires that air quality maintenance plans contain contingency measures to enable prompt response to any violation of the NAAQS occurring after an area has been redesignated to "attainment". The contingency measures specified in the plan should provide an appropriate source-related response to reestablishing and maintaining compliance the NAAQS.

The contingency measure set forth in this maintenance plan is specifically directed to motor vehicles, the predominant source category of CO emissions within Philadelphia County. The contingency measure proposed herein provides for the reinstatement of the seasonal oxygenated fuel program in response to a violation of the CO NAAQS attributable to motor vehicle emissions. This contingency measure has been proposed from the standpoint that it directly applies to the predominant source of the CO emissions and that it can be implemented without undue delay.

The Commonwealth has revised its existing oxygenated fuel program rule, at Chapter 126.1 of Title 25 of the Pennsylvania Code, to permit the use of oxygenated fuel as a contingency measure in the Philadelphia region, if required. If triggered, implementation of the oxygenated fuel program would commence at the beginning of the next control period, consistent with the provisions of Chapter 126.1.

This contingency measures are consistent with that approved for the first ten year plan.

Appendix I. - Meteorological Analysis

The following analysis indicates that meteorological conditions during the attainment period were not unusually favorable.

Since January 1989 only one exceedance and no violation of the standard has occurred. This exceedance occurred within the overnight period from Friday, February 18, 1994, 6:00 p.m. to Saturday, February 19, 1994, 6:00 a.m. During this time the highest CO level - 9.8 ppm for the 8-hour average was reached at the Air Management Services (AMS) Laboratory. This is the only air monitoring site within Philadelphia County where an exceedance occurred.

A meteorological analysis of the February 1994 event in comparison with similar meteorological conditions of 2000, 2001, and 2002 was performed. This analysis was to assure the improvement in air quality was not due to abnormally favorable meteorological conditions.

NOAA hourly climatological data for Philadelphia from: http://pasc.met.psu.edu/cgi-bin/hourly.pl?id=PHL for 2000, 2001, and 2002 for the time period 6:00 p.m. to 12:00 noon with the following criteria:

1) low morning temperatures (between 0 and 5 degrees Celsius)
2) low wind speeds (2.5 m/s and less)

YEAR	# Hours	Low Temp Count	Low Wind Speed Count	Count of Both
2000	6,862	954.00	1,423.00	227.00
2001	5,181	868.00	1,207.00	234.00
2002	6,519	1,123.00	1,278.00	196.00
Total	**18,562**	**2,945.00**	**3,908.00**	**657.00**

Appendix II. A. - Point Source Detail

a. Inventory Description

Point sources for carbon monoxide are mostly represented by utility and large industrial fuel burning as well as chemical processes.

b. Compiling the Point Source List

Air Management Services (AMS) has maintained, in computer format, an emission inventory of point sources since 1970 and has updated it each year. The point source inventory in 2002 includes all Title V and Synthetic Minor facilities. These are facilities that have the potential to emit a major source level of criteria pollutant. This includes 25 tons of nitrogen oxides (NOx), 25 tons of volatile organic compounds (VOC), 100 tons of particulate matter less than 10 microns (PM10), 100 tons of sulfur dioxide (SO2), 100 tons of carbon monoxide (CO), 25 tons of combined hazardous air pollutants (HAP) or 10 tons of a single HAP. If a facility is required to submit an inventory due to one pollutant an inventory of all pollutants is required.

Yearly emission inventories were calculated by facilities and required to be delivered to Air Management Services (AMS) by March 1, 2003 for the 2002 calendar year emissions data. Emissions are typically estimated using emission factors from AP-42 or stack tests. The data entry program used by facilities is i-STEPS, a commercial product. The contractor for this software was Pacific Environmental Services, Inc. The estimation methods prescribed by EPA include the consideration of Rule Effectiveness of control equipment which is intended to account for equipment breakdowns, periods of reduced control efficiency and other conditions. Because no source in the inventory has a control device for carbon monoxide, this factor was not applicable.

Computer and manual checks were made to ensure the required data entered was reasonable and calculated correctly.

Table 16 lists point sources contained in the inventory. Emissions from the boilers at a refinery listed represents the largest source among the point sources.

Table 16 - CO Emissions by from Individual Point Sources

		CO Emissions		
			CO Season	
FACILITY	**PLID**	**Tons/Yr**	**Tons/Day**	**Lbs/Day**
ALBERT EINSTEIN MEDICAL CENTER	08034	15.79	0.02448	48.962
ALLIED TUBE & CONDUIT CORPORATION	03363	0.00	0.00000	0.000
ANGELICA TEXTILE SERVICES	02131	1.26	0.00065	1.306
ARBILL INDUSTRIES, INC.	03811	0.43	0.00201	4.025
ARDEX LABORATORIES, INC.	03487	0.04	0.00037	0.733
		CO Emissions		

			CO Season	
FACILITY	**PLID**	**Tons/Yr**	**Tons/Day**	**Lbs/Day**
ASHLAND CHEMICAL-PHILADELPHIA CPD PLANT	03062	1.85	0.00311	6.227
BELLEVUE	06513	28.52	0.12406	248.127
CALEDONIAN DYE WORKS	03058	0.33	0.00109	2.182
CARDONE INDUSTRIES INC.	03887	0.94	0.00000	0.003
CATALYST INTERNATIONAL/GASKET MATERIALS	03349	0.03	0.00000	0.000
CLEAN EARTH OF PHILADELPHIA, INC.	02148	6.49	0.02871	57.412
CONOCOPHILLIPS CO. PHILADELPHIA TERM	05004	0.00	0.00000	0.000
CONVENT OF THE SISTERS OF ST JOSEPH	09039	0.98	0.00000	0.000
DELAWARE VALLEY WOOL SCOURING CO.	03462	0.53	0.00147	2.944
E I DUPONT MARSHALL LABORATORY	02065	1.31	0.00631	12.626
EXELON GENERATING CO - RICHMOND	04903	0.30	0.00112	2.248
EXELON GENERATION CO - DELAWARE STATION	04901	20.31	0.20472	409.437
EXELON GENERATION CO - SOUTHWARK	04905	1.12	0.03811	76.227
EXELON GENERATION CO. - SCHUYLKILL STA.	04904	1.56	0.05242	104.847
FABRICON PRODUCTS INC.	03103	0.21	0.00154	3.079
FRIENDS HOSPITAL	08031	0.91	0.00372	7.444
GEII INSPECTION & REPAIR SERVICES	03217	0.25	0.00104	2.076
GERMANTOWN COMMUNITY HEALTH SERVICES	08039	0.28	0.00410	8.193
GIRARD COLLEGE POWER PLANT	08918	2.35	0.00000	0.000
GRAPHIC ARTS, INCORPORATED	02260	0.07	0.00038	0.760
GRAYS FERRY COGENERATION PARTNERS	04944	2.38	0.00602	12.038
HAHNEMANN HOSP	08054	0.25	0.00306	6.114
HOUSE OF CORRECTIONS	09519	5.83	0.01537	30.737
INOLEX CHEMICAL COMPANY	02059	8.99	0.01390	27.791
INTERSTATE BRANDS CORPORATION	05811	7.37	0.03588	71.750
JEANES HOSPITAL	08011	4.14	0.01819	36.381
JEFFERSON SMURFIT CORPORATION (U.S)	01566	48.76	0.14904	298.082
JOHN F. KENNEDY MEDICAL CENTER	08009	0.35	0.00202	4.033
JOWITT AND RODGERS CO	03154	0.03	0.00019	0.384
KINDER-MORGAN LIQUID TERMINALS CORPORATI	05003	1.05	0.00335	6.698
KIRKBRIDE CENTER	08024	0.35	0.00212	4.247
KRAFT FOODS N.A., INC. - NABISCO	03201	5.29	0.02434	48.675
KURZ-HASTINGS INC	01585	3.23	0.00148	2.969
KVAERNER PHILADELPHIA SHIPYARD, INC.	01569	1.73	0.01560	31.204
LA FRANCE CORPORATION	03164	0.78	0.00397	7.938
LAUREL LINEN SERVICE INC.	07297	0.33	0.00070	1.404
LAWRENCE MCFADDEN CO.	02074	0.05	0.00047	0.933
LUITHLEN DYE CO	03175	0.30	0.00152	3.045
M A BRUDER & SONS	02005	0.37	0.00550	11.001
MAILWELL GRAPHICS -PHILADELPHIA	03679	0.02	0.00003	0.061
		CO Emissions		
			CO Season	

FACILITY	PLID	Tons/Yr	Tons/Day	Lbs/Day
MERCY HOSPITAL OF PHILADELPHIA	08043	0.27	0.01180	23.603
MODEL FINISHING CO	03514	0.24	0.00066	1.317
NAVAL FOUNDRY AND PROPELLER CENTER	09702	0.15	0.00316	6.325
NAVAL SUPPORT ACTIVITY , PHILADELPHIA	09707	0.42	0.00003	0.055
NAVAL SURFACE WARFARE CENTER CD-SSES	09724	1.46	0.04752	95.037
NAZARETH HOSPITAL	08008	3.98	0.02977	59.535
NEWMAN & COMPANY	03489	12.40	0.04163	83.263
NORTHEAST FOODS - PHILADELPHIA BAKING CO	03048	1.73	0.00747	14.933
NORTHEAST WPCP	09513	9.54	0.02614	52.284
O' BRIEN COGENERATION INC. (N E)	01533	3.06	0.03060	61.200
O` BRIEN COGENERATION INC. (S W)	01534	0.59	0.00084	1.683
PAID BOILER STEAM PLANT	09715	4.61	0.00000	0.000
PARK TOWNE PLACE APARTMENTS	06526	1.53	0.00284	5.672
PEARL PRESSMAN LIBERTY	07721	0.02	0.00008	0.156
PECO ELECTRIC SHOP - OREGON	04907	0.45	0.00120	2.400
PERFECSEAL	01591	0.31	0.01248	24.963
PHILADELPHIA GAS WORKS - PASSYUNK PLANT	04921	5.41	0.00003	0.053
PHILADELPHIA GAS WORKS - RICHMOND PLANT	04922	11.10	0.06947	138.941
PHILADELPHIA INTERNATIONAL AIRPORT	09502	4.08	0.02157	43.148
PHILADELPHIA WATER DEPT. (S W / B R C)	09515	12.54	0.03618	72.356
PHILADELPHIAN CONDOMINIUMS	06512	49.30	0.12647	252.933
PIONEER LEATHERTOUCH INC	02245	0.00	0.00000	0.000
PRESBYTERIAN MEDICAL CENTER	08023	3.53	0.03079	61.581
PUROLITE INC.	01617	2.39	0.00948	18.967
REGAL CORRUGATED BOX COMPANY INC.	03531	0.80	0.00431	8.625
RICHARDSAPEX INC - PHILADELPHIA FACILITY	03820	0.23	0.00144	2.870
RIVERSIDE MATERIALS, INC.	01421	38.89	0.27221	544.422
ROHM & HAAS COMPANY	01531	1.83	0.00611	12.223
ROYAL-PIONEER CO	03281	0.41	0.00109	2.181
RYDER TRUCK RENTAL, INC.	02030	0.01	0.00010	0.191
SAINT AGNES HOSPITAL	08016	5.67	0.05753	115.055
SAINT CHRISTOPHERS HOSPITAL FOR CHILDREN	08576	1.69	0.00177	3.546
SAINT JOSEPH`S UNIVERSITY	08904	1.78	0.00956	19.126
SEAGULL LIGHTING	03294	0.18	0.00044	0.887
SEPTA BERRIDGE/COURTLAND MAINT SHOP	04172	1.43	0.01076	21.520
SMITH- EDWARDS- DUNLAP COMPANY	02255	0.09	0.00035	0.709
SMURFIT-STONE CONTAINER CORPORATION	02051	0.21	0.00060	1.193
ST SERVICES PHILADELPHIA TERMINAL	05013	1.98	0.00627	12.537
SUN CHEMICAL CORPORATION- GPI DIVISION	02052	0.09	0.00064	1.277
SUNOCO CHEMICALS (FORM. ALLIED SIGNAL)	01551	145.47	0.19694	393.874
		CO Emissions		
			CO Season	
FACILITY	**PLID**	**Tons/Yr**	**Tons/Day**	**Lbs/Day**

SUNOCO INC. (R&M)	01501	1,806.20	4.93253	9,865.067
SUNOCO, INC SCHUYLKILL RIVER TANK FARM	01517	8.60	0.02389	47.778
T.D.P.S. MATERIALS, INC.	01416	5.98	0.05126	102.514
TASTY BAKING CO	02054	3.85	0.69584	1,391.678
TEMPLE UNIV HOSPITAL - EPISCOPAL CAMPUS	08053	1.90	0.01136	22.728
TEMPLE UNIVERSITY HEALTH SCIENCES CAMPUS	08906	8.56	0.01141	22.811
TEMPLE UNIVERSITY MAIN CAMPUS,FACILITIES	08905	20.33	0.39263	785.263
TENET - MEDICAL COL. OF PA - MAIN CAMPUS	08037	1.82	0.01303	26.069
THE BUDD CO	01564	4.94	0.05482	109.642
THE CHILDREN`S HOSPITAL OF PHILADELPHIA	08069	5.67	0.03938	78.750
TRIGEN - EDISON	04902	14.06	0.00000	0.000
TRIGEN - SCHUYLKILL	04942	15.54	0.00000	0.000
UNITED STATES MINT	09703	7.71	0.22584	451.678
UNIVERSITY OF PENNSYLVANIA	08912	2.07	0.00620	12.394
V A MEDICAL CENTER	09705	3.73	0.03017	60.336
WILLIAM J. GREEN FEDERAL BUILDING - GSA	09723	1.26	0.00000	0.001
WISTAR INSTITUTE	08927	1.88	0.00597	11.939
TOTALS		**2,421.45**	**8.38**	**16,753.63**

Appendix II. B - Area Source Detail

a. Inventory Description

The area source emission inventory is a collective estimate of emissions for sources that are either too small or too numerous to be compiled individually in the point source inventory. Most emissions in this category come from the combustion of fossil and other fuels and must be adjusted for sources that are in the point source inventory. Often this is done by subtracting the activity, such as gallons of fuel burned in the point sources, from the total fuel burned in Philadelphia County.

The methods used to estimate emissions were based on the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

b. Emissions Summary

Table 17 provides a summary of the emission estimates in the area source category.

Table 17 - CO Emissions for CO Season Day by Area Source SubCategory

SUBCATEGORY	**2002** Tons/Day
STATIONARY SOURCE FUEL COMBUSTION	
ELECTRIC UTILITY	**0.000**
FUEL OIL COMBUSTION	**0.747**
Distillate Industrial	0.129
Residual Industrial	0.040
Distillate Commercial	0.390
Residual Commercial	0.021
Distillate Residential	0.168
Residual Residential	0.000
NATURAL GAS COMBUSTION	**8.055**
Industrial	0.763
Commercial	3.031
Residential	4.261
COAL COMBUSTION	**0.710**
Industrial	0.000
Commercial	0.000
Residential Anthracite	0.710
SUBCATEGORY	**2002** Tons/Day
WOOD COMBUSTION	**0.711**
Residential Wood	0.711

WASTE DISPOSAL TREATMENT & RECOVERY	**8.465**
Commercial Solid Waste Incineration	4.100
Industrial Solid Waste Incineration	1.336
Commercial Open Burning	0.837
Industrial Open Burning	0.175
MISCELLANEOUS AREA SOURCES	**0.290**
Forest Wildfires	0.000
Managed Slash Burning	0.000
Structure Fires	0.290
Firefighting Training	0.000
Grand Total	**16.96**

c. Estimation Techniques

All emissions estimates were adjusted for the carbon monoxide season.

The following summarizes the emission estimation techniques used for each subcategory of area source emissions.

Stationary Source Fuel Combustion

1. Electric Utility

Emissions for this category were estimated as point sources and are discussed in Appendix II A.

2. Fuel Oil Combustion

The total sales of fuel oil for combustion were derived from the Energy Information Administration Form EIA-821, "Annual Fuel Oil and Kerosene Sales Report," for 2002. This source reports fuel use for each state by fuel type and purpose for which they are sold. Fuel use was then allocated to Philadelphia County by population of Philadelphia County vs. Pennsylvania. Population is from the U.S Census Bureau.

Example Calculation (provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

The general method for estimating emissions from fuel oil burning is illustrated below using the example of **industrial distillate oil**.

$$Annual\ Emissions = (Emission\ Factor)(PA\ Industrial\ Distillate\ Fuel\ Oil\ Use)\left(\frac{Philadelphia Population}{PA Population}\right)$$

where:

CO Emission Factor = 5 lbs/1000 gallons/year

Emissions were calculated by using the emission factors in the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Table 1.3-1.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{5\ lbs CO / 1000 gallons}{year}\right)(106{,}763{,}000\ gallons)\left(\frac{1{,}492{,}231}{12{,}335{,}091}\right)$$

$$Annual\ CO\ Emissions = 64577.983\ pounds\ CO\ \ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 32.289\ tons\ CO\ per\ year$$

from industrial distillate oil.

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.0040
Winter work weekday CO emissions = 32.298 × 0.0040=0.129 tons CO per day

3. Natural Gas Combustion

Information for natural gas use came from Philadelphia Gas Works (PGW) which is the sole supplier of natural gas in Philadelphia County. PGW supplied the following:

Gas Consumed/Sold	**Year 2002**
Residential:	40.5 bcf
Commercial:	15.1 bcf
Industrial:	3.8 bcf

Example Calculation (provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

The general method for estimating emissions from natural gas burning is illustrated below using the example of **industrial natural gas**.

$$Annual\ Emissions = (Emission\ Factor)(PhilaNaturalGas\ Use)$$

where:

CO Emission Factor = 84 lbs/MSCF/year

Emissions were calculated by using the emission factors in the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Table 1.4

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{84\ lbs CO / MSCF}{year} \right)(3{,}800 MSCF)$$

$$Annual\ CO\ Emissions = 319{,}200\ pounds\ CO\ \ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 159.6\ tons\ CO\ per\ year$$

from industrial natural gas.

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.00478
*Winter work weekday CO emissions = 159.6 * 0.00478 = 0.763 tons CO per day*

4. Coal Combustion

Regulations essentially banned the sale and burning of coal in Philadelphia County since the early 1970's. An emission estimate of zero was therefore made for industrial and commercial users.

Residential coal consumption, in tons per dwelling unit, was estimated using the following equation provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004:

$$Coal\ consumption\ per\ dwelling\ unit = 0.003874\ e^{(7.6414-(1000/heating\ degree\ days))}$$

The amount of coal used by all dwelling units was then calculated by multiplying the number of units by the amount of coal used per dwelling unit.

The number of dwelling units was found by interpolating from the U.S. Bureau of the Census for 2000 which had 148 coal dwelling units based on population of 1,517,550 in 2000 to 1,492,231 in 2002 from the U.S. Census Bureau. The number of dwelling units in 2002 was estimated to be 146.

Tons coal burned = Tons of coal per dwelling unit x Number of dwelling units

Example Calculation (provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

Residential Coal Combustion:

$$Annual\ Emissions = (Pollutant\ Emission\ Factor)(Percent\ Ash\ Content, if\ applicable) \cdot (Number\ of\ Coal\text{-}Burning\ Dwelling\ Units)\left(0.003874e^{\left(7.6414-\frac{1000}{HDD}\right)} \Big/ Coal\text{-}Burning\ Dwelling\ Units\right)$$

where:

CO Emission Factor = 275 lbs/ton anthracite coal/year;
Anthracite Coal Sulfur Content = 0.89% sulfur
Anthracite Coal Ash Content = 13.38% ash
Number of Coal-Burning Dwelling Units = 146
HDD = Heating Degree Days = 4226

Because anthracite is mined in the eastern half of Pennsylvania, the emission calculations assume that eastern counties burn anthracite coal.

Emissions were calculated by using the emission factor in the Pacific Environmental Services, Inc., "Final Summary of the Development and Results of a Methodology for Calculating Area Source Emissions from Residential Fuel Combustion," prepared for U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, September 2002.

Heating Degree Day (HDD) data were obtained from the National Oceanic and Atmospheric Administration and total 4,226 for the Year 2002.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{275\ lbs\ CO \big/ tons\ coal}{year} \right) (146\ dwelling\ units) \left[0.003874 e^{\left(7.6414 - \frac{1000}{4226}\right)} tons\ coal \big/ dwelling\ unit \right]$$

$$Annual\ CO\ Emissions = 255{,}679.407\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 127.840\ tons\ CO\ per\ year$$

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor=0.00555
Winter work weekday CO emissions = 127.840 × 0.00555 = 0.710 tons CO per day

5. Wood

Residential use of wood was estimated using the following method:

Residential wood use (tons/year) = 0.0017 x NHUHW x HDG x ARPH/5.0

Where NHUHW = number of housing units using wood
HDG = heating degree days
ARPH = average number of rooms per housing unit
CO Emission Factor = 230.8 lbs/ton

The number of housing units using wood was found by interpolating from the U.S. Bureau of the Census for 2000 which had 170 housing units using wood based on population of 1,517,550 in 2000 to 1,492,231 in 2002 from the U.S. Census Bureau.

The number of dwelling units in 2002 was estimated to be 167.

The average number of rooms per housing unit from the U.S. Bureau of the Census for 2000 is was 5.6 average.

Heating Degree Day (HDD) data were obtained from the National Oceanic and Atmospheric Administration and total 4,226 for the Year 2002.

Emissions were calculated by using the emission factors in the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Table 1.10-1.

Residential wood use (tons/year) = 0.0017 x 167 x 4226 x 5.5/5.0 = 1319.738

Once wood usage was determined, emissions were estimated with an emission factor.

CO Emissions (tons/year) = (Tons Burned * Emission Factor) / 2000 Lbs/Ton

CO Emissions (tons/year) = (1319.738 * 230.8)/2000

CO Emissions (tons/year) = 152.298

Emissions for the typical CO season day were estimated by correcting for the winter season use by a seasonal adjustment factor of 1.7 for residential stationary source fossil fuel use 7 days per week.

CO Emissions (tons/day) = (152.298 Tons/Year * 1.7) / (52 Weeks/Yr * 7 Days/Week)

CO Emissions (tons/day) = 0.711

Waste Disposal Treatment & Recovery

Residential on-site incineration is not permitted in Philadelphia County and is estimated as zero emissions.

Commercial Solid Waste Incineration:

Annual Emissions = (Emission Factor)(Loading Factor)(Population)

where:

CO Emission Factor = 37 lbs CO/ton waste burned/year
Loading Factor = 54 tons/1000 people
Population = 1,492,231 – Philadelphia

Emissions were calculated by using the emission factors in the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources.

Loading Factor is provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

Population is from the U.S Census Bureau.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{37\ lbs\ CO \Big/ ton\ waste\ burned}{year} \right) \left(\frac{54\ tons\ waste}{1000\ people} \right) (1{,}492{,}231\ \ people)$$

$$Annual\ CO\ Emissions = 2{,}981{,}477.538\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 1490.739\ tons\ CO\ per\ year$$

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.00275
Winter work weekday CO emissions = 1490.739× 0.00275 = 4.100 tons CO per day

Industrial Solid Waste Incineration:

Annual CO Emissions = (Emission Factor)(Loading Factor)(Number of Employees)

where:

CO Emission Factor = 37 lbs CO/ton waste burned/year
Loading Factor = 560 tons/1000 employees
Employees = 46,880 employees in manufacturing in Philadelphia

Emissions were calculated by using the emission factors in the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources.

Loading Factor is provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

Number of employees in manufacturing is from 2002 American Community Survey Profile – Population and Housing Profile: Philadelphia, PA.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{37\ lbs\ CO \Big/ ton\ waste\ burned}{year} \right) \left(\frac{560\ tons\ waste\ burned}{1000\ employees} \right) (46{,}880\ employees)$$

$$Annual\ CO\ Emissions = 971{,}353.6\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 485.677\ tons\ CO\ per\ year$$

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.00275
Winter work weekday CO emissions = 6070.96× 0.00275 = 1.336 tons CO per day

Open Burning

Open burning is not permitted in Philadelphia County and is estimated as zero emissions for residential sources. However, in order to account for violations of these prohibitions, estimates were made under the categories of industrial and commercial sources.

Commercial/Institutional Open Burning:

$$Annual\ Emissions = (EmissionFactor)(Loading\,Factor)(Population)\left(1 - \frac{CE}{100} \cdot \frac{RP}{100} \cdot \frac{RE}{100}\right)$$

where:

CO Emission Factor = 85 lbs CO/ton waste/year
Loading Factor = 24 tons waste/1000 people
Population = 1,492,231
CE (Control Efficiency) = 100%
RP (Rule Penetration) = 100%
RE (Rule Effectiveness) = 80%

The emission factor is from the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Table 2.5-1.

Loading Factor, CE, RP, and RE are provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

Population is from the U.S Census Bureau.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{85\ lbs\ CO \Big/ ton\ waste}{year} \right) \left(\frac{24\ tons\ waste}{1000\ people} \right) (1{,}492{,}231\ people) \left(1 - \frac{100}{100} \cdot \frac{100}{100} \cdot \frac{80}{100} \right)$$

$$Annual\ CO\ Emissions = 608{,}830.248\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 304.415\ tons\ CO\ per\ year$$

from commercial/institutional open burning.

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.00275
Winter work weekday CO emissions = 304.415 × 0.00275 = 0.837 tons CO per day

Industrial Open Burning:

$$Annual\ Emissions = (Emission\ Factor)(Loading\ Factor)(Employees)\left(1 - \frac{CE}{100} \cdot \frac{RP}{100} \cdot \frac{RE}{100} \right)$$

where:

CO Emission Factor = 85 lbs CO/ton waste/year
Loading Factor = 160 tons waste/1000 employees
Employees = 46,880 employees in manufacturing in Philadelphia
Control Efficiency = 100%
Rule Penetration = 100%
Rule Effectiveness = 80%

The emission factor is from the Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Table 2.5-1.

Loading Factor, CE, RP, and RE are provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

Number of employees in manufacturing is from 2002 American Community Survey Profile – Population and Housing Profile: Philadelphia, PA.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{85\ lbs\ CO \Big/ ton\ waste}{year} \right) \left(\frac{160\ tons\ waste}{1000\ employees} \right) (46{,}880\ \ employees) \left(1 - \frac{100}{100} \cdot \frac{100}{100} \cdot \frac{80}{100} \right)$$

$$Annual\ CO\ Emissions = 127{,}513.6\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 63.757\ tons\ CO\ per\ year$$

From industrial open burning.

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.00275
Winter work weekday CO emissions = 63.757 × 0.00275 = 0.175 tons CO per day

Miscellaneous Sources

1. Forest Wildfires

The Fairmont Park Commission asserted that the damage to even individual trees by fire is very rare. An emission estimate of zero was therefore made.

2. Managed (Slash/Prescribed) Burning

There is no slash or prescribed burning permitted in Philadelphia County. Information provided by the Fairmont Park Commission reaffirmed that no slash/prescribed burning occurs.

3. Structure Fires

Annual Emissions = (Emission Factor)(Loading Factor)(Per Capita # of Fires)(Population)

where:
CO Emission Factor = 60 lbs CO/ton material burned/year
Loading Factor = 1.15 tons material/fire
Per Capita Number of Fires = 0.0018 fires/person
Population = 1,492,231

Emission Factor, Loading Factor, and Per Capita Number of Fires are provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods,

Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004)

The loading factor was determined from the Eastern Research Group, "Emission Inventory Improvement Program, Document Series, Volume III, Area Sources, Chapter 18, Structure Fires," prepared for Area Sources Committee, Emission Inventory Improvement Program, January 2001.

The per capita number of fires was found from the National Fire Protection Association, Fire Loss in the United States During 2002, September 2003.

Population is from the U.S Census Bureau.

CO Emissions:

$$Annual\ CO\ Emissions = \left(\frac{60\ lbs\ CO / ton\ material}{year} \right) \left(\frac{1.15\ tons\ material}{fire} \right) \left(\frac{0.0018\ fires}{person} \right) (1{,}492{,}231\ people)$$

$$Annual\ CO\ Emissions = 185{,}335.090\ pounds\ CO\ per\ year \cdot \frac{1\ ton}{2000\ lbs} = 92.668\ tons\ CO\ per\ year$$

Emissions for the typical CO season day were estimated by correcting for the winter season use with the winter workday week allocation factor provided in the Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods, Pechan Rpt. No. 04.02.006/9420.109, prepared by E.H. Pechan & Associates, Inc., February 2004.

Winter work weekday CO emissions = annual CO emissions × winter work weekday allocation factor
Winter work weekday allocation factor = 0.003126
Winter work weekday CO emissions = 92.668× 0.003126 = 0.290 tons CO per day
From Structural fires.

4. Firefighting Training

The only firefighting training is conducted at the U S Navy base in Philadelphia County and is accounted for in the point source inventory.

5. Aircraft/Rocket Engine Firing and Testing

There is no aircraft or rocket engine testing conducted in Philadelphia County. Internal combustion and turbine engine testing is conducted at the US Navy base and are included in the point source inventory.

6. Asphalt Roofing Kettles

Roofing kettles are generally gas fired and were not considered a significant source of CO emissions and were not estimated.

7. Sewage Sludge Incinerators

Philadelphia County did not have any sewage sludge incinerators in 2002. Is this true??

8. Hazardous Waste Treatment Facilities

Hazardous waste treatment facilities were included in the point source inventory and were not estimated as part of the area source inventory.

9. Coffee Roasting

CO emissions are considered insignificant for this source category in Philadelphia County. Gas-fired heating is most common.

10. Meat Smoke Houses

Smoke houses in Philadelphia County do not burn wood. A combination of steam heat and liquid smoke are used to smoke the meat.

11. Asphalt roofing manufacture

There was none in Philadelphia County in 2002.

Table 18 includes all area source calculations.

Table 18 - Calculation of Area Source Emissions

I Fuels								**Total**
Industrial	**Distillate**							
Annual emission = (Emission factor)*Total sales in PA*population in Philadelphia/Population in PA								
CO emission								
1,492,231	Phili Population							
12,335,091	Pennsylvania Population							
106763000	gallons in PA							
5/1000	0.005	lb co/ 1000 gallons emission factor						
2000	lb/tons							
32.28899127	tons/year 2002							
Co emission lb/yr seasonal								
0.004	Seasonal Emission allocation factor							
CO Emission=	**0.129155965**	**ton/day**						**0.1292**
Industrial	**Residual**							
Annual emission = (Emission factor)*Total sales in PA*population in Philadelphia/Population in PA								
CO emission								
1,492,231								
12,335,091								
32929000	gallons in PA							
5/1000	0.005	lb co/ 1000 gallons emission factor						
2000	lb/tons							
9.958920165	tons/year 2002							
Co emission lb/yr seasonal								
0.004	Seasonal Emission allocation factor							
CO Emission=	**0.039835681**	**ton/day**						**0.03984**
Commercial	**Distillate**							
Annual emission = (Emission factor)*Total sales in PA*population in Philadelphia/Population in PA								
CO emission								
1,492,231								
12,335,091								
322007000	gallons in PA							
5/1000	0.005	lb co/ 1000 gallons emission factor						
2000	lb/tons							
97.38655913	tons/year 2002							
Co emission lb/yr seasonal								
0.004	Seasonal Emission allocation factor							
CO Emission=	**0.389546237**	**ton/day**						**0.3895**
Commercial	**Residual**							
Annual emission = (Emission factor)*Total sales in PA*population in Philadelphia/Population in PA								
CO emission								
1,492,231								
								Total

12,335,091								
16950000	gallons in PA							
5/1000	0.005	lb co/ 1000 gallons emission factor						
2000	lb/tons							
5.126292836	tons/year 2002							
Co emission lb/yr seasonal								
0.004	Seasonal Emission allocation factor							
CO Emission=	**0.020505171**	**ton/day**						**0.02**
Residential	**Distillate**							
Annual emission = (Emission factor)*Total sales in PA*population in Philadelphia/Population in PA								
CO emission								
1,492,231								
12,335,091								
885728000	gallons in PA							
5/1000	0.005	lb co/ 1000 gallons emission factor						
2000	lb/tons							
267.8761712	tons/year 2002							
Co emission lb/yr seasonal								
0.000626	Seasonal Emission allocation factor							
CO Emission=	**0.167690483**	**ton/day**						**0.17**
						Fuel Total		**0.75**
II Natural Gas								
Residential								
40	lb/mmcf(million cubic feet/year)emission factor							
2000	lb/ton							
0.02	ton/mmcf							
0.00526	winter allocation factor							
40500	MMcf							
Winter CO Emission=winter allocation factor*fuel usage								
Winter CO	**4.2606**	**Ton/day**						**4.26**
Commercial								
84	lb/mmcf(million cubic feet/year)emission factor							
2000	lb/ton							
0.042	ton/mmcf							
0.00478	winter allocation factor							
15100	MMcf							
Winter CO Emission=winter allocation factor*fuel usage								
Winter CO	**3.031476**	**Ton/day**						**3.03**
Industrial								
84	lb/mmcf(million cubic feet/year)emission factor							
								Total
2000	lb/ton							

0.042	ton/mmcf							
0.00478	winter allocation factor							
3800	MMcf							
Winter CO Emission=winter allocation factor*fuel usage								
Winter CO	**0.762888**	**Ton/day**						**0.76**
						Natural Gas Total		**8.05**
III Coal Combustion								
Residential								
Emission factor=	275	lb/ton anthracite/yr						
Coal consumption=	3504	tons						
0.00555	Winter season							
1,492,231	Phili Population							
12,335,091	Pennsylvania Population							
146	dwelling unit							
CO emission Anthracite=		255679.4						
2000	lb/ton							
CO emission=	**0.709510354**	**tons CO per day**						**0.71**
						Coal Total		**0.71**
IV Wood								
Residential								
0.0017								
167	House							
4226	Heating days							
5.5	average room							
2000	lb/ton							
230.8	emission factor							
1.7	seasonal factor							
52	weeks							
7	days/week							
5								
Residential wood use=		**0.711281**	**tons/day**					**0.71**
						Wood Total		**0.71**
V Waste Incineration								
Commercial								
Annual Emission=(Emission factor*Loading factor*population								
37	lbs/ton waste burned /year							
								Total
1492231	Philadelphia population							
0.054	Loading	(54 ton/1000 people)						

	factor							
CO Emission=	2981477.538		tons CO/year					
0.00275	Winter allocation factor							
winter Co emission		**4.099532**	**tons of CO per day**					**4.10**
Industrial								
Annual Emission=(Emission factor*Loading factor*employee								
560	tons CO/1000 employee(emission factor)							
46880	Philadelphia employee							
0.56	Loading factor							
37	lbs/ton waste burned /year							
0.00275	Winter allocation factor							
CO Emission=	485.6768	tons CO/year						
0.00275	Winter allocation factor							
winter Coemission		**1.335611**	**tons of CO per day**					**1.34**
					Waste Incineration Total			**5.44**
VI Open Burning								
Commercial								
Annual Emission=Emission factor*loading factors*population*(1-CE*RP*RE								
85	lbs/ton waste /year (CO emission factor)							
0.8	RE(rule effectiveness)							
1	CE(Control Efficiency)							
1	RP(rule penetration)							
0.00275	winterfactor							
0.024	(24 tons/1000 people)							
1492231	Phili population							
0.2	factors							
Winter CO=	**0.837141591**	**tons/day**						**0.84**
Industrial								
Annual Emission=Emission factor*loading factors*population*(1-CE*RP*RE								
85	lbs/ton waste /year (CO emission factor)							
0.8	RE(rule effectiveness)							
1	CE(Control Efficiency)							
1	RP(rule penetration)							
0.00275	winterfactor							
0.16	(160 tons/1000 people)							
46880	employees							
								Total
0.2	all factors							
Winter CO=	**0.1753312**	**tons CO/day**						**0.18**

						Open Burning Total		**1.01**
VII Forest Wild Fire								
140	lbs/ton of flora/year							
11	tons of floara/acre							
0	Acres Burned							
0.00056	winter allocation factor							
Winter work emission=		**0**	**ton/day**					**0**
						Forest Fire Total		**0**
VIII Structural Fires								
60	lbs/ton material burned/year							
1.15	tons material/fire							
0.0018	fires/person							
1492231	phili population							
2000	lb/ton							
0.003126	winter allocation factors							
Winter CO	**0.289678746**	**ton/day**						**0.29**
						Structural Fire Total		**0.29**
			Grand Total For Area Source =					**16.96**
								tons/day

Appendix II. C - Highway Source Detail

Guidance documents from EPA were used to develop the CO emissions inventory. They include:

- *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.
- *Policy Guidance on the Use of MOBILE6 for SIP Development and Transportation Conformity,* US EPA Office of Air and Radiation, and Office of Transportation and Air Quality, dated January 18, 2002.
- *User's Guide to MOBILE6.1 and MOBILE6.2, Mobile Source Emission Factor Model*, EPA420-R-03-010, dated August 2003.

The methodologies used to produce the MOBILE6.2 emission results conform to the recommendations provided in EPA's Technical Guidance. A mix of local data and national default input data (internal to MOBILE6.2) 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, hourly distributions, temperatures/humidity, 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:

PPSUITE Post Processor

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 for Pennsylvania. The software has gone through a significant revision to ensure consistency with the MOBILE6.2 emissions model. PPSUITE plays a key role in the development of roadway speed estimates, which are supplied as input to the MOBILE6.2 model. The software is also used to prepare the MOBILE6.2 input shell and to process the MOBILE6.2 outputs. This submission utilizes version 5.03 of the network analyzer portion (PPNET) of PPSUITE.

Philadelphia County – I/M Program

The Philadelphia County is included in the I/M program that inspects the emissions for light duty passenger cars and light duty trucks (<9,000#). This modeling makes the following assumptions about I/M:

Basic I/M Program (1990, 1992)

- Model years 1968 to 2050 receive the idle test.

PA97 with ASM Program with Phase-In Cutpoints (2002)

- Gas cap pressure check applied to model years 1975 to present.
- Model years 1981 to 2050 receive the ASM 5015 program with phase-in cutpoints and 1975 to 1980 model years receive the idle test. The anti-tampering program that includes seven inspections applies to model years 1975 to 2050.

OBDII and PA97 with ASM I/M Program with Final Cutpoints (2007, 2013, 2017)

- An OBDII computer check for 1996 and newer model year vehicles along with the gas cap pressure check, which is applied to all model years (1975 to present).
- Model years 1981 to 1995 receive the ASM 5015 program with final cutpoints and 1975 to 1980 model years receive the idle test. The anti-tampering program that includes seven inspections applies to model years 1975 to 1995.

Fuels Program

The Philadelphia county area is required to have federal reformulated gasoline (RFG) for years 1996 and greater. Like conventional gasoline, RFG must meet fuel volatility requirements that vary by geographic region. Philadelphia County was modeled using the RFG requirements for winter time and in the "North" for years 2002, 2007, 2013 and 2017. Reid Vapor Pressure (RVP) of 13.47 was used for 1990 and 1992.

Vehicle Age/Diesel Sales Distributions

Vehicle age distributions are input to MOBILE based on registered vehicles that reflect winter conditions. These distributions reflect the percentage of vehicles in the fleet up to 25 years old and are listed by the 16 MOBILE6.2 vehicle types. Updated 2002 vehicle age distributions have been acquired by the 16 MOBILE6.2 vehicle types for this inventory submission from the PENNDOT Bureau of Motor Vehicles Registration Database. 2002, 2007, 2013 and 2017 inventories utilize this data but the 1990 and 1992 inventories use the 1990 vehicle age distribution data. Due to insufficient data, only data for light-duty vehicles was used as local inputs. The heavy-duty vehicles used the internal MOBILE6.2 defaults.

The analysis utilizes default diesel sales fraction data.

Vehicle Mix Patterns

Vehicle mix patterns are calculated for each county, functional class utilizing a combination of PENNDOT truck percentages and MOBILE6.2 default distributions. The calculation of the pattern files is described in the technical documentation that follows.

Weather Data

Official weather information was obtained from the National Climatic Data Center for the year 2002 to calculate the minimum and maximum temperatures, ambient temperature,

absolute humidity, cloud cover, sunrise and sunset data based on the three months, December, January and February. The 2002 data was used for all the years.

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

Federal new vehicle emissions control and fuel programs that were modeled separately using MOBILE5 are now incorporated into MOBILE6.2. The NLEV program became effective in 1999 and is represented in MOBILE6.2 using the northeast NLEV phase-in schedule. The Tier 2 / Low Sulfur Fuel Program takes effect in 2004 and provides benefit for subsequent years. The HDE rule does not take full effect until 2004, but some manufacturers of heavy-duty engines were required to implement in 2002 thus providing early reduction benefits. Therefore, these new federal vehicle emissions control and fuel programs are included in the modeling for 2002 and future years. In addition, MOBILE6 also includes the effects of the heavy-duty highway diesel engine and ultra-low sulfur fuel program which becomes effective in 2007.

Other Changes incorporated into MOBILE6 (and MOBILE6.2)

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 NOx 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 NOx 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 NOx 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 NOx off-cycle emissions effects are incorporated into MOBILE6. These effects include the Defeat Device, NOx 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.

Table 19 displays the Mobile6.2 Inputs

Table 19 - Mobile6.2 Inputs

	1990	1992	2002	2007	2013	2017
	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd
Analysis Day	Average Weekday (Dec, Jan, Feb)	Average Weekday (Dec, Jan, Feb)	Average Weekday (Dec, Jan, Feb)	Average Weekday (Dec, Jan, Feb)	Average Weekday (Dec, Jan, Feb)	Average Weekday (Dec, Jan, Feb)
Traffic Data						
PENNDOT Roadway Management System (RMS) Source Data Year	1990	1990	2002	2002	2002	2002
HPMS VMT Adjustment Year	1990	1990	2002	2002	2002	2002
PENNDOT Seasonal Factor Data	1990	1990	2002	2002	2002	2002
PENNDOT Hourly Pattern Data	1990	1990	2001 (2002 Not Available)	2001 (2002 Not Available)	2001 (2002 Not Available)	2001 (2002 Not Available)
	1990	1992	2002	2007	2013	2017

	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd	Winter Wkd
PENNDOT RMS Truck Percentages Used for Vehicle Mixes	1990	1990	2002	2002	2002	2002
MOBILE6 Defaults Used to Disaggregate Auto and Truck Vehicle Mix Categories	1990	1992	2002	2007	2013	2017
Trended Growth Factors (Based on historic PENNDOT Global Update Factors 1996-2002)	No Forecast	Forecast from 1990-1992	No Forecast 2002 Data	Forecast from 2002-2007	Forecast from 2002-2013	Forecast from 2002-2017
M6 Parameters						
Emissions Calendar Year	1990	1992	2002	2007	2013	2017
Evaluation Month	1 (January)	1 (January)	1 (January)	1 (January)	1 (January)	1 (January)
Season	2 - Winter	2 - Winter	2 - Winter	2 - Winter	2 - Winter	2 - Winter
Reid Vapor Pressure (RVP)	13.47	13.47	13.47	13.47	13.47	13.47
Reformulated Gasoline (RFG)	NA	NA	2N	2N	2N	2N
Min/Max Temperatures	46.5/30.6	46.5/30.6	46.5/30.6	46.5/30.6	46.5/30.6	46.5/30.6
Absolute Humidity	17.742	17.742	17.742	17.742	17.742	17.742
Cloud Cover	Default	Default	Default	Default	Default	Default
Altitude	Low	Low	Low	Low	Low	Low
Peak Sun	Default	Default	Default	Default	Default	Default
Sunset/Sunrise	Default	Default	Default	Default	Default	Default
CAAA Standards	Enabled	Enabled	Enabled	Enabled	Enabled	Enabled
Tier2 Standards	NA	NA	NA	Enabled	Enabled	Enabled
2007 HDDV Rule	NA	NA	NA	Enabled	Enabled	Enabled
North-East NLEV	NA	NA	Included	Included	Included	Included
M6 Parameters						

Emissions Calendar Year	1990	1992	2002	2007	2013	2017
Refueling Emissions	Not Included	Not Included	Not Included	Not Included	Not Included	Not Included
Registration Data	90 Local Data + National Truck Defaults	90 Local Data + National Truck Defaults	02 Local Data + National Truck Defaults	02 Local Data + National Truck Defaults	02 Local Data + National Truck Defaults	02 Local Data + National Truck Defaults
Emissions Calendar Year	1990	1992	2002	2007	2013	2017
Diesel Sales Fractions	National Defaults	National Defaults	National Defaults	National Defaults	National Defaults	National Defaults
VMT by Hour	90 Local Data (varies by cty, fc)	90 Local Data (varies by cty, fc)	02 Local Data (varies by cty, fc)	02 Local Data (varies by cty, fc)	02 Local Data (varies by cty, fc)	02 Local Data (varies by cty, fc)
VMT by Facility	Each facility run as separate scenario	Each facility run as separate scenario	Each facility run as separate scenario	Each facility run as separate scenario	Each facility run as separate scenario	Each facility run as separate scenario
VMT by Speed	Calculated by PPSUITE	Calculated by PPSUITE	Calculated by PPSUITE	Calculated by PPSUITE	Calculated by PPSUITE	Calculated by PPSUITE

Table 20 displays the Inspection/Maintenance Program Input Parameters

Table 20 - Inspection/Maintenance Program Input Parameters

Inspection/Maintenance Program								
Input Parameters								
	1990 & 1992	**2002**			**2007, 2013, 2017**			
	Basic I/M Program	**PA 97 w/ASM Program w/Phase-In Cutpoints**			**Philadelphia Annual OBDII and PA97 with/ASM Program w/FINAL cutpoints**			
I/M Program	Idle	Idle	ASM 5015 Phase-In	GC	OBD I/M	ASM 5015 FINAL	EVAP OBD & GC	GC
Program Start Year	1984	1984	1997	1997	2004	1997	2004	1997
I/M Stringency	17.8	20	20		20	20		
I/M Model Years								
First Year	1968	1975	1981	1975	1996	1981	1996	1975
Last Year	2050	1980	2050	2050	2050	1995	2050	1995
I/M Waiver Rates								
Pre-81 Model Years	2.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Post-81 Model Years	1.1%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
I/M Compliance	94.0%	96.0%	96.0%	96.0%	96.0%	96.0%	96.0%	96.0%
	1990 & 1992	**2002**			**2007, 2013, 2017**			

	Basic I/M Program	PA 97 w/ASM Program w/Phase-In Cutpoints			Philadelphia Annual OBDII and PA97 with/ASM Program w/FINAL cutpoints			
Program Type: Test Only (T/O) Test & Repair computerized (TRC) Test & Repair Manual (TRM)	TRM	TRC	TRC	TRC	TRC	TRC	TRC	TRC
Inspection Frequency Annual Biennial	Annual	Annual	Annual	Annual	Annual	Annual	Annual	Annual
I/M Vehicles 1 = I/M Benefits not calculated 2 = I/M Benefits calculated								
LDGV	2	2	2	2	2	2	2	2
LDGT1	2	2	2	2	2	2	2	2
LDGT2	2	2	2	2	2	2	2	2
LDGT3	2	2	2	2	2	2	2	2
LDGT4	2	2	2	2	2	2	2	2
HDGV2B	1	1	1	1	1	1	1	1
HDGV3	1	1	1	1	1	1	1	1
HDGV4	1	1	1	1	1	1	1	1
HDGV5	1	1	1	1	1	1	1	1
HDGV6	1	1	1	1	1	1	1	1
HDGV7	1	1	1	1	1	1	1	1
HDGV8A	1	1	1	1	1	1	1	1
HDGV8B	1	1	1	1	1	1	1	1
GAS BUS	1	1	1	1	1	1	1	1
I/M Effectiveness	0.50	1.00			1.00			
I/M TTC Credits	Not Included	Included			Included			
New Model Year Exemption	First Model Year	First Model Year			First Model Year			
I/M Exemptions	<5000 mi	<5000 mi			<5000 mi			

Table 21 displays the Anti-Tampering Program Input Parameters

Table 21 - Anti-Tampering Program Input Parameters

Anti-Tampering Program Input Parameters	
	2002, 2007, 2013, & 2017
	ATP Parameters
Program Start Year	97
I/M Model Years	
First Year	75
Last Year	50
I/M Vehicles 1 = I/M Benefits not calculated 2 = I/M Benefits calculated	
	2002, 2007, 2013, & 2017

	ATP Parameters
LDGV	2
LDGT1	2
LDGT2	2
LDGT3	2
LDGT4	2
HDGV2B	1
HDGV3	1
HDGV4	1
HDGV5	1
HDGV6	1
HDGV7	1
HDGV8A	1
HDGV8B	1
GAS BUS	1
Inspection Frequency: Annual Biennial	Annual
I/M Compliance	96.0%
Inspections Performed: 1 = Not Performed 2 = Performed	
Air Pump System	2
Catalyst Removal	2
Fuel Inlet Restrictor	2
Tailpipe Lead Deposit Test	1
EGR System	2
Evaporative Control System	2
PCV System	2
Gas Cap	2

Table 22 displays the CO Modeling Winter Weekday VMT and CO Inventory.

Table 22 - Philadelphia County CO Modeling Winter Weekday VMT and CO Inventory by Facility Type

Philadelphia County						
Year	**Area**	**Functional Class**	**VMT**	**VHT**	**Speed (mph)**	**CO (tpd)**
1990	Urban					
	11	Interstate	3,780,746	103,065	36.7	241.70
	12	Other Fwy/Ex	365,527	6,917	52.8	23.56
	14	Prin. Arterial	5,425,590	386,594	14.0	363.52
	16	Minor Arterial	2,292,020	118,303	19.4	142.79
	17	Collector	1,023,729	61,813	16.6	64.76
	19	Local	1,319,475	80,253	16.4	83.82
Year	**Area**	**Functional Class**	**VMT**	**VHT**	**Speed (mph)**	**CO (tpd)**
		Urban Subtotal	14,207,087	756,945	18.77	920.15
		Region Total	14,207,087	756,945	18.77	920.15
1992	Urban					
	11	Interstate	3,984,919	120,269	33.1	231.11
	12	Other Fwy/Ex	380,013	7,282	52.2	22.30
	14	Prin. Arterial	5,640,524	421,434	13.4	344.23
	16	Minor Arterial	2,382,911	124,501	19.1	133.42
	17	Collector	1,064,346	66,109	16.1	60.66
	19	Local	1,371,682	84,248	16.3	77.16
		Urban Subtotal	14,824,395	823,843	17.99	868.88
		Region Total	14,824,395	823,843	17.99	868.88
Year	**Area**	**Functional Class**	**VMT**	**VHT**	**Speed (mph)**	**CO (tpd)**
2002	Urban					
	11	Interstate	4,339,566	143,315	30.3	128.32
	12	Other Fwy/Ex	473,430	8,806	53.8	14.62
	14	Prin. Arterial	5,183,026	238,208	21.8	141.12
	16	Minor Arterial	2,669,674	139,898	19.1	73.02
	17	Collector	1,257,510	84,941	14.8	35.56
	19	Local	1,636,649	194,832	8.4	42.06
		Urban Subtotal	15,559,855	810,000	19.21	434.69
		Region Total	15,559,855	810,000	19.21	434.70

Year	Area	Functional Class	VMT	VHT	Speed (mph)	CO (tpd)
2007	Urban					
	11	Interstate	4,790,865	202,367	23.7	98.27
	12	Other Fwy/Ex	511,120	9,631	53.1	10.89
	14	Prin. Arterial	5,595,623	288,332	19.4	107.60
	16	Minor Arterial	2,882,192	163,999	17.6	55.59
	17	Collector	1,357,614	100,329	13.5	27.14
	19	Local	1,766,981	239,164	7.4	31.76
		Urban Subtotal	16,904,396	1,003,822	16.84	331.25
		Region Total	16,904,396	1,003,822	16.84	331.25

Year	Area	Functional Class	VMT	VHT	Speed (mph)	CO (tpd)
2013	Urban					
	11	Interstate	5,365,421	312,292	17.2	83.84
	12	Other Fwy/Ex	557,942	10,765	51.8	8.96
	14	Prin. Arterial	6,108,188	365,576	16.7	89.69
	16	Minor Arterial	3,146,173	203,610	15.5	46.42
	17	Collector	1,481,962	121,671	12.2	22.72
	19	Local	1,928,774	296,722	6.5	26.62
		Urban Subtotal	18,588,460	1,310,636	14.18	278.23
		Region Total	18,588,460	1,310,636	14.18	278.24

Year	Area	Functional Class	VMT	VHT	Speed (mph)	CO (tpd)
2017	Urban					
	11	Interstate	5,767,721	419,996	13.7	79.64
	12	Other Fwy/Ex	590,091	11,688	50.5	8.21
	14	Prin. Arterial	6,460,168	429,421	15.0	83.58
	16	Minor Arterial	3,327,447	236,674	14.1	43.29
	17	Collector	1,567,325	139,219	11.3	21.07
	19	Local	2,039,866	335,053	6.1	25.17
		Urban Subtotal	19,752,618	1,572,051	12.56	260.96
		Region Total	19,752,618	1,572,051	12.56	260.97

Table 23 displays the Highway CO Emission Summaries from 1990 to 2017.

Table 23 - Highway CO Emission Summary From 1990 to 2017

Winter Weekday	VMT	Speed	CO (tpd)
1990	14,207,087	18.77	920.15
1992	14,824,395	17.99	824.56
2002	15,559,855	19.21	434.70
2007	16,904,395	16.84	331.25
2013	18,588,460	14.18	278.24
2017	19,752,618	12.56	260.97

Below are the Philadelphia County MOBILE6.2 Input Files:

Philadelphia County, 1990

```
MOBILE6 INPUT FILE

REPORT FILE         :  m6output.out       REPLACE
DATABASE OUTPUT     :
WITH FIELDNAMES     :
EMISSIONS TABLE     :  M6OUTPUT_PHIL90A.TB1  REPLACE
POLLUTANTS          :  HC CO NOX
AGGREGATED OUTPUT   :
RUN DATA            : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP         : NLEVNE.D
FUEL RVP            : 13.47
EXPRESS HC AS VOC   :
EXPAND EXHAUST      :
EXPAND EVAPORATIVE  :
NO REFUELING        :
REG DISTRIBUTION    : PHIL90ag.dat
I/M PROGRAM         : 1 1984 1999 1 TRM IDLE
I/M MODEL YEARS     : 1 1968 2050
I/M VEHICLES        : 1 22222 11111111 1
I/M STRINGENCY      : 1 17.8
I/M COMPLIANCE      : 1 94.0
I/M WAIVER RATES    : 1 2.0 1.1
I/M EFFECTIVENES    : 0.50 0.50 0.50
NO I/M TTC CREDITS : 1


SCENARIO RECORD     :[11 0673] 11
```

```
CALENDAR YEAR      :1990
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          3780746
*       2272491  151998  505143  204726   94063  174409   17883   10519
*          8415   33609   41498   49388  177091    8941    4208   26364
VMT FRACTIONS      :
        .601070 .040203 .133609 .054150 .024879 .046131 .004730 .002782
        .002226 .008890 .010976 .013063 .046840 .002365 .001113 .006973
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination)

Philadelphia County, 1992

```
MOBILE6 INPUT FILE

REPORT FILE        :  m6output.out       REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
EMISSIONS TABLE    :  M6OUTPUT_PHIL92A.TB1  REPLACE
POLLUTANTS         :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA           : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP        : NLEVNE.D
FUEL RVP           : 13.47
EXPRESS HC AS VOC  :
EXPAND EXHAUST     :
EXPAND EVAPORATIVE :
NO REFUELING       :
REG DISTRIBUTION   : PHIL90ag.dat
I/M PROGRAM        : 1 1984 1999 1 TRM IDLE
I/M MODEL YEARS    : 1 1968 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M STRINGENCY     : 1 17.8
I/M COMPLIANCE     : 1 94.0
I/M WAIVER RATES   : 1 2.0 1.1
I/M EFFECTIVENES   : 0.50 0.50 0.50
NO I/M TTC CREDITS : 1


SCENARIO RECORD    :[11 0673] 11

CALENDAR YEAR      :1992
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          3984919
*       2338279  174616  580796  212352   97428  183101   19236   11752
```

```
*          9091   36365   44403   51887  185152    9091    4268   27102
VMT FRACTIONS      :
        .586783 .043819 .145749 .053289 .024449 .045948 .004827 .002949
        .002281 .009126 .011143 .013021 .046463 .002281 .001071 .006801
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination)

Philadelphia County, 2002

```
MOBILE6 INPUT FILE

REPORT FILE        :  m6output.out       REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
EMISSIONS TABLE    :  M6OUTPUT_PHIL02A.TB1  REPLACE
POLLUTANTS         :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA           : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP        : NLEVNE.D
FUEL PROGRAM       : 2 N
FUEL RVP           : 13.47
EXPRESS HC AS VOC  :
EXPAND EXHAUST     :
EXPAND EVAPORATIVE :
NO REFUELING       :
REG DISTRIBUTION   : PHIL02ag.dat
I/M PROGRAM        : 1 1984 2050 1 TRC IDLE
I/M PROGRAM        : 2 1997 2050 1 TRC ASM 5015 PHASE-IN
I/M PROGRAM        : 3 1997 2050 1 TRC GC
I/M MODEL YEARS    : 1 1975 1980
I/M MODEL YEARS    : 2 1981 2050
I/M MODEL YEARS    : 3 1975 2050
I/M VEHICLES       : 1 22222 11111111 1
I/M VEHICLES       : 2 22222 11111111 1
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 1 96.0
I/M COMPLIANCE     : 2 96.0
I/M COMPLIANCE     : 3 96.0
I/M WAIVER RATES   : 1 3.0 3.0
I/M WAIVER RATES   : 2 3.0 3.0
I/M WAIVER RATES   : 3 3.0 3.0
I/M EFFECTIVENES   : 1.00 1.00 1.00
ANTI-TAMP PROGRAM  : 97 75 50 22222 11111111 1  11 096. 22212222


SCENARIO RECORD    :[11 0673] 11

CALENDAR YEAR      :2002
```

```
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          4339565
*       2027471  308219 1025087  315914  145451  158751   15782   12488
*          9145   34907   41544   45280  162094    7915    3736   25781
VMT FRACTIONS      :
        .467206 .071025 .236219 .072799 .033517 .036582 .003637 .002878
        .002107 .008044 .009573 .010434 .037353 .001824 .000861 .005941
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination

Philadelphia County, 2007

```
MOBILE6 INPUT FILE

REPORT FILE        :  m6output.out       REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
EMISSIONS TABLE    :  M6OUTPUT_PHIL07A.TB1  REPLACE
POLLUTANTS         :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA           : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP        : NLEVNE.D
FUEL PROGRAM       : 2 N
FUEL RVP           : 13.47
EXPRESS HC AS VOC  :
EXPAND EXHAUST     :
EXPAND EVAPORATIVE :
NO REFUELING       :
REG DISTRIBUTION   : PHIL02ag.dat
I/M PROGRAM        : 1 2004 2050 1 TRC OBD I/M
I/M PROGRAM        : 2 1997 2050 1 TRC ASM 5015 FINAL
I/M PROGRAM        : 3 2004 2050 1 TRC EVAP OBD & GC
I/M PROGRAM        : 4 1997 2050 1 TRC GC
I/M MODEL YEARS    : 1 1996 2050
I/M MODEL YEARS    : 2 1981 1995
I/M MODEL YEARS    : 3 1996 2050
I/M MODEL YEARS    : 4 1975 1995
I/M VEHICLES       : 1 22222 11111111 1
I/M VEHICLES       : 2 22222 11111111 1
I/M VEHICLES       : 3 22222 11111111 1
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 1 96.0
I/M COMPLIANCE     : 2 96.0
I/M COMPLIANCE     : 3 96.0
I/M COMPLIANCE     : 4 96.0
I/M WAIVER RATES   : 1 3.0 3.0
```

```
I/M WAIVER RATES   : 2 3.0 3.0
I/M WAIVER RATES   : 3 3.0 3.0
I/M WAIVER RATES   : 4 3.0 3.0
I/M EFFECTIVENES   : 1.00 1.00 1.00
ANTI-TAMP PROGRAM  : 97 75 50 22222 11111111 1  11 096. 22212222


SCENARIO RECORD    :[11 0673] 11

CALENDAR YEAR      :2007
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          4790866
*       1908592  397182 1320682  406952  187334  174608   17157   14008
*         10370   38820   46041   50113  178734    9013    4072   27187

VMT FRACTIONS      :
        .398382 .082904 .275667 .084943 .039102 .036446 .003581 .002924
        .002165 .008103 .009610 .010460 .037307 .001881 .000850 .005675
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination)

Philadelphia County, 2013

```
MOBILE6 INPUT FILE

REPORT FILE        :  m6output.out       REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
EMISSIONS TABLE    :  M6OUTPUT_PHIL13A.TB1  REPLACE
POLLUTANTS         :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA           : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP        : NLEVNE.D
FUEL PROGRAM       : 2 N
FUEL RVP           : 13.47
EXPRESS HC AS VOC  :
EXPAND EXHAUST     :
EXPAND EVAPORATIVE :
NO REFUELING       :
REG DISTRIBUTION   : PHIL02ag.dat
I/M PROGRAM        : 1 2004 2050 1 TRC OBD I/M
I/M PROGRAM        : 2 1997 2050 1 TRC ASM 5015 FINAL
I/M PROGRAM        : 3 2004 2050 1 TRC EVAP OBD & GC
I/M PROGRAM        : 4 1997 2050 1 TRC GC
I/M MODEL YEARS    : 1 1996 2050
I/M MODEL YEARS    : 2 1981 1995
I/M MODEL YEARS    : 3 1996 2050
I/M MODEL YEARS    : 4 1975 1995
```

```
I/M VEHICLES       : 1 22222 11111111 1
I/M VEHICLES       : 2 22222 11111111 1
I/M VEHICLES       : 3 22222 11111111 1
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 1 96.0
I/M COMPLIANCE     : 2 96.0
I/M COMPLIANCE     : 3 96.0
I/M COMPLIANCE     : 4 96.0
I/M WAIVER RATES   : 1 3.0 3.0
I/M WAIVER RATES   : 2 3.0 3.0
I/M WAIVER RATES   : 3 3.0 3.0
I/M WAIVER RATES   : 4 3.0 3.0
I/M EFFECTIVENES   : 1.00 1.00 1.00
ANTI-TAMP PROGRAM  : 97 75 50 22222 11111111 1  11 096. 22212222


SCENARIO RECORD    :[11 0673] 11

CALENDAR YEAR      :2013
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          5365420
*       1749102  511363 1702007  524682  241173  195346   18987   16005
*         12049   43572   51605   56109  199849   10041    4990   28541
VMT FRACTIONS      :
        .325994 .095307 .317218 .097790 .044950 .036408 .003539 .002983
        .002246 .008121 .009618 .010458 .037248 .001871 .000930 .005319
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination)

Philadelphia County, 2017

```
MOBILE6 INPUT FILE

REPORT FILE        :  m6output.out       REPLACE
DATABASE OUTPUT    :
WITH FIELDNAMES    :
EMISSIONS TABLE    :  M6OUTPUT_PHIL17A.TB1  REPLACE
POLLUTANTS         :  HC CO NOX
AGGREGATED OUTPUT  :
RUN DATA           : 0673

MIN/MAX TEMPERATURE:  30.6  46.5
94+ LDG IMP        : NLEVNE.D
FUEL PROGRAM       : 2 N
FUEL RVP           : 13.47
EXPRESS HC AS VOC  :
EXPAND EXHAUST     :
EXPAND EVAPORATIVE :
```

```
NO REFUELING       :
REG DISTRIBUTION   : PHIL02ag.dat
I/M PROGRAM        : 1 2004 2050 1 TRC OBD I/M
I/M PROGRAM        : 2 1997 2050 1 TRC ASM 5015 FINAL
I/M PROGRAM        : 3 2004 2050 1 TRC EVAP OBD & GC
I/M PROGRAM        : 4 1997 2050 1 TRC GC
I/M MODEL YEARS    : 1 1996 2050
I/M MODEL YEARS    : 2 1981 1995
I/M MODEL YEARS    : 3 1996 2050
I/M MODEL YEARS    : 4 1975 1995
I/M VEHICLES       : 1 22222 11111111 1
I/M VEHICLES       : 2 22222 11111111 1
I/M VEHICLES       : 3 22222 11111111 1
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 1 20
I/M STRINGENCY     : 2 20
I/M COMPLIANCE     : 1 96.0
I/M COMPLIANCE     : 2 96.0
I/M COMPLIANCE     : 3 96.0
I/M COMPLIANCE     : 4 96.0
I/M WAIVER RATES   : 1 3.0 3.0
I/M WAIVER RATES   : 2 3.0 3.0
I/M WAIVER RATES   : 3 3.0 3.0
I/M WAIVER RATES   : 4 3.0 3.0
I/M EFFECTIVENES   : 1.00 1.00 1.00
ANTI-TAMP PROGRAM  : 97 75 50 22222 11111111 1  11 096. 22212222


SCENARIO RECORD    :[11 0673] 11

CALENDAR YEAR      :2017
EVALUATION MONTH   : 1
ABSOLUTE HUMIDITY  :  17.7
SEASON             : 2
*VMT TOTALS          5767721
*       1715412  577769 1924534  593108  272523  209641   20886   17677
*         12833   47074   55651   60431  214486   10672    5369   29655
VMT FRACTIONS      :
        .297416 .100173 .333673 .102832 .047250 .036347 .003621 .003065
        .002225 .008162 .009649 .010477 .037187 .001850 .000931 .005142
VMT BY FACILITY    :V067311F.def
VMT BY HOUR        :V067311H.def
SPEED VMT          :V067311S.def

END OF RUN         :
```

(Scenarios Repeated for each Area, Functional Class Combination)

Appendix II. D - Nonroad Source Detail

The "Nonroad Source" category includes a diverse collection of equipment ranging from lawn mowers and chain saws to recreational and farm equipment and construction machinery. Calculations are based on being conservative.

OVERVIEW OF THE DRAFT EPA NONROAD2002A EMISSIONS MODEL

DRAFT EPA NONROAD2002A Emissions Model User's Guide 1-2:

Equipment Types

This version of the nonroad emissions model predicts emissions for all nonroad equipment categories listed above with the exception of commercial marine, locomotive, and aircraft emissions. The model includes more than 80 basic and 260 specific types of nonroad equipment, and further stratifies equipment types by horsepower rating. Fuel types include gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG).

Pollutants Reported

The draft EPA NONROAD2002a model estimates emissions for six exhaust pollutants: hydrocarbons (HC), NO_X, carbon monoxide (CO), carbon dioxide (CO_2), sulfur oxides (SO_X), and PM. The user selects among five different types for reporting HC — as total hydrocarbons (THC), total organic gases (TOG), non-methane organic gases (NMOG), non-methane hydrocarbons (NMHC), or volatile organic compounds (VOC). Particulate matter can be reported as PM of 10_ or less (PM_{10}) or PM of 2.5_ or less ($PM_{2.5}$). The model also estimates emissions of non-exhaust HC for four modes — diurnal, refueling spillage, vapor displacement, and crankcase emissions. All emissions are reported as short tons (i.e., 2000 lbs).

Geographic and Temporal Coverage

In each run of the model, the user selects what geographic area(s) are to be included. At the broadest level, the model estimates national total emissions. More commonly users will specify emissions by state, or for one or more counties within a state. At the most detailed level, the user can estimate sub-county emissions; however, this is an advanced feature and the user must supply sub-county input data. Thus the model is capable of estimating emissions for nonattainment areas which may consist of multiple counties or sub-counties in one or more states.

The draft EPA NONROAD2002a model can estimate current year emissions for the specified geographic area as well as project future year emissions and backcast past year emissions for calendar years 1970 through 2050. In estimating future year projections and in backcasting, the model includes growth and scrappage rates for equipment in addition to a variety of control program options. The model can calculate emissions for a variety of time periods — an entire year, one of four seasons, or any particular month. Emissions for the period selected are estimated either for the total period or for a typical day (weekday or weekend) in that period.

Model Inputs
The draft EPA NONROAD2002a model estimates emissions for each specific type of nonroad equipment by multiplying the following input data estimates:
• Equipment population for base year (or base year population grown to a future year), distributed by age, power, fuel type, and application;
• Average load factor expressed as average fraction of available power ;
• Available power in horsepower;
• Activity in hours of use per year; and
• Emission factor with deterioration and/or new standards.
The emissions are then temporally and geographically allocated using appropriate allocation factors. There are several input files that provide necessary information to calculate and allocate emissions estimates. These input files correspond to the basic data needed to provide the calculations: emission factors, base year equipment population, activity, load factor, average lifetime, scrappage function, growth estimates, and geographic and temporal allocation. Default values are provided for all input files. The user can replace the default data files when better information becomes available, either from EPA for national defaults or from local sources for locality-specific data. The input files are also modifiable to test control strategies.

DRAFT EPA NONROAD2002A Emissions Model User's Guide 4-5:
Modifying /OPTIONS/
The options packet, /OPTIONS/, defines some of the parameters that make episode-specific emission factor adjustments. These options include fuel specifications that will be in effect during the modeling period and ambient temperatures that are typical during the same period. In addition, you can define the title that describes your modeling scenario and which will appear on your model reports.

The order of the records is fixed. The order is as follows:
1 - Char 80: First title on reports
2 - Char 80: Second title on reports
3 - Real 10: Fuel RVP of gasoline for this simulation
4 - Real 10: Oxygen weight percent of gasoline for simulation
5 - Real 10: Percent sulfur for gasoline
6 - Real 10: Percent sulfur for diesel
7 - Real 10: Percent sulfur for LPG/CNG
8 - Real 10: Minimum daily temperature (deg. F)
9 - Real 10: Maximum daily temperature (deg. F)
10 - Real 10: Representative average daily temperature (deg. F)
11 - Char 10: Flag to determine if region is high altitude (LOW or HIGH)

The acceptable range of values for each of the fuel specification and ambient temperature options are as follows:

Fuel RVP 6 to 16
Oxygen (wt.%) 0 to 5
Fuel Sulfur (%) 0 to 0.5
Temperature (°F) -40 to 120

Altitude* Low or High (Specify high where average altitude > 5000 ft)

*High altitude adjustments are not included in this version of the model.

The minimum temperature that you define for your modeling scenario is the average low for the time period selected. For example, when modeling a typical summer day, the minimum temperature should be the average low temperature in Fahrenheit for the summer season. Moreover, when modeling an entire year, the minimum temperature should be the average daily low for the year and not the lowest temperature ever recorded. Other modeling parameters, such as RVP, sulfur, and oxygen content, depend on local fuel characteristics. Data for an area should be available from the state or local air agency.

User's Guide for the EPA draft EPA NONROAD2002a Emissions Model:
United States Environmental Protection Agency Air and Radiation EPA420-P-02-013, December 2002

Classification	tons/season
Industrial Total	1,403.60
Total Lawn & Garden	2,958.08
Commercial Total	3,695.86
Total Construction	477.44
Recreational Total	127.57
Railway Total	12.99
Marine Recreation Total	5.38
Agricultural	0.00
Logging	0.00
Underground Mining	0.00
Oil Field	0.00
Airport Services	0.00
Grand Total tons/season	8,680.93
Tons per Day	96.45

Emissions from all nonroad categories are summarized in Table 24:

Table 24 - Nonroad Emissions

A. Industrial		Philadelphia County		
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2260003030	Sweepers/Scrubbers	Industrial Equipment	2 Stroke	0.53170693
2260003040	Other General Industrial Eqp	Industrial Equipment	2 Stroke	0.043399412
2265003010	Aerial Lifts	Industrial Equipment	4 Stroke	68.93533869
2265003020	Forklifts	Industrial Equipment	4 Stroke	204.9224049
2265003030	Sweepers/Scrubbers	Industrial Equipment	4 Stroke	61.88116071
2265003040	Other General Industrial Eqp	Industrial Equipment	4 Stroke	125.446383
2265003050	Other Material Handling Eqp	Industrial Equipment	4 Stroke	5.690068294
2265003060	AC\Refrigeration	Industrial Equipment	4 Stroke	4.505835051
2265003070	Terminal Tractors	Industrial Equipment	4 Stroke	21.36161796
2267003010	Aerial Lifts	Industrial Equipment	LPG	8.38458021
2267003020	Forklifts	Industrial Equipment	LPG	776.8052829
2267003030	Sweepers/Scrubbers	Industrial Equipment	LPG	6.03595686
2267003040	Other General Industrial Equipm	Industrial Equipment	LPG	1.8022598
2267003050	Other Material Handling Equipment	Industrial Equipment	LPG	0.44329035
2267003070	Terminal Tractors	Industrial Equipment	LPG	3.790495885
2268003020	Forklifts	Industrial Equipment	CNG	58.135197
2268003030	Sweepers/Scrubbers	Industrial Equipment	CNG	0.068592176
2268003040	Other General Industrial Equipment	Industrial Equipment	CNG	0.037325855
2268003060	AC\Refrigeration	Industrial Equipment	CNG	0.193676704
2268003070	Terminal Tractors	Industrial Equipment	CNG	0.15819871
2270003010	Aerial Lifts	Industrial Equipment	Diesel	2.53467398
2270003020	Forklifts	Industrial Equipment	Diesel	11.91425315
2270003030	Sweepers/Scrubbers	Industrial Equipment	Diesel	3.859424871
2270003040	Other General Industrial Eqp	Industrial Equipment	Diesel	4.296751757
2270003050	Other Material Handling Eqp	Industrial Equipment	Diesel	0.441595196
2270003060	AC\Refrigeration	Industrial Equipment	Diesel	26.81649847
2270003070	Terminal Tractors	Industrial Equipment	Diesel	4.56333911
		Industrial Total		**1403.6**
				tons/season
				15.60
				tons/day
B. Lawn & Garden				
SCC	EQUIP	CLASSIFICATION	Engine	CO exhaust

			Type	
2260004015	Rotary Tillers < 6 HP	Lawn and Garden Equipment (Res)	2 Stroke	1.71937432
2260004016	Rotary Tillers < 6 HP	Lawn and Garden Equipment (Com)	2 Stroke	0.950752852
2260004020	Chain Saws < 6 HP	Lawn and Garden Equipment (Res)	2 Stroke	94.038162
2260004021	Chain Saws < 6 HP	Lawn and Garden Equipment (Com)	2 Stroke	60.1030611
2260004025	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Res)	2 Stroke	32.5929885
2260004026	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Com)	2 Stroke	9.3916164
2260004030	Leafblowers/Vacuums	Lawn and Garden Equipment (Res)	2 Stroke	20.3569912
2260004031	Leafblowers/Vacuums	Lawn and Garden Equipment (Com)	2 Stroke	9.5555792
2260004035	Snowblowers	Lawn and Garden Equipment (Res)	2 Stroke	319.928733
2260004036	Snowblowers	Lawn and Garden Equipment (Com)	2 Stroke	116.968007
2260004071	Commercial Turf Equipment	Lawn and Garden Equipment (Com)	2 Stroke	0.003762448
2265004010	Lawn mowers	Lawn and Garden Equipment (Res)	4 Stroke	327.5860355
2265004011	Lawn mowers	Lawn and Garden Equipment (Com)	4 Stroke	32.06176413
2265004015	Rotary Tillers < 6 HP	Lawn and Garden Equipment (Res)	4 Stroke	27.665297
2265004016	Rotary Tillers < 6 HP	Lawn and Garden Equipment (Com)	4 Stroke	15.812851
2265004025	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Res)	4 Stroke	1.8344405
2265004026	Trimmers/Edgers/Brush Cutter	Lawn and Garden Equipment (Com)	4 Stroke	0.804843541
2265004030	Leafblowers/Vacuums	Lawn and Garden Equipment (Res)	4 Stroke	3.5073199
2265004031	Leafblowers/Vacuums	Lawn and Garden Equipment (Com)	4 Stroke	34.91388564
2265004035	Snowblowers	Lawn and Garden Equipment (Res)	4 Stroke	324.986028
2265004036	Snowblowers	Lawn and Garden Equipment (Com)	4 Stroke	118.812471
2265004040	Rear Engine Riding Mowers	Lawn and Garden Equipment (Res)	4 Stroke	77.5749664
2265004041	Rear Engine Riding Mowers	Lawn and Garden Equipment (Com)	4 Stroke	4.180831799
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2265004046	Front Mowers	Lawn and Garden Equipment (Com)	4 Stroke	4.562513863
2265004051	Shredders < 6 HP	Lawn and Garden Equipment (Com)	4 Stroke	1.81709744
2265004055	Lawn & Garden Tractors	Lawn and Garden	4 Stroke	1030.762665

		Equipment (Res)		
2265004056	Lawn & Garden Tractors	Lawn and Garden Equipment (Com)	4 Stroke	56.39829781
2265004066	Chippers/Stump Grinders	Lawn and Garden Equipment (Com)	4 Stroke	9.007134551
2265004071	Commercial Turf Equipment	Lawn and Garden Equipment (Com)	4 Stroke	179.3246365
2265004075	Other Lawn & Garden Eqp.	Lawn and Garden Equipment (Res)	4 Stroke	33.83891078
2265004076	Other Lawn & Garden Eqp.	Lawn and Garden Equipment (Com)	4 Stroke	4.968151216
2267004066	Chippers/Stump Grinders	Lawn and Garden Equipment (Com)	LPG	0.454476173
2270004031	Leafblowers/Vacuums	Lawn and Garden Equipment (Com)	Diesel	2.59818E-05
2270004036	Snowblowers	Lawn and Garden Equipment (Com)	Diesel	0.317020181
2270004046	Front Mowers	Lawn and Garden Equipment (Com)	Diesel	0.75945549
2270004056	Lawn & Garden Tractors	Lawn and Garden Equipment (Com)	Diesel	0.09922549
2270004066	Chippers/Stump Grinders	Lawn and Garden Equipment (Com)	Diesel	0.190472139
2270004071	Commercial Turf Equipment	Lawn and Garden Equipment (Com)	Diesel	0.231395822
2270004076	Other Lawn & Garden Eqp.	Lawn and Garden Equipment (Com)	Diesel	0.001705599
		Total Lawn & Garden		**2958.08**
				tons/season
				32.87
				tons/day
C. Commercial				
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2260006005	Generator Sets	Commercial Equipment	2 Stroke	5.81840266
2260006010	Pumps	Commercial Equipment	2 Stroke	42.43504228
2260006015	Air Compressors	Commercial Equipment	2 Stroke	0.014071823
2265006005	Generator Sets	Commercial Equipment	4 Stroke	1685.60067
2265006010	Pumps	Commercial Equipment	4 Stroke	400.7498179
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2265006015	Air Compressors	Commercial Equipment	4 Stroke	209.4739911
2265006025	Welders	Commercial Equipment	4 Stroke	510.5484616
2265006030	Pressure Washers	Commercial Equipment	4 Stroke	735.4042705
2267006005	Generator Sets	Commercial Equipment	LPG	16.08838555
2267006010	Pumps	Commercial Equipment	LPG	3.968537904

2267006015	Air Compressors	Commercial Equipment	LPG	4.84576999
2267006025	Welders	Commercial Equipment	LPG	9.07946486
2267006030	Pressure Washers	Commercial Equipment	LPG	0.119259823
2268006005	Generator Sets	Commercial Equipment	CNG	5.656798484
2268006010	Pumps	Commercial Equipment	CNG	0.279266018
2268006015	Air Compressors	Commercial Equipment	CNG	0.42434902
2268006020	Gas Compressors	Commercial Equipment	CNG	24.4895406
2270006005	Generator Sets	Commercial Equipment	Diesel	16.51264571
2270006010	Pumps	Commercial Equipment	Diesel	3.546290786
2270006015	Air Compressors	Commercial Equipment	Diesel	7.575819634
2270006020	Gas Compressors	Commercial Equipment	Diesel	0.017411776
2270006025	Welders	Commercial Equipment	Diesel	12.72397661
2270006030	Pressure Washers	Commercial Equipment	Diesel	0.48998929
		Commercial Total		**3695.86**
				tons/season
				41.07
				tons/day
D. Construction				
SCC	EQUIP	CLASSIFICATION	Engine Type	CO exhaust
2260002006	Tampers/Rammers	Construction and Mining Equipment	2 Stroke	9.7760115
2260002009	Plate Compactors	Construction and Mining Equipment	2 Stroke	0.45306155
2260002021	Paving Equipment	Construction and Mining Equipment	2 Stroke	0.54160923
2260002027	Signal Boards/Light Plants	Construction and Mining Equipment	2 Stroke	0.003334955
2260002039	Concrete/Industrial Saws	Construction and Mining Equipment	2 Stroke	26.2915043
2260002054	Crushing/Proc. Equipment	Construction and Mining Equipment	2 Stroke	0.10985724
2265002003	Pavers	Construction and Mining Equipment	4 Stroke	8.90364816
2265002006	Tampers/Rammers	Construction and Mining Equipment	4 Stroke	0.065726973
2265002009	Plate Compactors	Construction and Mining Equipment	4 Stroke	15.2962276
2265002015	Rollers	Construction and Mining Equipment	4 Stroke	16.79249707
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2265002021	Paving Equipment	Construction and Mining Equipment	4 Stroke	30.09461961
2265002024	Surfacing Equipment	Construction and Mining Equipment	4 Stroke	13.68208846
2265002027	Signal Boards/Light Plants	Construction and Mining Equipment	4 Stroke	0.699981723

2265002030	Trenchers	Construction and Mining Equipment	4 Stroke	27.39168916
2265002033	Bore/Drill Rigs	Construction and Mining Equipment	4 Stroke	8.079751825
2265002039	Concrete/Industrial Saws	Construction and Mining Equipment	4 Stroke	65.9162001
2265002042	Cement & Mortar Mixers	Construction and Mining Equipment	4 Stroke	26.3528292
2265002045	Cranes	Construction and Mining Equipment	4 Stroke	1.766311581
2265002054	Crushing/Proc. Equipment	Construction and Mining Equipment	4 Stroke	3.81791191
2265002057	Rough Terrain Forklifts	Construction and Mining Equipment	4 Stroke	2.639081033
2265002060	Rubber Tire Loaders	Construction and Mining Equipment	4 Stroke	6.471931846
2265002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	4 Stroke	20.00222768
2265002072	Skid Steer Loaders	Construction and Mining Equipment	4 Stroke	11.33568248
2265002078	Dumpers/Tenders	Construction and Mining Equipment	4 Stroke	4.142019357
2265002081	Other Construction Equipment	Construction and Mining Equipment	4 Stroke	2.208194078
2267002003	Pavers	Construction and Mining Equipment	LPG	0.198739171
2267002015	Rollers	Construction and Mining Equipment	LPG	0.35658114
2267002021	Paving Equipment	Construction and Mining Equipment	LPG	0.051298199
2267002024	Surfacing Equipment	Construction and Mining Equipment	LPG	0.034309443
2267002030	Trenchers	Construction and Mining Equipment	LPG	0.6217282
2267002033	Bore/Drill Rigs	Construction and Mining Equipment	LPG	0.204336495
2267002039	Concrete/Industrial Saws	Construction and Mining Equipment	LPG	0.61128711
2267002045	Cranes	Construction and Mining Equipment	LPG	0.225920767
2267002054	Crushing/Proc. Equipment	Construction and Mining Equipment	LPG	0.039067633
2267002057	Rough Terrain Forklifts	Construction and Mining Equipment	LPG	0.405488507
2267002060	Rubber Tire Loaders	Construction and Mining Equipment	LPG	1.015513382
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2267002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	LPG	0.110892456
2267002072	Skid Steer Loaders	Construction and Mining Equipment	LPG	0.71301591
2267002081	Other Construction Equipment	Construction and Mining Equipment	LPG	0.32477742

2268002081	Other Construction Equipment	Construction and Mining Equipment	CNG	0.014244625
2270002003	Pavers	Construction and Mining Equipment	Diesel	1.642225085
2270002006	Tampers/Rammers	Construction and Mining Equipment	Diesel	0
2270002009	Plate Compactors	Construction and Mining Equipment	Diesel	0.067444633
2270002015	Rollers	Construction and Mining Equipment	Diesel	5.231492781
2270002018	Scrapers	Construction and Mining Equipment	Diesel	5.972767402
2270002021	Paving Equipment	Construction and Mining Equipment	Diesel	0.440617645
2270002024	Surfacing Equipment	Construction and Mining Equipment	Diesel	0.139323424
2270002027	Signal Boards/Light Plants	Construction and Mining Equipment	Diesel	0.48166617
2270002030	Trenchers	Construction and Mining Equipment	Diesel	2.84163311
2270002033	Bore/Drill Rigs	Construction and Mining Equipment	Diesel	2.433310809
2270002036	Excavators	Construction and Mining Equipment	Diesel	13.45198791
2270002039	Concrete/Industrial Saws	Construction and Mining Equipment	Diesel	0.208132413
2270002042	Cement & Mortar Mixers	Construction and Mining Equipment	Diesel	0.120302297
2270002045	Cranes	Construction and Mining Equipment	Diesel	2.18349972
2270002048	Graders	Construction and Mining Equipment	Diesel	4.280930005
2270002051	Off-highway Trucks	Construction and Mining Equipment	Diesel	16.57038057
2270002054	Crushing/Proc. Equipment	Construction and Mining Equipment	Diesel	0.623252364
2270002057	Rough Terrain Forklifts	Construction and Mining Equipment	Diesel	7.899465367
2270002060	Rubber Tire Loaders	Construction and Mining Equipment	Diesel	25.13690507
2270002066	Tractors/Loaders/Backhoes	Construction and Mining Equipment	Diesel	28.98755533
2270002069	Crawler Tractor/Dozers	Construction and Mining Equipment	Diesel	25.7686443
SCC	EQUIPMENTS	CLASSIFICATION	Engine Type	CO exhaust
2270002072	Skid Steer Loaders	Construction and Mining Equipment	Diesel	20.32935148
2270002075	Off-Highway Tractors	Construction and Mining Equipment	Diesel	1.880217803
2270002078	Dumpers/Tenders	Construction and Mining Equipment	Diesel	0.040910173
2270002081	Other Construction Equipment	Construction and Mining Equipment	Diesel	2.951287665

		Total Construction		**477.45**
				tons/Season
				5.30
				tons/day
E. Recreational				
SCC	EQUIP	CLASSIFICATION	Engine Type	CO exhaust
2260001010	Motorcycles: Off-Road	Recreational Equipment	2 Stroke	3.9684918
2260001020	Snowmobiles	Recreational Equipment	2 Stroke	0
2260001030	ATVs	Recreational Equipment	2 Stroke	3.0691736
2260001060	Specialty Vehicles/Carts	Recreational Equipment	2 Stroke	2.359387316
2265001010	Motorcycles: Off-Road	Recreational Equipment	4 Stroke	1.7127709
2265001030	ATVs	Recreational Equipment	4 Stroke	12.015856
2265001050	Golf Carts	Recreational Equipment	4 Stroke	102.26338
2265001060	Specialty Vehicles/Carts	Recreational Equipment	4 Stroke	2.0720466
2267001060	Specialty Vehicle Carts	Recreational Equipment	LPG	0.019804845
2270001060	Speciality Vehicle Carts	Recreational Equipment	Diesel	0.085023014
		Recreational Total		**127.57**
				tons/season
				1.42
				tons/day
F Railway Maintenance				
SCC	EQUIP	CLASSIFICATION	Engine Type	CO exhaust
2285002015	Railway Maintenance	Railroad Equipment	Diesel	3.859015566
2285004015	Railway Maintenance	Railroad Equipment	4 Stroke	9.094607301
2285006015	Railway Maintenance	Railroad Equipment	LPG	0.040333956
		Railway Total		**12.99**
				tons/season
				0.14
				tons/day
G. Marine Recreation				
SCC	EQUIP	CLASSIFICATION	Engine Type	CO exhaust
2282005010	Outboard	Pleasure Craft	2 Stroke	2.703138159

2282005015	Personal Water Craft	Pleasure Craft	2 Stroke	1.175783516
2282010005	Inboard/Sterndrive	Pleasure Craft	4 Stroke	1.489688312
2282020005	Inboard/Sterndrive	Pleasure Craft	Diesel	0.009406059
2282020010	Outboards	Pleasure Craft	Diesel	0.000361526
		Marine Total		**5.38**
				0.06
				tons/day
H. Agricultural				0
I. Logging				0
J. Underground Mining				0
K. Oil Field				0
L. Airport Services				0
M. Aircraft				**342.9**
				ton/season
				3.81
				tons/day
N. Marine Vessels				**31.5**
				ton/season
				0.35
				tons/day
O. Railroads				**62.82**
				ton/season
				0.698
				tons/day
		Grand Total		**9118**
				tons/season
				101.31
				tons/day

All the nonroad were calculated with the model except for aircraft, marine vessels, and railroads as described below.

1. Aircraft

Although both the Northeast Airport and International Airport are associated with Philadelphia County, the International Airport is in adjacent Delaware County. An estimate was therefore only made for the Northeast Philadelphia Airport. The Northeast Philadelphia Airport does not handle air carrier (commercial) traffic.

Aircraft emissions were calculated using estimated aircraft operations in 2002 reported to the FAA by regional airports. Generic emission factors were generated using a compilation of emission factors found in EDMS 4.12 from widely used planes in five different categories: single engine, multi-engine, jet, military and air taxi aircraft. Annual emissions were calculated and divided by 365 to obtain daily emissions.

2. Marine Vessels, Commercial

Philadelphia County has two navigable waterways: the Delaware and Schuylkill Rivers. The reference used to estimate emissions were the Procedures For Emission Inventory Preparation Volume IV: Mobile Sources and Waterborne Commerce of United States 1989. The method used to calculate emissions was:

Determine the average length of time spent for a round trip on the two rivers according to the formula:

$T = (2.2d/8 \text{ miles/hr})$ where T= time and d = distance

For waterways in Philadelphia County of navigable lengths:

Schuylkill River d = .55 miles T = 1.058 hours/ vessel
Delaware River d = 8.8 miles T = 2.42 hours/ vessel

Data for the two rivers was then obtained and sorted according to draft size (D):

Drafts between six and twelve feet $6' < D < 12'$

Drafts between twelve and eighteen feet $12' < D < 18'$

Drafts greater than eighteen feet $D > 18'$

For each draft size there is a corresponding fuel consumption rate:

$6' < D < 12'$ 10 gallons / hour
$12' < D < 18'$ 44 gallons / hour
$D > 18'$ 128 gallons / hour

This data was input into the following equation to estimate fuel use per vessel:

estimated fuel use per vessel = Fuel consumption rate x time on river (T)

Where (T = 2.42 Delaware; T = 1.058 Schuylkill)

Finally the estimated fuel use per vessel is multiplied by the number of vessels and the appropriate emission factor:

6'<D< 12'	99.7 lb. CO / 1000 gallons
12 <D < 18'	62.2 lb. CO / 1000 gallons
D >18 '	135.4 lb. CO / 1000 gallons

Example:

Schuylkill River Vessels (assume diesel):

Drafts (D):

6'<D<12'

10 gallons/hour
1.058 hours/ vessel x 10 gallons/hour = 10.58 gallons/vessel

With 2651 self propelled vessels per year:

= 2651 vessels/ year x 10.58 gallons/vessel x 99.71bs. CO / 1000 gallons

= 2796 lbs CO/year = 0.00383 tons CO/day

Dockside Layovers (assume diesel):

Dockside layovers were calculated for vessels with drafts greater than 18 feet. The following assumptions were made:

1.) Three day layover
2.) Vessels use 660 gallons/day
3.) An emission factor of 44 lbs. CO / 1000 gallons used

The number of vessels over 18 feet in draft for each river was summed and then multiplied by the number of days and gallons used per day to get a fuel usage. This fuel usage was then multiplied by the emission factor to get the emission estimate.

An example calculation follows:

902 vessels x 660 gallons/day x 3 days = 1785960 gallons

1785960 gallons x 44 lbs. CO / 1000 gallons = 78582 lbs CO/yr = 0.107 tons CO/day

Marine Vessel								
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = 6'<D<12'		Schuylkill River						
0.55	miles distance							
1.058	hour/vessel							
10	gallon/hour							
0.0997	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	days							
CO emission=	**0.003830608**	**ton/year**						**0.003831**
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = 12'<D<18'		Schuylkill River						
0.55	miles distance							
1.058	hour/vessel							
44	gallon/hour							
0.0622	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	days							
CO emission=	**0.010515153**	**ton/year**						**0.0105**
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = D>18'		Schuylkill River						
0.55	miles distance							
1.058	hour/vessel							
128	gallon/hour							
0.1354622	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	days							
CO emission=	**0.066619387**	**ton/year**						**0.0667**
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = 6'<D<12'		Delaware						
8.8	miles distance							

2.42	hour/vessel							
10	gallon/hour							
0.0997	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	days							
CO emission=	**0.008761882**	**ton/year**						**0.00876**
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = 12'<D<18'		Schuylkill River						
8.8	miles distance							
2.42	hour/vessel							
44	gallon/hour							
0.0622	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	days							
CO emission=	**0.024051673**	**ton/year**						
CO Emission = fuel usage /vessel *time on river * Total number of vessel *emission factor								
Draft Size = D>18'		Schuylkill River						
8.8	miles distance							
2.42	hour/vessel							
128	gallon/hour							
0.1354622	(lb/1000 gallons)							
2651	vessels/year							
2000	lb/ton							
365	**days**							
CO emission=	**0.152380828**	**ton/year**						**0.1524**
Dockside Layovers(assume diesel)			This calculated draft greater than 18'					
Assumption								
1. Three day layover								
2. Vessels use 660 gallons/day								
3. An emission factor of 44 lbs CO/1000 gallons used								
900	number of vessels > 18'							
660	gallons/day							
3	day layover							
0.044	(44 lbs/1000 gallons							
CO emission	**39.204**	**tons of CO**						
CO emission	**0.107408219**	**tons of CO/day**						
								0.1074
						Marine Vessels		**0.349591**

						Total	

3. Railroads

Philadelphia County has three Class I railroads operating within its boundaries. Each of these were contacted for information. The reference for estimating emissions was Procedures for Emission Inventory Preparation Vol. IV: Mobile Sources 1992. No changes are made in Track miles from 1990. Results and calculations are the same as 1990 except there was some track miles reduction because of decrease production in some areas.

The following estimating methods were used for two of the railroads:

Line haul emissions:

Calculate a fuel consumption index by dividing the railroad system's gross ton miles (GTM) by the system's fuel usage.

Multiply by the traffic density representing Pennsylvania to estimate fuel use in the state.

Emissions are then calculated by multiplying the fuel use by an emission factor of 0.0626 lb. of carbon monoxide per gal. of fuel.

Emissions are allocated to Philadelphia County by a proportion of the miles of track in the state under control by the railroad and the miles of track in Philadelphia County.

Yard emissions:

Multiply the “yard switching fuel consumption” by an emission factor of 0.0894 lb. of carbon monoxide per gal. of fuel.

Emissions are allocated to Philadelphia County by a proportion of the miles of track in the state under control by the railroad and the miles of track in Philadelphia County.

Amtrak:

The third railroad, Amtrak, is a passenger service railroad in Philadelphia County. The company's use of electric powered locomotives and recommendations for emission estimates resulted in the estimates being based on Amtrak's fuel consumption for each route segment and mileage of each in Philadelphia County.

The estimate of the fuel used in Philadelphia County was made by:

Fuel Use gallons = fuel use for route segment x mileage in city/ mileage for route segment

Emissions were calculated by multiplying the fuel use by an emission factor of 0.0626 lb. of carbon monoxide per gal. of fuel.

Rail Road								
Line Haul Emission								
77635684	Fuel usage in Gallons in Segment							
0.0626	Emission factor lb/gallons							
2000	lb/ton							
14272	PA miles of track							
660	Phili miles of track							
365	day/year							
CO emission = fuel factor*fuel usage								
CO=	**0.307873249**	**ton/day**						**0.3079**
Yard Emission								
68785874	Fuel usage in Gallons in Segment							
0.0894	Emission factor lb/gallons							
2000	lb/ton							
14272	PA miles of track							
660	Phili miles of track							
365	day/year							
CO emission = fuel factor*fuel usage								
CO=	**0.389558798**	**ton/day**						**0.38956**
Amtrak								
74287	Fuel usage in Gallons in Segment							
0.0626	Emission factor lb/gallons							
2000	lb/ton							
104	PA miles of track							
4.75	Phili miles of track							
365	day/year							
CO emission = fuel factor*fuel usage								
CO=	**0.000290954**	**ton/day**						**0.000291**
						Rail Road Total		**0.697751**

The Procedures for Emission Inventory Preparation Volume IV: Mobile Sources 1992 was used for these calcualtions. Philadelphia mileage for Amtrak is 4.7 miles with 74,287 gallons/year and the emission factor is very small at 0.0626 lb/gal which results in 0.0003 tons/CO Season Day. Line haul emissions use 77,635,685 gallons/year with 660 miles of track in Philadelphia. The results is 0.31 tons/CO Season Day. Yard emissions use 68,785,874 gallons/year with 660 miles of track in Philadelphia. The results are 0.389 tons/CO Season Day.

Below are the Input Values for Philadelphia County Nonroad Model Run:

Parameter	Input Value
Fuel RVP, psi	6.7
Oxygen Weight %	0%

Gasoline Sulfur	0.03%
Diesel Sulfur	0.33%
Liquefied Petroleum Gas /Compressed Natural Gas Sulfur	0%
Minimum Temperature, ^{o}F	20
Maximum Temperature, ^{o}F	72
Average Ambient Temperature, ^{o}F	41

Appendix III. - Growth Projections

A. Growth Factor Methodology – EGAS

The projected emission inventories for the future years 2007, 2013, and 2017 were all calculated by applying growth factors to the 2002 Base Year Inventory. EGAS provided the growth factors.

B. Point Source Growth Calculation

Growth in the point source inventory was calculated based on growth in income. Table 25 lists the 18 categories used, their SIC, the indicator of growth, and the growth factors for the projected years. The point source emissions were separated into the 18 categories listed and multiplied by the appropriate growth factor as shown.

Table 25 - Point Source Indicators of Growth

A. Point Sources Growth Factors(Base Year 2002)					
SIC	1996	2002	2007	2013	2017
20	0.8829242	1	0.912431	1.1979516	1.263906
26	0.876117	1	0.90818	1.2033468	1.269318
27	1.0207206	1	1.034967	1.0565479	1.114219
28	0.9145784	1	0.942099	1.160417	1.223889
29	0.9621861	1	0.987458	1.1068027	1.167805
30	0.9444654	1	0.947387	1.1111636	1.166698
31	0.8333333	1	1	1.1666667	1.166667
32	0.7567731	1	0.835113	1.4847132	1.657182
33	0.7737543	1	0.786371	1.5764469	1.759517
34	0.749569	1	0.80992	1.5324189	1.709317
SIC	1996	2002	2007	2013	2017
35	1.2004802	1	1.110667	1.2004802	1.30048
36	1.0908694	1	1.006588	1.2337733	1.376568
37	0.7329766	1	0.796718	1.5559628	1.736642
39	0.6818027	1	0.748966	1.6533715	1.846526
49	0.84538	1	0.901188	1.2460901	1.332657
50	0.8267196	1	0.88144	1.3345734	1.461227
51	0.8267196	1	0.88144	1.3345734	1.461227
97	1.1026574	1	1.065437	1.0499504	1.0152
		Average	0.988934	1.123951	1.139553
		8.38	8.287265	9.4187094	9.549454

C. Area Source Growth Calculation

For the projection of the area source base year inventory EGAS was used exclusive of any other source of data. Because the area source is primarily based on population it was decided to use the EGAS projections of future population for most categories. In the cases of Commercial Marine Vessels and On-Site Incineration where population was not used in the emission estimate Total Manufacturing Income Growth was used for the operating railroads in Philadelphia County. A listing of all the indicators of growth by SCC is shown in Table 26. A listing of the growth factors used in projecting the Base Year Inventory is shown in Table 26.

Table 26 - Base Year 2002 Area Source Growth Factor

SCC	1996	2002	2007	2013	2017
21-02-001-000	1.049097	1	1.019198	1.040285	1.056651
21-02-002-000	1.049097	1	1.019198	1.040285	1.056651
21-02-004-000	0.983284	1	1.080039	1.142182	1.181415
21-02-005-000	0.864378	1	1.057740	1.136226	1.157749
21-02-006-000	0.937119	1	1.027926	1.067472	1.111610
21-03-001-000	0.910746	1	1.014207	1.024954	1.080327
21-03-002-000	0.910746	1	1.014207	1.024954	1.080327
21-03-004-000	1.401934	1	0.889948	0.826300	0.779055
21-03-005-000	1.250938	1	1.015761	1.027770	1.020015
21-03-006-000	0.948586	1	1.026086	1.055492	1.055492
21-04-001-000	0.932487	1	0.936777	0.887355	0.870570
21-04-002-000	0.932487	1	0.936777	0.887355	0.870570
21-04-004-000	1.131221	1	0.923190	0.870248	0.836764
21-04-005-000	1.119319	1	0.925229	0.872061	0.837810
21-04-006-000	1.086484	1	0.966536	0.965449	0.965667
21-04-008-000	1.063264	1	0.985433	0.977033	0.971079
22-75-000-000	0.812083	1	1.150154	1.291781	1.381435
22-75-020-000	0.912908	1	1.082526	1.170896	1.232152
22-75-050-000	0.812083	1	1.150154	1.291781	1.381435
22-75-060-000	0.812083	1	1.150154	1.291781	1.381435
22-80-000-000	0.798148	1	1.089392	1.223561	1.308484
22-80-001-000	0.798148	1	1.089392	1.223561	1.308484
22-80-002-000	0.916758	1	1.036853	1.092225	1.127246
22-80-003-000	0.798148	1	1.089392	1.223561	1.308484
22-80-004-000	0.798148	1	1.089392	1.223561	1.308484
22-85-000-000	1.219214	1	0.784686	0.612411	0.461838
22-85-002-005	1.219214	1	0.784686	0.612411	0.461838
22-85-002-010	0.965717	1	1.023273	1.049637	1.071173
26-01-000-000	0.965717	1	1.023273	1.049637	1.071173
26-01-010-000	0.839278	1	1.150818	1.338396	1.453545
26-01-020-000	0.848680	1	1.101841	1.220487	1.297632
26-01-030-000	0.965717	1	1.023273	1.049637	1.071173
26-10-000-000	0.965717	1	1.023273	1.049637	1.071173
26-10-010-000	0.839278	1	1.150818	1.338396	1.453545
26-10-020-000	0.848680	1	1.101841	1.220487	1.297632
26-10-030-000	0.965717	1	1.023273	1.049637	1.071173
	Average		1.026575	1.068581	1.095869
SCC	1996	2002	2007	2013	2017
			(Year 2002 = 18)		
			18.47836	19.23446	19.72565

Table 27 displays Area Source Categories by SIC.

Table 27 - Area Source Categories by SIC

SCC	Categories
21-02-001-000	Coal Combustion Industrial Anthracite
21-02-002-000	Coal Combustion Industrial Bitumin/Subbitum
21-02-004-000	Fuel Oil Combustion Distillate Industrial
21-02-005-000	Fuel Oil Combustion Residual Industrial
21-02-006-000	Natural Gas & LPG Industrial
21-03-001-000	Coal Combustion Commercial Anthracite
21-03-002-000	Coal Combustion Commercial Bitumin/Subbitum
21-03-004-000	Fuel Oil Combustion Distillate Commercial
21-03-005-000	Fuel Oil Combustion Residual Commercial
21-03-006-000	Natural Gas & LPG Commercial
21-04-001-000	Coal Combustion Residential Anthracite
21-04-002-000	Coal Combustion Residential Bitumin/Subbitum
21-04-004-000	Fuel Oil Combustion Distillate Residential
21-04-005-000	Fuel Oil Combustion Residual Residential
21-04-006-000	Natural Gas & LPG Residential
21-04-008-000	Wood Combustion Residential
22-75-000-000	Aircraft
22-75-020-000	Commercial Aircraft
22-75-050-000	General Aviation
22-75-060-000	Air Taxi
22-80-000-000	Marine Vessels, Commercial
22-80-001-000	Coal
22-80-002-000	Diesel Fuel
22-80-003-000	Residual Oil
22-80-004-000	Gasoline
22-85-000-000	Railroads
SCC	Categories
22-85-002-005	Diesel Line Haul Locomotives
22-85-002-010	Diesel Yard Locomotives
26-01-000-000	On-site Incineration
26-01-010-000	Industrial On-site Incineration
26-01-020-000	Commercial On-site Incineration
26-01-030-000	Residential On-site Incineration
26-10-000-000	Open Burning
26-10-010-000	Industrial
26-10-020-000	Commercial
26-10-030-000	Residential

D. Highway Vehicle Growth Calculation

The emissions for the projected inventories of highway sources are calculated using growth in VMT. For further discussion of the methods used please consult Appendix II C and Appendix II C a.

CO Modeling for Philadelphia County reflects the highway mobile sources emission estimations for the years 1990, 1992, 2002, 2007, 2013 and 2017.

E. Nonroad Growth Calculation

The growth projections for nonroad sources were based on one of three indicators of growth: population, income, or employment.

EGAS was not used for the Nonroad model because EGAS is based on only population growth whereas the Nonroad model has its own calculations for growth based on population, income, or employment. The Nonroad growth calculation was used for future years.

Appendix IV. - Proportional Rollback Analysis

A. Methodology

Estimates of future design values are estimated by a roll back method (ratio) based on the change in future emissions. This method assumes changes in air quality are directly proportional to changes in emissions. Below is an example of the method used to calculate a future design value.

B. Example Calculations for Year 2007

The emissions from each source category are used in proportion to break down the contributions to the design value.

2002 Emissions with the design value of 2.9 ppm:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient Level (ppm)
Point	8.38	1.49	0.04
Area	16.96	3.02	0.09
Highway	434.70	77.43	2.24
Nonroad	101.30	18.05	0.52
Total	**561.34**	**100.00**	**2.89**

Future values of these ambient levels are estimated in proportion to the projected emissions. Estimates are made for each source category and summed for the estimate of the future design value.

2007 emissions:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient Level (ppm)
Point	8.28	1.76	0.04
Area	17.45	3.71	0.09
Highway	331.25	70.59	1.71
Nonroad	112.29	23.93	0.58
Total	**469.26**	**100.00**	**2.42**

2007 emission/2002 emission * category's contribution to ambient levels in 2002 = projected ambient concentration in 2007

Example calculating point source contribution for 2007:

2002 to 2007 Design Value Rollback

Source Category	2002 Emissions (Tons/Day)	2007 Emissions (Tons/Day)
Point	8.38	8.28
Area	16.96	17.45
Highway	434.7	331.25
Nonroad	101.30	112.29
Total	**561.34**	**469.27**

Sources	2002 Ambient Level (ppm)	2007 Ambient Level (ppm)	Ratio
Point	0.04	0.04	1.01
Area	0.09	0.09	0.97
Highway	2.24	1.71	1.31
Nonroad	0.52	0.58	0.90
Total	**2.89**	**2.42**	**1.20**

C. Example Calculations for Year 2013

The emissions from each source category are used in proportion to break down the contributions to the design value.

2002 Emissions with the design value of 2.9 ppm:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient Level (ppm)
Point	8.38	1.50	0.04
Area	16.96	3.02	0.09
Highway	434.7	77.44	2.24
Nonroad	101.30	18.04	0.52
Total	**561.34**	**100.00**	**2.89**

Future values of these ambient levels are estimated in proportion to the projected emissions. Estimates are made for each source category and summed for the estimate of the future design value.

2013 emissions:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient Level (ppm)
Point	9.41	2.19	0.05
Area	18.27	4.24	0.09
Highway	278.24	64.62	1.43
Nonroad	125.25	29.09	0.65
Total	**430.600**	**100.00**	**2.22**

2013 emission/2002 emission * category's contribution to ambient levels in 2002 = projected ambient concentration in 2013

Example calculating point source contribution for 2013:

2002 to 2013 Design Value Rollback

Source Category	2002 Emissions (Tons/Day)	2013 Emissions (Tons/Day)
Point	8.38	9.41
Area	16.96	18.27
Highway	434.7	278.24
Nonroad	101.30	125.25
Total	**561.34**	**430.60**

Sources	2002 Ambient Level (ppm)	2013 Ambient Level (ppm)	Ratio
Point	0.04	0.05	0.89
Area	0.09	0.09	0.93
Highway	2.24	1.43	1.56
Nonroad	0.52	0.65	0.81
Total	**2.90**	**2.22**	**1.30**

D. Example Calculations for Year 2017

The emissions from each source category are used in proportion to break down the contributions to the design value.

2002 Emissions with the design value of 2.9 ppm:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient Level (ppm)
Point	8.38	1.49	0.04
Area	16.96	3.02	0.09
Highway	434.7	77.44	2.24
Nonroad	101.30	18.05	0.52
Total	**561.34**	**100.00**	**2.90**

Future values of these ambient levels are estimated in proportion to the projected emissions. Estimates are made for each source category and summed for the estimate of the future design value.

2017 emissions:

Source Category	Emissions (Tons/Day)	Contribution to Ambient Level (Percentage)	Ambient (ppm)
Point	9.54	2.26	0.05
Area	18.76	4.44	0.10
Highway	260.97	61.76	1.35
Nonroad	134.04	31.72	0.69
Total	**422.57**	**100.00**	**2.18**

2017 emission/2002 emission * category's contribution to ambient levels in 2002 = projected ambient concentration in 2017

Example calculating point source contribution for 2017:

2002 to 2017 Design Value Rollback

Source Category	2002 Emissions (Tons/Day)	2017 Emissions (Tons/Day)
Point	8.38	9.54
Area	16.96	18.76
Highway	434.7	260.97
Nonroad	101.30	134.04
Total	**561.34**	**422.57**

Sources	2002 Ambient Level (ppm)	2017 Ambient Level (ppm)	Ratio

Point	0.04	0.05	0.88
Area	0.09	0.10	0.90
Highway	2.24	1.35	1.67
Nonroad	0.52	0.69	0.76
Total	**2.90**	**2.18**	**1.33**

Figure 9 plots both air quality (design value) and emissions on the y-axis vs time.

Figure 9 - CO Design Values (ppm) and Emissions (tons/day) vs. Time