

Commonwealth of Pennsylvania



pennsylvania
DEPARTMENT OF ENVIRONMENTAL
PROTECTION

Proposed State Implementation Plan Revision: 2011 Base Year Inventory for the Pennsylvania Portion of Five 2008 Ozone Nonattainment Areas:

**Allentown-Bethlehem-Easton
Lancaster
Philadelphia-Wilmington-Atlantic City
Pittsburgh-Beaver Valley
Reading**

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Attachment 1: 2011 Nonpoint Source Annual Inventory

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Attachment 1: 2011 Nonroad Source Annual Inventory

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Attachment 1: 2011 Onroad Source Annual Inventory

Attachment 2: 2011 Onroad Source Ozone Season Inventory

Introduction and Overview

Maintaining concentrations of ground-level ozone below the health-based ambient air quality standard is important because ozone is a serious human health threat, and also can cause damage to important food crops, forests, and wildlife.

Repeated exposure to ozone pollution may cause a variety of adverse health effects for both healthy people and those with existing conditions including difficulty in breathing, chest pains, coughing, nausea, throat irritation, and congestion. It can exacerbate bronchitis, heart disease, emphysema, and asthma, and reduce lung capacity. Asthma is a significant and growing threat to children and adults. Ozone can aggravate asthma, causing more frequent occurrence of asthma attacks, increased use of medication, and requiring additional medical treatment and more frequent visits to hospital emergency clinics. Because ozone pollution usually forms in hot weather, anyone who spends time outdoors in the summer may be affected, particularly children, the elderly, outdoor workers and people exercising. Children are most at risk from exposure to ozone because they are active outside, playing and exercising during the summertime when ozone levels are highest.

Ozone is one of the most pervasive and detrimental pollutants known to affect vegetation, causing more injury to trees and crops than any other air pollutant in the United States. Ozone interferes with photosynthesis, the process by which plants convert water and sunlight to food. Ozone makes plants more susceptible to disease, insects, other pollutants and harsh weather. It damages the foliage of trees and other plants, ruining the landscapes of cities, parks and forests, and recreation areas. Research has shown that current ozone concentrations result in reductions of over 10 percent in wood growth in forests of the Northeast. There is strong scientific evidence showing that current levels of ozone are reducing crop yields, particularly in sensitive species such as soybean, cotton, and peanuts. Annual crop loss from ozone for soybeans alone in Illinois, Indiana and Ohio has been calculated to range from \$199 million to \$346 million. The U.S. Environmental Protection Agency (EPA) has estimated national crop yield losses due to ozone in excess of \$1 billion annually. One of the key components of ozone, oxides of nitrogen (NO_x), contributes to fish kills and algae blooms in sensitive waterways, such as the Chesapeake Bay.

Ozone is not emitted directly to the atmosphere, but is formed by photochemical reactions between volatile organic compounds (VOCs) and NO_x in the presence of sunlight. The long, hot, humid days of summer are particularly conducive to ozone formation, so ozone levels are a concern primarily during the months of May through September. The primary sources of man-made VOCs and NO_x, the ozone precursors, are the evaporation of fuels and solvents (gasoline and consumer products), combustion of fuels (motor vehicles, power plants and non-road engines), and industrial processes.

This document contains a detailed explanation of the 2011 base year emissions inventory for stationary, area, nonroad, and mobile anthropogenic sources as well as biogenic sources in the areas in Pennsylvania that EPA designated as nonattainment for the 2008 National Ambient Air Quality Standards (NAAQS). The inventory will be included as part of Pennsylvania's State Implementation Plan (SIP) to meet the requirements for the 2008 ozone NAAQS. Annual

anthropogenic emissions were estimated for VOC, NO_x, and carbon monoxide (CO). Typical ozone season day emissions were estimated for VOC, NO_x, and CO.

On March 27, 2008, the U.S. Environmental Protection Agency (EPA) published a final rule establishing revised primary and secondary 8-hour ozone National Ambient Air Quality Standards (NAAQS) (73 FR 16436) of 75 parts per billion. The final *Air Quality Designations for the 2008 Ozone National Ambient Air Quality Standards* were published in the *Federal Register* on May 21, 2012 (77 FR 30088). EPA designated ozone nonattainment areas for the 2008 ozone NAAQS including 36 areas classified across the country as “marginal” ozone nonattainment areas. These marginal areas include the Allentown-Bethlehem-Easton, Lancaster, Philadelphia-Wilmington-Atlantic City (Pennsylvania portion), Pittsburgh-Beaver Valley, and Reading as “marginal” nonattainment areas (77 FR 30088; May 21, 2012). This final rule was effective on July 20, 2012. The federal Clean Air Act (CAA), 42 U.S.C.A. § 7401 *et seq.* (the Act), requires all areas of the nation to attain and maintain compliance with the NAAQS. These federal standards are designed to protect the public health and welfare from six criteria pollutants, one of which is ozone

This base year inventory is required by Section 182(a)(1) of the CAA at § 7511a(a)(1):

(1) Inventory – Within 2 years after November 15, 1990, the State shall submit a comprehensive, accurate, current inventory of actual emissions from all sources, as described in section 7502(c)(3) of this title, in accordance with guidance provided by the Administrator.

Section 172(c)(3) of the CAA, the referenced section, § 7502(c)(3), reads:

(3) Inventory – Such plan provisions shall include a comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area, including such period revisions as the Administrator may determine necessary to assure that the requirements of this part are met.

EPA regulations, at 40 CFR § 51.1115 (relating to emissions inventory requirement), require the inventory to be submitted no later than 24 months after the effective date of designation.

Pennsylvania has chosen 2011 for the base year based upon EPA’s final rule entitled “Implementation of the 2008 National Ambient Air Quality Standards for Ozone: State Implementation Plan Requirements” (80 FR 12263, March 6, 2015).

The base year inventory must also meet the requirements for the public comment process set forth in Section 110(a)(2) of the CAA, 40 CFR § 51.102 and Section 7.5 of the Pennsylvania Air Pollution Control Act (35 P.S. Section 4007.5(b)). On **[to be determined]**, the Pennsylvania Department of Environmental Protection (DEP or Department) provided notice of a public comment period and the opportunity for a hearing on the “State Implementation Plan Revision: 2011 Base Year Inventory for the Pennsylvania Portion of Five 2008 Ozone Nonattainment Areas.”

Summary of the Base Year Emissions Inventory

1. 2011 Base Year Inventory

Effective July 20, 2012, EPA designated the following Pennsylvania counties as nonattainment for the 2008 ozone NAAQS (77 FR 30088, May 21, 2012):

Allentown-Bethlehem-Easton, PA

- Carbon County
- Lehigh County
- Northampton County

Lancaster, PA

- Lancaster County

Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE

- Bucks County
- Chester County
- Delaware County
- Montgomery County
- Philadelphia County

Pittsburgh-Beaver Valley, PA

- Allegheny County
- Armstrong County
- Beaver County
- Butler County
- Fayette County
- Washington County
- Westmoreland County

Reading, PA

- Berks County

Summaries of the ozone precursor emissions in tons per day (TPD) and tons per year (TPY) for the Pennsylvania 2008 ozone NAAQS nonattainment areas are shown in Tables 1a through 1e. Summaries for each source category are included throughout this document. Differences between the summary and the tables in the individual sections of this document are due to differences in rounding. The 2011 National Emission Inventory (NEI) version 2 data files used for this document were obtained as a download from the EPA Emission Inventory System (EIS) Gateway. The Sparse Matrix Operator Kernel Emissions (SMOKE) files from the gateway were imported into the Emissions Modeling Framework (EMF) system in order to apply the necessary data filters and summer day averages.

2011 Base Year SIP Emission Inventory

Table 1a: 2011 Base Year Emission Inventories Summary by Sector for the 2008 Allentown-Bethlehem-Easton Marginal Ozone Nonattainment Area

Source Category	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Point	3.5844	24.0763	44.5565	1,298.2944	8,882.4313	15,980.1187
Nonpoint	52.4620	4.3983	10.7226	21,874.0747	2,365.4084	17,758.0824
Nonroad	7.3491	8.4916	81.1983	2,624.7749	2,372.2160	26,305.6727
Highway	17.1800	35.5600	172.5900	6,169.9800	12,833.6100	76,800.1200
Total	80.5755	72.5262	309.0674	31,967.1240	26,453.6657	136,843.9938

Table 1b: 2011 Base Year Emission Inventories Summary by Sector for the 2008 Lancaster Area Marginal Ozone Nonattainment Area

Source Category	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Point	6.0096	3.3279	4.9232	2,161.8035	1,225.2810	1,811.4742
Nonpoint	31.6881	4.1839	14.0763	13,262.0758	2,043.6030	13,992.7848
Nonroad	9.4751	8.1193	75.9137	3,854.6239	2,369.2314	26,064.9100
Highway	11.9900	24.4200	121.0300	4,233.6300	8,879.1200	52,716.3700
Total	59.1628	40.0511	215.9432	23,512.1332	14,571.2354	94,585.5390

Table 1c: 2011 Base Year Emission Inventories Summary by Sector for the Pennsylvania Portion of the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Ozone Nonattainment Area

Source Category	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Point	13.8162	39.8652	35.4149	5,044.1788	14,466.8247	12605.2393
Nonpoint	144.0575	27.7843	24.6034	55,434.4159	14,394.6064	27,032.5230
Nonroad	41.8480	39.2817	510.4407	14,368.4324	11,090.2074	162,745.4696
Highway	60.5800	123.3900	631.6900	21,497.8300	43,869.0400	259,855.7300
Total	260.3017	230.3212	1,202.1490	96,344.8571	83,820.6785	462,238.9619

Table 1d: 2011 Base Year Emission Inventories Summary by Sector for the 2008 Pittsburgh-Beaver Valley Marginal Ozone Nonattainment Area

Source Category	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Point	10.6595	160.0714	120.1636	3,900.9235	57,329.8382	43,988.6819
Nonpoint	191.5216	65.3470	85.7973	63,326.9810	27,064.6374	49,340.2937
Nonroad	24.8491	27.7845	284.5770	9,281.1724	7,908.6977	93,498.8397
Highway	43.5400	88.8500	446.6400	16,584.5300	32,360.4000	210,881.4800
Total	270.5702	342.0529	937.1779	93,093.6069	124,663.5733	397,709.2953

Table 1e: 2011 Base Year Emission Inventories Summary by Sector for the 2008 Reading Marginal Ozone Nonattainment Area

Source Category	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Point	3.4007	8.6847	5.4075	1,223.7618	3,139.5588	1,946.4482
Nonpoint	32.6838	4.2975	11.0720	13,462.6586	2,055.8245	11,792.2040
Nonroad	4.5626	5.4649	46.8275	1,650.9746	1,528.6220	15,312.2966
Highway	9.8600	22.1100	98.8800	3,479.3500	8,073.1900	43,022.4700
Total	50.5071	40.5571	162.1870	19,816.7450	14,797.3983	72,073.4188

Ozone is typically a pollutant of concern in the summertime. Ozone formation depends on the presence of ozone precursors as well as the amount of sunlight and other meteorological impacts. Because ozone varies by season and weather conditions, the baseline is provided both as an annual total and also as an average daily value during the ozone season. The ozone season is defined as May 1 through September 30.

2. Point Sources

A point source is a stationary, identifiable source of air pollution that usually emits the air pollutants through a stack or vent. A facility contains one or more point sources and is not limited to industrial facilities. Examples of an air pollution facility are steel mills, oil refineries, electric generating facilities, and coal preparation plants. A non-industrial facility may contain a large boiler or other air pollution source.

The data for the 2011 SO_x, VOC, NO_x, CO, lead and lead compounds, primary PM_{2.5}, primary PM₁₀, and ammonia point source emission inventory is derived from the Pennsylvania Air Information Management System (AIMS). The AIMS sources are identified and inventoried by Pennsylvania regional air quality offices through permitting operations and regional and central office field inspections and surveys. The AIMS system is designed to include all point source emission categories needed for completing any federally required reports, including but not limited to SIP preparation.

The AIMS database is linked to DEP's eFACTS (Environment Facility, Application, Compliance Tracking System) database. This allows Department-wide sharing of data for all program areas. In addition, the public is provided better access to the information through DEP's Internet website.

The point source inventories for Allegheny and Philadelphia Counties will be prepared by the Allegheny County Health Department and the Philadelphia Air Management Services respectively. The two county agencies will submit their point source emission inventories directly to EPA's National Emission Inventory. The county agencies will also provide their point source data to DEP in order that effective SIP preparation may be undertaken.

DEP has developed instructions for companies to complete the annual inventory submission, also known as the Annual Emission Statement. The instructions describe the database fields in the AIMS/eFACTS system. The instructions are revised annually to reflect any new guidance for the applicable reporting year.

Information on the emission inventory reporting system, including the Instructions for Completing The Annual Emission Statement, can be found at:

<http://files.dep.state.pa.us/Air/AirQuality/AQPortalFiles/Business%20Topics/Emission%20Inventory/docs/2700-BK-DEP1936.pdf>

Annually, facilities complete worksheets or enter data into the Air Emissions System (AES) for each source that operated and emitted pollutants for the year. Data required for processes include monthly material throughputs, days and weeks the sources operated, material processed, maximum throughput per hour, and correct Source Classification Code (SCC) number. In addition to process data required, combustion unit data must include fuel used, fuel characteristics such as sulfur content and British Thermal Units (Btu), and any laboratory results. For each source, an estimate of total emissions from criteria and hazardous pollutants must be supplied, including the method used for completing the estimate. If the company estimates emissions using anything other than emissions factors, it must provide the methodology. Usually that methodology involves material balance. The company is also required to provide site emissions, which must equal the total of all individual sources. For those companies submitting through AES, error messages are returned when emissions are significantly different from those expected, at which time the company will either change the entry or justify why the numbers are acceptable.

After the companies provide these data, inspectors or permit reviewers input and/or review the data in the AIMS system. For those companies submitting data on paper, the reviewer may receive an error message for emissions significantly different from previous years. At that time, the reviewer will contact the company for more information and either request a change submittal or enter the reason for the discrepancy.

As part of the Annual Emission Statement, point sources are required to provide operating data and emissions estimates to DEP annually. Section 5.3 of the Instructions for Completing the Annual Emission Statement instructs owners and operators of a facility to provide an estimate of emissions for each sub-facility within a facility. Continuous Emissions Monitors' (CEM) data is considered the most reliable and is preferred by the DEP to develop an emissions estimate. While startup emissions are not explicitly discussed in the instructions or the Annual Emission Statement reporting forms, companies are told to report all emissions. Additionally, all facilities with startup emissions have an operating permit. The permit includes additional data collection and reporting requirements. Some equipment will have actual CEM data associated with its operation that will measure emissions for point source equipment. Emissions produced by some equipment will be calculated using operating data, throughputs and factors. The

owner or operator is required to tell DEP which calculation method was used as well as the amount of emissions produced by the equipment.

Tables 2a through 2e, below, summarize point source emissions for the five 2008 ozone NAAQS nonattainment areas in Pennsylvania. More detailed information about the point source calculations and data is available in Appendix A – Point Sources and the attachments 2011OzonePoint_Final and 2011PointAnnual_Final.

Table 2a: 2011 Base Year SIP Point Source Emission Inventories for the 2008 Allentown-Bethlehem-Easton Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Carbon	0.5427	1.8660	24.5578	195.6113	729.9423	8,762.6631
Lehigh	2.0674	1.7237	6.6595	757.6371	627.6723	2,467.1831
Northampton	0.9742	20.4867	13.3392	345.0461	7,524.8167	4,750.2724
Total Emissions	3.5844	24.0763	44.5565	1,298.2944	8,882.4313	15,980.1187

Table 2b: 2011 Base Year SIP Point Source Emission Inventories for the 2008 Lancaster Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Lancaster	6.0096	3.3279	4.9232	2,161.8035	1,225.2810	1,811.4742

Table 2c: 2011 Base Year SIP Point Source Emission Inventories for the Pennsylvania Portion of the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Bucks	1.4391	3.5099	1.6816	524.0020	1,270.9407	611.1234
Chester	2.1985	4.2331	4.9712	799.1257	1,529.9727	1,817.2060
Delaware	3.8463	21.1831	18.6638	1,393.1782	7,641.9772	6,444.8662
Montgomery	1.9999	3.9794	3.3699	729.4912	1,456.0920	1,229.2485
Philadelphia	4.3324	6.9597	6.7284	1,598.3817	2,567.8421	2,502.7952
Total Emissions	13.8162	39.8652	35.4149	5,044.1788	14,466.8247	12,605.2393

**Table 2d: 2011 Base Year SIP Point Source Emission Inventories for the
2008 Pittsburgh-Beaver Valley Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Allegheny	4.5671	30.6712	21.9206	1,669.7652	11,123.8322	7,919.9235
Armstrong	0.6251	68.4145	14.2624	227.6070	24,395.9115	5,092.5689
Beaver	1.6351	46.2054	74.5896	600.6571	16,538.3754	27,537.0123
Butler	1.5295	2.8332	4.8958	560.6556	975.4216	1,794.8047
Fayette	0.3152	0.9680	0.4483	114.9782	344.4647	161.3691
Washington	0.3897	6.7958	2.8270	142.6282	2,439.3938	444.9362
Westmoreland	1.5977	4.1833	2.8270	584.6322	1,512.4391	1,038.0673
Total Emissions	10.6595	160.0714	120.1636	3,900.9235	57,329.8382	43,988.6819

**Table 2e: 2011 Base Year SIP Point Source Emission Inventories for the
2008 Reading Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Berks	3.4007	8.6847	5.4075	1,223.7618	3,139.5588	1,946.4482

3. Nonpoint Sources

Nonpoint sources are stationary air pollutant emission sources that are not inventoried at the facility level. While point sources are inventoried individually, nonpoint sources are typically inventoried at the county level. Area inventory development is described in the Introduction to Area Source Emission Inventory Development, Volume III: Chapter 1, published in 2001 by the Emission Inventory Improvement Program (http://www.epa.gov/ttn/chief/eiip/techreport/volume03/iii01_apr2001.pdf). Individual emissions sources are grouped with other like sources into source categories. These source categories are grouped in such a way that they can be estimated collectively using one methodology. Most nonpoint source categories do not have an analogue in the point source inventory. Nonpoint emissions are generally estimated by multiplying an emission factor by some known indicator or collective activity for each nonpoint source category at the county level. Throughput estimates are derived from county-level activity data, by apportioning national or statewide activity data to counties, from census numbers, and from county employee numbers. Control efficiency, rule penetration and rule effectiveness are all taken into account. More specific information on the procedure used for each industry type is contained in Pennsylvania 2002 Area Source Criteria Air Pollutant Emission Estimation Methods (E.H. Pechan & Associates, Inc., February 2004), which is contained in the Technical Appendix for informational purposes only.

Tables 3a through 3e, below, summarize nonpoint source emissions for the five 2008 ozone NAAQS nonattainment areas in Pennsylvania. More detailed information about the nonpoint source calculations and data is available in Appendix B – Nonpoint Sources and the attachments 2011OzoneNonpointPA_Final and 2011NonpointAnnual_Final.

**Table 3a: 2011 Base Year SIP Nonpoint Source Emission Inventories for the
2008 Allentown-Bethlehem-Easton Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO_x (TPD)	CO (TPD)	VOC (TPY)	NO_x (TPY)	CO (TPY)
Carbon	18.5742	0.6276	4.4734	7,093.6465	302.9266	3,133.5461
Lehigh	17.8975	2.1268	3.3302	7,831.4999	1,141.1625	7,892.4848
Northampton	15.9903	1.6440	2.9189	6,948.9283	921.3193	6,732.0515
Total Emissions	52.4620	4.3983	10.7226	21,874.0747	2,365.4084	17,758.0824

**Table 3b: 2011 Base Year SIP Nonpoint Source Emission Inventories for the
2008 Lancaster Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO_x (TPD)	CO (TPD)	VOC (TPY)	NO_x (TPY)	CO (TPY)
Lancaster	31.6881	4.1839	14.0763	13,262.0758	2,043.6030	13,992.7848

**Table 3c: 2011 Base Year SIP Nonpoint Source Emission Inventories for the
Pennsylvania Portion of the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE
Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO_x (TPD)	CO (TPD)	VOC (TPY)	NO_x (TPY)	CO (TPY)
Bucks	32.7039	3.2037	4.8973	12,654.5789	1,777.1277	6,066.8019
Chester	28.4227	2.6233	4.8515	10,934.1763	1,445.5963	5,142.2033
Delaware	17.6733	6.3309	3.1956	6,784.8299	2875.8471	3,411.1548
Montgomery	32.2084	4.3852	6.0136	12,761.6800	2480.6733	8,545.6368
Philadelphia	33.0492	11.2412	5.6454	12,299.1508	5815.3620	3,866.7262
Total Emissions	144.0575	27.7843	24.6034	55,434.4159	14,394.6064	27,032.5230

**Table 3d: 2011 Base Year SIP Nonpoint Source Emission Inventories for the
2008 Pittsburgh-Beaver Valley Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO_x (TPD)	CO (TPD)	VOC (TPY)	NO_x (TPY)	CO (TPY)
Allegheny	42.9087	14.8256	10.3721	17,088.4994	7,145.8163	11,642.8966
Armstrong	21.4875	9.8166	13.2642	8,043.9338	3,694.8729	5,754.6515
Beaver	16.2882	5.0596	6.0422	6,170.5766	2,077.9516	3,367.1520
Butler	26.3446	3.8922	9.6402	9,983.0774	1,635.8255	5,363.0508
Fayette	27.2265	8.3067	11.7757	10,271.9696	3,227.1075	5,945.3373
Washington	24.2702	9.5708	15.2236	9,238.3018	3,747.1048	7,522.4014
Westmoreland	32.9959	13.8755	19.4792	12,513.6999	5,535.9586	9,744.8042
Total Emissions	191.5216	65.3470	85.7973	73,310.0584	27,064.6374	49,340.2937

**Table 3e: 2011 Base Year SIP Nonpoint Source Emission Inventories for the
2008 Reading Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Berks	32.6838	4.2975	11.0720	13,462.6586	2,055.8245	11,792.2040

4. Nonroad Sources

Pennsylvania did not prepare a nonroad inventory in 2011 and instead depended on the EPA’s nonroad calculations. All descriptions, methodologies and estimated emissions in this document are from EPA.

Nonroad sources include aircraft, railroad and commercial marine vessel (CMV) sectors. Each source type is calculated using a unique methodology. All methodologies are described in the November 2013 EPA document 2011 National Emissions Inventory (NEI), version 1 Technical Support Document found at:

http://www.epa.gov/ttn/chief/net/2011nei/2011_neiv1_tsd_draft.pdf

The aircraft sector includes all aircraft types used for public, private and military purposes. This includes four types of aircraft: (1) commercial, (2) air taxis, (3) general aviation, and (4) military. A critical detail about the aircraft is whether each aircraft is turbine or piston driven, which allows the emissions estimation model to assign the fuel used, namely jet fuel or aviation gas, respectively. The fraction of turbine and piston driven aircraft is either collected or assumed for all aircraft types. Commercial aircraft include those used for transporting passengers, freight or both. Commercial aircraft tend to be larger aircraft powered with jet engines. Air taxis carry passengers, freight or both, but usually are smaller aircraft and operate on a more limited basis than the commercial aircraft. General aviation aircraft include most other aircraft used for recreational flying and personal transportation. Finally, military aircraft are associated with military purposes, and they sometimes have activity at non-military airports.

The 2011 NEI also includes emission estimates for aircraft auxiliary power units (APU) and aircraft ground support equipment (GSE) typically found at airports, such as aircraft refueling vehicles, baggage handling vehicles and equipment, aircraft towing vehicles, and passenger buses. These APUs and GSE are located at the airport facilities as point sources along with the aircraft exhaust emissions. However, these emissions are included in the EIS sectors for nonroad equipment (such as gasoline, diesel, and other). EPA developed emissions estimates associated with aircrafts’ landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport on its descent from cruising altitude, lands, taxis to the gate, and idles during passenger deplaning. It continues as the aircraft idles during passenger boarding, taxis back out onto the runway for subsequent takeoff, and ascends (climbs out) to cruising altitude. Thus, the five specific operating modes in an LTO are (1) approach, (2) taxi/idle-in, (3) taxi/idle-out, (4) takeoff, and (5) climbout. The LTO cycle provides a basis for calculating aircraft emissions. During each mode of operation, an aircraft engine operates at a fairly standard

power setting for a given aircraft category. Emissions for one complete cycle are calculated using emission factors for each operating mode for each specific aircraft engine combined with the typical period of time the aircraft is in the operating mode.

The locomotive sector includes railroad locomotives powered by diesel-electric engines. A diesel-electric locomotive uses 2-stroke or 4-stroke diesel engines and an alternator or a generator to produce the electricity required to power its traction motors. The locomotive source category is further divided up into categories: Class I line haul, Class II/III line haul, Passenger, Commuter, and Yard. EPA's 2011 national rail estimates were developed by applying growth factors to the 2008 NEI values based on railroad freight traffic data from the 2008 and 2011 R-1 reports submitted by all Class I rail lines to the Surface Transportation Board and employment statistics from the American Short Lines and Regional Railroad Association for Class II and III. See Eastern Research Group, Inc. project report Development of 2011 Railroad Component for National Emissions Inventory, September 5, 2012 for details. This document can be found at:

<http://dnr.mo.gov/env/apcp/ozone/apndx-b-6.pdf>

For more information on the 2008 methodology, refer to the 2008 documentation and background information at EPA's Office of Transportation And Air Quality website for nonroad emissions (<http://www.epa.gov/otaq/locomotives.htm>). The emissions were allocated to line haul shape IDs and yard locations based on 2008 allocations.

The commercial marine vessel (CMV) sector includes boats and ships used either directly or indirectly in the conduct of commerce or military activity. The majority of vessels in this category are powered by diesel engines that are fueled with either distillate or residual fuel oil blends. For the purpose of this inventory, we assume that Category 3 (C3) vessels primarily use residual blends while Category 1 and 2 (C1 and C2) vessels typically used distillate fuels. The C3 inventory includes vessels that use C3 engines for propulsion. C3 engines are defined as having displacement above 30 liters per cylinder. The resulting inventory includes emissions from both propulsion and auxiliary engines used on these vessels, as well as those on gas and steam turbine vessels. Geographically, the inventories include port and inter-port emissions that occur within the area that extends 200 nautical miles from the official U.S. baseline, which is roughly equivalent to the border of the U.S. Exclusive Economic Zone. Only some of these emissions are allocated to states based on official state boundaries that typically extend 3 miles offshore. The C1 and C2 vessels tend to be smaller ships that operate closer to shore, and along inland and inter-coastal waterways. Naval vessels are not included in this inventory, though Coast Guard vessels are included as part of the C1 and C2 vessels. The CMV source category does not include recreational marine vessels, which are generally less than 100 feet in length, most being less than 30 feet, and powered by either inboard or outboard engines. These emissions are included in those calculated by the NONROAD model; they reside in the nonroad data category and EIS "Mobile Non-Road Equipment" sectors of the 2011 NEI. Each of the commercial marine SCCs requires an appropriate emissions type (M=maneuvering, H=hoteling, C=cruise, Z=reduced speed

zone) because emission factors vary by emission type. Each SCC and emissions type combination was allocated to a shape file identifier in the nonpoint inventory. The default values are those assumed when the actual emission type may be unknown; for example, emissions that occur in shipping lanes are assumed to be “cruising” and cannot be “hoteling,” which only occurs at ports.

EPA estimated CMV emission estimates as a collaborative effort between the Office of Transportation and Air Quality (OTAQ) and OAQPS. EPA developed the C3 commercial marine inventories for a base year of 2002 and then projected to 2011 by applying regional adjustment factors to account for growth. In addition, EPA developed and applied NO_x adjustment factors to account for implementation of the NO_x Tier 1 standard. The C3 growth factors, NO_x adjustment factors by tier and calendar year, and NO_x adjustment factors by engine type and speed are defined in Appendix A of the EPA project report “Documentation for the Commercial Marine Vessel Component of the National Emissions Inventory Methodology,” March 30, 2010. For C1 and C2 marine diesel engines, the emission estimates were consistent with the 2011 Locomotive and Marine federal rulemaking. EPA derived hazardous air pollutant (HAP) estimates by applying toxic fractions to VOC or PM estimates. EPA then allocated these emissions to individual geographic information system GIS polygons using methods that varied by operating mode (namely, hoteling, maneuvering, reduced speed zone, and underway). The HAP emissions were estimated by applying speciation profiles to each polygon’s VOC and PM estimates. EPA allocated emissions estimates based on activity to GIS polygons representing port and waterway. GIS polygons allowed the estimation/allocation of emissions to defined port, waterway, and coastal areas. Detailed information about the reports and standards mentioned above can be found at:

<http://www.epa.gov/otaq/marine.htm>

Other nonroad sectors include small and large nonroad vehicles, gas and diesel-powered equipment and small engines. The emissions for these sectors are included in Tables 4a through 4e and are addressed in greater depth in Appendix C – Nonroad.

Tables 4a through 4e, below, summarize nonroad emissions for the five 2008 ozone NAAQS nonattainment areas in Pennsylvania. More detailed information about the nonroad source calculations and data is available in Appendix C – Nonroad Sources and the attachments 2011OzoneNonroadPA_Final and 2011NonroadPA_Final.

Table 4a: 2011 Base Year SIP Nonroad Source Emission Inventories for the 2008 Allentown-Bethlehem-Easton Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Carbon	1.2092	0.5794	6.8533	537.5024	186.4554	2,661.2617
Lehigh	3.6203	4.5180	46.4310	1,194.2887	1,247.6999	14,614.8129
Northampton	2.5197	3.3942	27.9140	892.9837	938.0606	9,029.5980
Total Emissions	7.3491	8.4916	81.1983	2,624.7749	2,372.2160	26,305.6727

**Table 4b: 2011 Base Year SIP Nonroad Source Emission Inventories for the
2008 Lancaster Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Lancaster	9.4751	8.1193	75.9137	3,854.6239	2,369.2314	26,064.9100

**Table 4c: 2011 Base Year SIP Nonroad Source Emission Inventories for the
2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE
Marginal Ozone Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Bucks	9.0837	7.6606	108.3284	3,205.5380	2,195.8430	34,395.2421
Chester	7.8808	8.0402	91.2893	2,646.1774	2,214.0913	28,833.2252
Delaware	5.0496	3.8635	60.9033	1,787.9662	1,123.9599	19,726.4341
Montgomery	12.6621	10.9024	157.6694	4,210.9276	3,076.2155	49,706.1548
Philadelphia	7.1718	8.8151	92.2503	2,517.8232	2,480.0977	30,084.4134
Total Emissions	41.8480	39.2817	510.4407	14,368.4324	11,090.2074	162,745.4696

**Table 4d: 2011 Base Year SIP Nonroad Source Emission Inventories for the
2008 Pittsburgh-Beaver Valley Ozone Marginal Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Allegheny	11.0818	14.0995	150.0494	3780.4631	3920.9727	47,439.2469
Armstrong	1.1163	1.0249	7.2098	556.4988	324.6825	2,919.0644
Beaver	1.4161	1.4667	14.9056	619.0133	444.3476	5,327.7370
Butler	2.6465	2.7071	24.1933	1,005.7236	764.9593	8,019.1469
Fayette	0.2267	1.5438	14.0699	871.7555	450.9703	5,069.2035
Washington	1.9038	3.0690	23.0668	680.1811	8,55.8740	7,440.4472
Westmoreland	4.5865	3.8735	51.2470	1,767.5369	1,146.8913	17,283.9938
Total Emissions	24.8491	27.7845	284.7418	9,281.1724	7,908.6977	93,498.8397

**Table 4e: 2011 Base Year SIP Nonroad Source Emission Inventories for the
2008 Reading Ozone Marginal Nonattainment Area**

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Berks	4.5626	5.4649	46.8275	1,650.9746	1,528.6220	15,312.2966

5. Onroad Sources

Onroad or highway sources are motorized vehicles that are operated on public roadways. This source category includes passenger cars, motorcycles, minivans, sport-utility vehicles, light-duty trucks, heavy-duty trucks and buses, including emissions from parking areas.

The highway mobile source emission inventory was developed using available travel data and EPA's MOVES2010b emission model. The methodologies used to produce the emission data conform to the recommendations provided in EPA's technical guidance No. EPA-420-B-1--028, listed below. A mix of local data and national default (internal to MOVES2010b) data has been used for this SIP revision. Local data has been used for the primary data items that have a significant impact on emissions. The primary data items include:

- Vehicle miles of travel (VMT) by vehicle type.
- Average speed distribution.
- Vehicle type mixes.
- Source type population (for light-duty vehicles).
- Vehicle age distribution.
- Hourly distributions.
- Meteorology data.
- Inspection/Maintenance program.
- Fuel supply.

Most local data inputs to the analysis process reflect the latest planning assumptions based on 2011 data obtained from the Pennsylvania Department of Transportation's Bureau of Motor Vehicles, and other local and national sources. Newer data was available and was used for control strategies (such as Inspection/Maintenance programs), vehicle age distributions and fuel characteristics.

The analysis methodology is consistent with past statewide inventory efforts including the 2011 NEI submission. This includes the use of custom post processing software to calculate hourly speeds and prepare key traffic input files to the MOVES2010b emission model. A detailed methodology is provided in Appendix D.

Analysis Methodology

Guidance documents from EPA were used to develop the onroad emissions inventories. The guidance was followed in detail to obtain accurate and approvable results. The guidance documents include:

- *Policy Guidance on the Use of MOVES2010 and Subsequent Minor Revisions for State Implementation Plan Development, Transportation Conformity, and Other Purposes*, U.S. EPA Office of Transportation and Air Quality, EPA-420-B-12-010, April 2012.
- *Using MOVES to Prepare Emission Inventories in State Implementation Plans and Transportation Conformity: Technical Guidance for MOVES2010, 2010a and 2010b*. U.S. EPA Office of Transportation and Air Quality, EPA-420-B-12-028, April 2012.

- *Motor Vehicle Emission Simulator (MOVES) – User Guide for MOVES2010b*, U.S. EPA Office of Transportation and Air Quality, EPA-420-B-12-001b, June 2012.

Tables 5a through 5e, below, summarize highway source emissions for the five 2008 ozone NAAQS nonattainment areas in Pennsylvania. More detailed information about the onroad source calculations and data is available in Appendix D – Onroad Sources and the attachments OnRoad_2011_Julwkd_summary_Baker and Onroad_Table_Final_Baker.

Table 5a: 2011 Base Year SIP Highway Source Emission Inventories for the 2008 Allentown-Bethlehem-Easton Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Carbon	1.94	4.39	21.76	706.66	1,592.35	9,454.14
Lehigh	8.24	17.13	85.53	2,938.97	6,154.43	37,317.95
Northampton	7.00	14.04	65.30	2,524.35	5,086.83	30,028.04
Total Emissions	17.18	35.56	172.59	6169.98	12,833.61	76,800.13

Table 5b: 2011 Base Year SIP Highway Source Emission Inventories for the 2008 Lancaster Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Lancaster	11.99	24.42	121.03	4,233.63	8,879.12	52,716.37

Table 5c: 2011 Base Year SIP Highway Source Emission Inventories for the Pennsylvania Portion of the 2008 Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Bucks	11.47	22.55	119.86	4,120.01	8,292.77	49,954.81
Chester	9.29	20.29	102.86	3,309.73	7,413.67	41,456.81
Delaware	8.68	17.25	88.68	3,097.85	6,222.26	37,084.67
Montgomery	14.50	28.89	159.89	5,156.21	10,458.00	64,680.67
Philadelphia	16.63	34.40	160.42	5,814.04	11,482.34	66,678.77
Total Emissions	60.58	123.39	631.69	21,497.83	43,869.04	259,855.73

Table 5d: 2011 Base Year SIP Highway Source Emission Inventories for the 2008 Pittsburgh-Beaver Valley Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Allegheny	20.40	41.15	208.35	7,755.25	14,865.96	98,535.36
Armstrong	1.61	3.33	15.76	611.63	1,223.02	7,454.79
Beaver	3.22	6.45	32.45	1,232.52	2,365.83	15,550.01
Butler	4.44	9.64	46.20	1,672.83	3,527.63	21,200.51
Fayette	2.91	5.31	27.66	1,114.77	1,950.20	13,397.21
Washington	4.02	8.71	42.75	1,540.23	3,197.99	20,163.87
Westmoreland	6.95	14.26	73.47	2,657.30	5,229.77	34,579.73
Total Emissions	43.54	88.85	446.64	16584.53	32,360.40	210,881.48

Table 5e: 2011 Base Year SIP Highway Source Emission Inventories for the 2008 Reading Marginal Ozone Nonattainment Area

County	VOC (TPD)	NO _x (TPD)	CO (TPD)	VOC (TPY)	NO _x (TPY)	CO (TPY)
Berks	9.86	22.11	98.88	3,479.35	8,073.19	43,022.47

6. Quality Assurance Procedures

Several quality assurance checks were employed by DEP’s Bureau of Air Quality to address the data quality: reality/peer review checks, sample calculations, sensitivity analysis, and range checks. Robust data comparisons and range checks are built into the eFACTS database and were applied to point source data. Nonpoint and area source category data were also checked via peer review and range checks, and compared to the previous inventories. Point source data was compared to the previous year, and any difference of more than 10% was investigated and corrected if necessary. Nonpoint data was compared to the 2008 inventory, and similar corrections were made, if necessary. Independent review was conducted by knowledgeable staff to ensure that data, assumptions, and procedures are reasonable. The objective of these checks is to ensure accuracy, completeness, comparability, and the representative nature of the data. Whether methods, assumptions, and emissions estimates were reasonable was assessed by relying on reviewer expertise and comparing emissions estimates to other inventory efforts.

Sample calculations provide verification of values by replicating calculations. The benefit is to ensure that calculations are done correctly. Emissions calculations were duplicated to spot check the accuracy of the arithmetic and, therefore, the resulting emissions estimates. Priority was given to those categories identified as the largest emissions contributors. For nonroad and highway emissions estimates, sample calculations were not used as a quality assurance mechanism. Preparing sample calculations for these sectors was not possible since the emissions estimates were generated using EPA-approved models. Rather, these data were checked by comparing the results of similar modeling runs conducted by other agencies such as state air

agencies, state transportation agencies, or the Mid-Atlantic Regional Air Management Association, Inc. (MARAMA) to ensure the results included herein were reasonable.

Acronyms and Abbreviations

AERR	Air Emissions Reporting Requirements
AES	Air Emissions System
AIM	Architectural and Industrial Maintenance
AIMS	Air Information Management System
APU	Auxiliary Power Unit
AQTAC	Air Quality Technical Advisory Committee
BTU	British Thermal Units
CAA	Clean Air Act
CAIR	Clean Air Interstate Rule
CA LEV	California Low Emission Vehicle (Program)
CAP	Criteria Air Pollutant
CBP	County Business Patterns
CE	Control Efficiency
CO	Carbon Monoxide
DEP	Pennsylvania Department of Environmental Protection
EDMS	Emissions and Dispersion Modeling System
eFACTS	Environment Facility Application Compliance Tracking System
EGAS	Economic Growth Analysis System
EIA	Energy Information Administration
EIIP	Emission Inventory Improvement Program
EIS	Emission Inventory System
EMF	Emissions Modeling Framework
EPA	U.S. Environmental Protection Agency
ERTAC	Eastern Regional Technical Advisory Committee
FAA	Federal Aviation Administration
FIRE	Factor Information Retrieval
FMVCP	Federal Motor Vehicle Control Program
GSE	Ground Support Equipment
ICI	Industrial, Commercial and Institutional
IC	Internal Combustion
I/M	Inspection and Maintenance
LTO	Landing and Takeoff
MECS	Manufacturing Energy Consumption Survey
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standard
NAICS	North American Industrial Classification System
NLEV	National Low Emission Vehicle (Program)
NO _x	Oxides of Nitrogen
NSR	New Source Review
PM ₁₀	Particulate Matter Less Than 10 Microns in Diameter
PM _{2.5}	Particulate Matter Less Than 2.5 Microns in Diameter
ppb	Parts per Billion
ppm	Parts per Million
RACT	Reasonably Available Control Technology

RE	Rule Effectiveness
RP	Rule Penetration
SCC	Source Classification Code
SEDS	State Energy Data System
SIP	State Implementation Plan
SMOKE	Sparse Matrix Operator Kernel Emissions
SO _x	Oxides of Sulfur
TSD	Technical Support Document
TPD	Tons Per Day
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compound