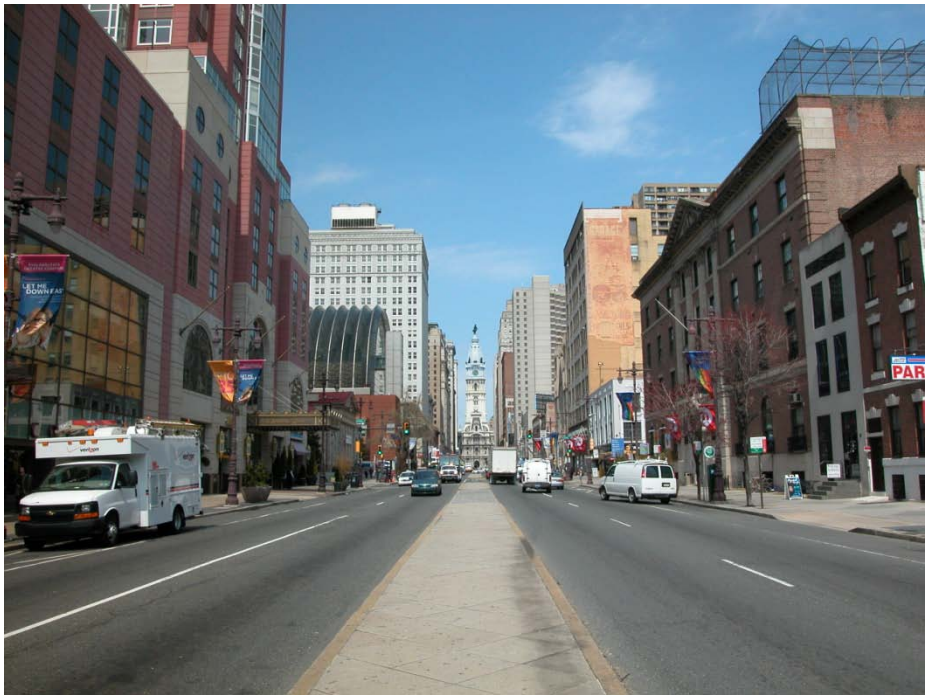
City of Philadelphia
Department of Public Health
Air Management Services

Philadelphia's Air Quality Report 2012



Executive Summary

This report focuses on the air quality of the City of Philadelphia, as presented by the Philadelphia Department of Public Health, Air Management Services (AMS), the local air pollution control agency for the City of Philadelphia. As an urban area, Philadelphia faces many of the same pollution challenges as other densely populated areas, such as emissions from vehicles and industries. The information contained in this report reviews Philadelphia's air quality for the year 2012, and reports how the City's air compared with the National Ambient Air Quality Standards (NAAQS). This report covers the following criteria pollutants: **ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter,** and **lead**. It also provides an overview of **Hazardous Air Pollutants,** also referred to as **air toxics**.

In general, trends show many air pollutants in Philadelphia to be decreasing. In 2012, Philadelphia was considered to be in attainment for all pollutants, with the exception of ozone and particulate matter that is less than 2.5 microns in diameter. There were 81 good days, 265 moderate days, and 20 unhealthy days in Philadelphia. In addition, air toxics that were measured in Philadelphia that showed an excess lifetime cancer risk of more than one in a million were: **1,1,2,2-tetrachloroethane, 1,2-dibromoethane, 1,2-dichloroethane, 1,3-butadiene, 1,4-dichlorobenzene, acetaldehyde, acrylonitrile, benzene, carbon tetrachloride, chloroform, and formaldehyde**.

For further information, please visit the Air Management Services website at:
http://www.phila.gov/health/AirManagement/index.html

or contact us at:
215-685-7580

Michael A. Nutter, Mayor
Donald F. Schwarz, Deputy Mayor for Health and Opportunity and Health Commissioner

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Introduction

AMS is responsible for the prevention, abatement, and control of air pollution and air pollution nuisances, achieving and maintaining federal National Ambient Air Quality Standards (NAAQS) in Philadelphia, and protecting the health and quality of life of the Philadelphia community from the adverse effects of air contaminants and noise.

AMS implements the environmental protection mandates contained in city, state, and federal laws, reviews construction and operating permits for compliance with air standards and guidelines, operates and maintains a citywide air sampling network to continuously monitor Philadelphia's air, routinely inspects pollution sources, services citywide complaints of air pollution, asbestos, and noise, issues violations, conducts enforcement actions, and advances voluntary emissions reductions.

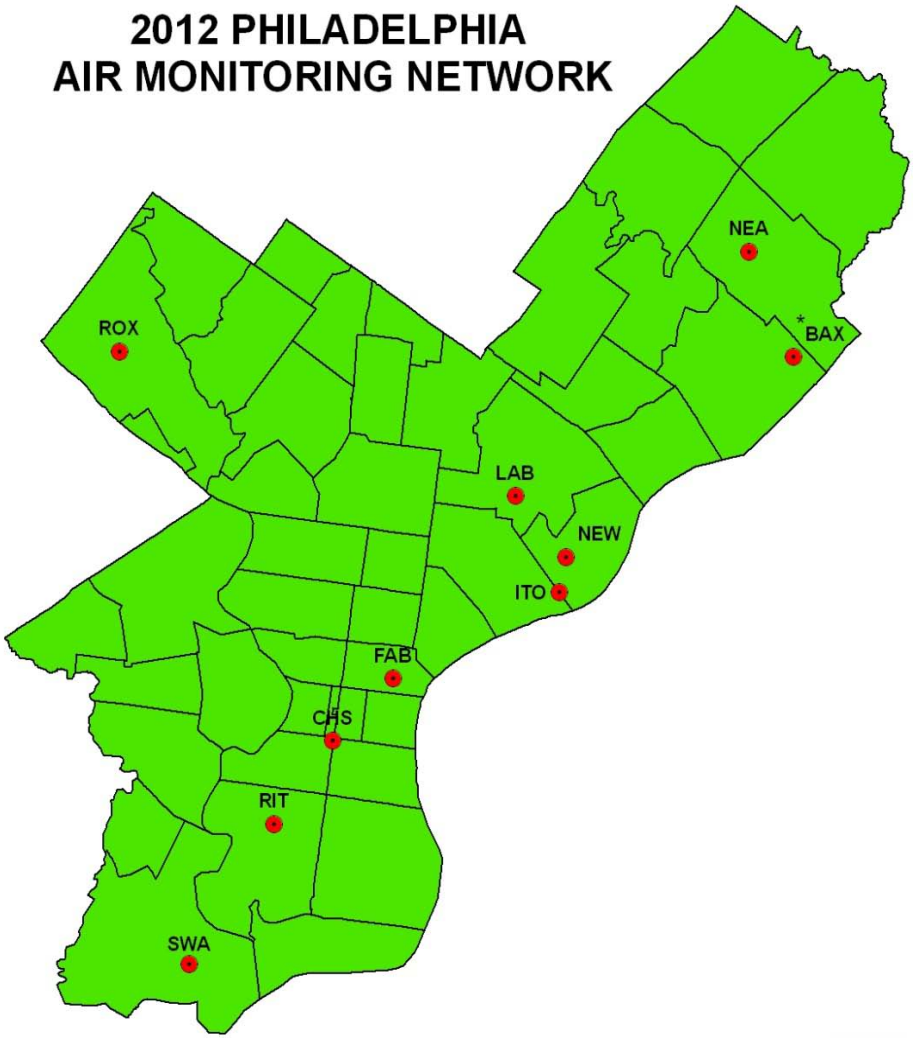
Air Monitoring Network

The City of Philadelphia is served by a network of ten air monitoring sites located throughout the City that measure the criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM_{10} and $PM_{2.5}$), and lead (Pb). Five of the sites also measure toxics, such as 1,3-butadiene, benzene and carbon tetrachloride. Many of the measurements are made in "real time", meaning that the measurements show pollution levels as they occur, instead of after the fact. The map on page 6 shows the location of air monitors and the pollutants measured at each monitoring location. AMS measures air quality for several reasons:

- To ensure that long-term goals and targets to reduce levels of air pollution are being met.
- To provide information to the public as to how good or bad the air quality is in Philadelphia.
- To ensure attainment with standards set forth by the United States Environmental Protection Agency.

An annual air monitoring network plan (AMNP) has been made available to the public starting in the Year 2007 and the 2013-2014 AMNP is located on the AMS website: http://www.phila.gov/health/AirManagement/index.html.

Figure 1 - 2012 Philadelphia Air Monitoring Network



* NCore

3/27/2012

			Parameter																		
AQS Site Code	AMS Site	Address	CO	SO_2	Ozone	NO_2	NO	PM_{10} FEM	$PM_{2.5}$ FEM	Speciated $PM_{2.5}$ Analysis by EPA	$PM_{2.5}$ FRM	PM_{10} SSI (quartz filter)	PM Coarse	Metals Analysis by WV (TSP sampler with quartz filter)	TSP Lead	PAMS VOC	Carbonyls	Toxics TO14	BaP analysis by Allegheny County, PA	MET	AMS Site
421010004	LAB	1501 E. Lycoming	X	X	X	X	X		X			X		X		X	X	X			LAB
421010014	ROX	Eva & Dearnley												X			X	X			ROX
421010024	NEA	Grant & Ashton			X															X	NEA
421010047	CHS	500 S. Broad				X	X				X			X			X	X			CHS
421010048	NEW	3900 Richmond						X												X	NEW
421010449	ITO	Castor & Delaware										X							X		ITO
421010055	RIT	24th & Ritner		X						X	X			X			X	X		X	RIT
421010057	FAB	3rd & Spring Garden									X										FAB
421010063	SWA	8200 Enterprise												X			X	X			SWA
421011002	*BAX	5200 Pennypack	X	X	X		X		X	X			X		X					X	BAX

Table 1 - Site Summary Table

AMS Site	Address	Statement of Purpose
LAB	1501 E. Lycoming	Built in 1964, this monitor assesses the City's impact on ozone precursors and is a designated Photochemical Assessment Monitoring Station (PAMS) site. New monitoring methods are often evaluated on this site.
ROX	Eva & Dearnley	As a periphery site, this site is best for measuring ozone in the City, because ozone is not emitted directly but forms in the presence of heat and sunlight. The ROX monitor, which does not directly border any industrial sites or heavy congestion areas, is useful for understanding the impact of ozone on areas of the City that are upwind of pollution sources.
NEA	Grant & Ashton	As a periphery site, this site is best for measuring ozone in the City, because ozone is not emitted directly but forms in the presence of heat and sunlight. The NEA monitor, which does not directly border any industrial sites or heavy congestion areas, is useful for understanding the impact of ozone on areas of the City that are upwind of pollution sources.
CHS	500 S. Broad	This site measures the impact of street traffic and pollutants that are transported into Center City from outside the area.
NEW	3900 Richmond	These sites were originally established to measure the impact of specific industrial facilities which are now closed. Today, the monitors conduct continuous particulate monitoring and provide information about the nearby wastewater treatment plant.
ITO	Castor & Delaware	This site was also established originally to measure the impact of industrial plants which are now defunct. Monitoring of lead, however, continues at this site.
RIT	24th & Ritner	This site was selected to help assess the impact of the petroleum refinery on the local community. The area was identified by air quality modeling.
FAB	3rd & Spring Garden	This site was established to monitor high levels of fine particulates in the City based on EPA Region III's air quality modeling of air toxics in Philadelphia. It shows high levels of fine particulate created by vehicle traffic.
SWA	8200 Enterprise	This site was established to measure toxics, carbonyls, and metals. Fine particulates may also be monitored. EPA Region III modeling analysis has shown that areas near the airport have high levels of aldehydes.
BAX	5200 Pennypack	This site was established as the NCore multi-pollutant station, one of 70 in the national network. NCore parameter requirements include measurements of $PM_{2.5}$, speciation, continuous mass, coarse particles ($PM_{10-2.5}$), O_3, trace levels of CO, SO_2, NO, and NO_y, and surface meteorology including wind speed and direction, temperature, and relative humidity.

Quality Assurance

The AMS Air Monitoring Laboratory's main responsibility is to provide accurate data on the quality of the City's air. Consequently, much effort is spent to achieve this objective. The measurement of pollutants in the atmosphere is being done to answer a number of questions such as:

- Are the National Ambient Air Quality Standards (NAAQS) being met in Philadelphia?
- How close or far away are we from meeting these standards?
- Which pollutants are getting worse (increasing in concentration) or improving?

Many of our measurements require detecting very small amounts of a pollutant, often expressed as parts per million (ppm) or parts per billion (ppb). An illustration: imagine a million yellow balls all the same size with several red balls in the middle of them; we would need to find those red balls and then be able to count them. The instruments used to measure air pollutants need to be reliable in identifying the pollutant and accurate in making the measurement every time. The main way we check to see if our instruments are giving accurate measurements is to send a sample of air which has a known amount (concentration) of a pollutant and compare what the instrument says is the concentration to what we know is the right concentration. Then adjustments (calibration) to an instrument can be made to give a better measurement. If the equipment is off by a significant margin, the instrument needs to be repaired or replaced. The Environmental Protection Agency (EPA) and our Laboratory have standard operating procedures on how accurate and reliable measurements need to be to answer the questions being asked. The instruments being used now are much more reliable than those available years ago. Steps to assure good data quality include:

- Automated calibration.
- Manual calibration conducted by chemists.
- Review of the data by an experienced engineer or scientist.

The system is geared towards public safety; for example, a few measurements can be enough to identify a problem in meeting the NAAQS, but many good measurements over a period of time (often three years) as well as additional types of analysis are needed to "demonstrate compliance" with the corresponding pollutant's standard on the NAAQS.

Air Quality Index

The Air Quality Index (AQI) is a color coding system for air quality used by government agencies across the United States. Media outlets disseminate air quality reports using the AQI to help warn the public about day-to-day pollution problems. Air quality alerts are issued when pollution is rated as Orange (Unhealthy for Sensitive Groups), Red (Unhealthy) or Maroon (Very Unhealthy). Alerts are more likely to occur in the summer months as described on pages 13-15, but can happen any time of the year.

The AQI is needed to report pollutant levels based on five criteria air pollutants: ground-level ozone, particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Using formulas created by the EPA, data for each pollutant is converted into a score ranging from 1 to 500. A level of 100 generally corresponds to the National Ambient Air Quality Standard for each pollutant, and an “Action Day” occurs when the AQI for any pollutant exceeds 100. On these days, the public is advised to do their part to reduce pollution and take precautions to protect themselves and their families from health effects. For example, on an Orange day, or Unhealthy for Sensitive Groups day, children, seniors and those with respiratory ailments are advised to minimize prolonged outdoor exposure. On a Red/Purple day, or Unhealthy day, all residents are advised to limit outdoor activity. Red and purple days are uncommon. The highest of the five pollutant scores is reported as the overall air quality rating for Philadelphia for a given day. That is, any individual pollutant can, on its own, trigger an Action Day. Action Days are reported through print, radio and television media and by local and regional air agencies.

Philadelphia's Real-Time Air Quality Website is located at www.phila.gov/aqi and provides the most up-to-date information about the air quality in Philadelphia. It lets you know what you should do to protect your health if the air quality is unhealthy.

Figure 2 on the next page shows the AQI summaries, as used by media outlets. The recommended actions that individuals should take to protect their health and plan their daily activities are described below the index.

Figure 2 - Color Coded Air Quality Index (AQI)

Air Quality Index (AQI) Values	Levels of Health Concern	Colors
When the AQI is in this range:	...air quality conditions are:	...as symbolized by this color:
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301 to 500	Hazardous	Maroon

"Good" The AQI value is between 0 and 50. Air quality is considered satisfactory, and air pollution poses little or no risk.
"Moderate" The AQI is between 51 and 100. Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people. For example, people who are unusually sensitive to ozone may experience respiratory symptoms.
"Unhealthy for Sensitive Groups" When AQI values are between 101 and 150, members of sensitive groups may experience health effects. This means they are likely to be affected at lower levels than the general public. For example, people with lung disease are at greater risk from exposure to ozone, while people with either lung disease or heart disease are at greater risk from exposure to particle pollution. The general public is not likely to be affected when the AQI is in this range.
"Unhealthy" Everyone may begin to experience health effects when AQI values are between 151 and 200. Members of sensitive groups may experience more serious health effects.
"Very Unhealthy" AQI values between 201 and 300 trigger a health alert, meaning everyone may experience more serious health effects.
"Hazardous" AQI values over 300 trigger health warnings of emergency conditions. The entire population is more likely to be affected.

Figure 3 below shows the annual summary of the number of good, moderate, and unhealthy air quality days in Philadelphia based on monitoring conducted by AMS since 1990.

Figure 3 - Philadelphia Annual AQI Summary Standardized by Current EPA Breakpoints

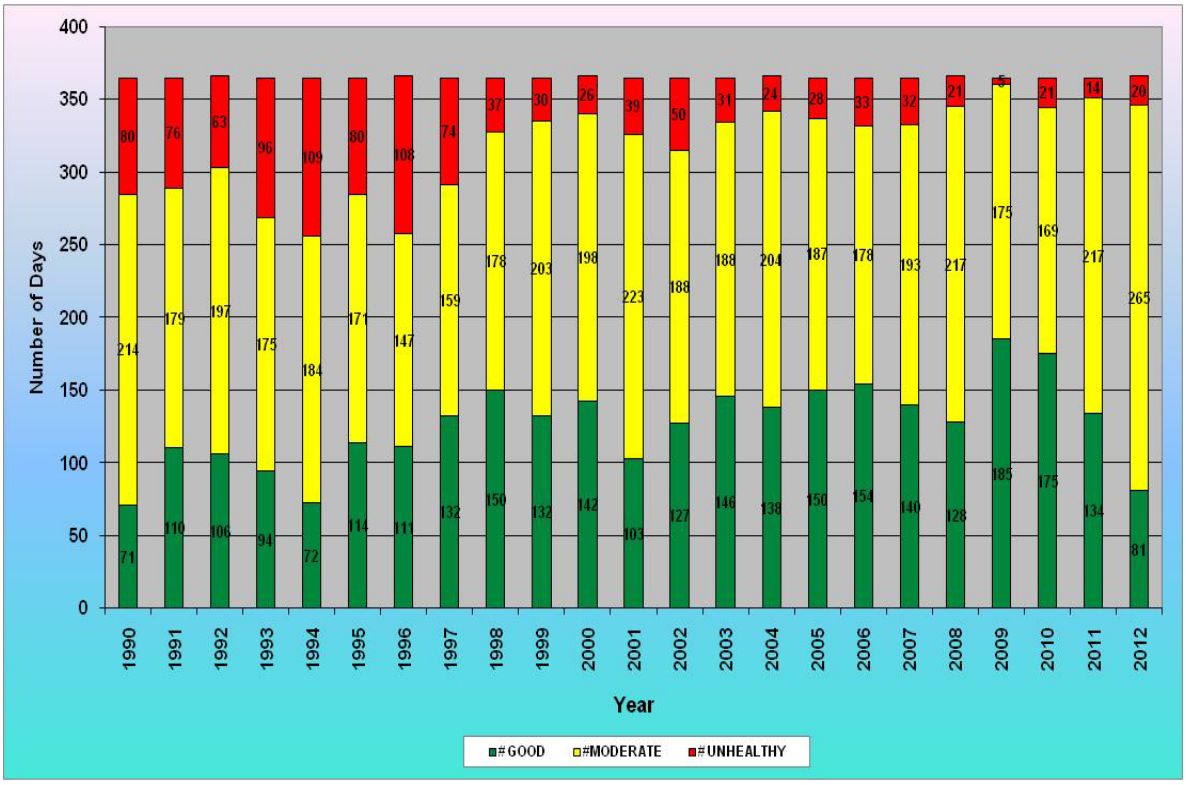


Figure 3 has been standardized with the current EPA AQI breakpoints or pollutant concentration cut-offs. Stricter standards have periodically gone into effect, including the 2008 NAAQS for ozone and the 2012 annual NAAQS for $PM_{2.5}$. The 8-hour standard (rolling average of eight hourly concentrations) for ozone was revised in 2008 to 0.075 ppm from 0.08 ppm and the annual standard for $PM_{2.5}$ was revised in 2012 to 12 micrograms per cubic meter ($\mu g/m^3$) from 15 micrograms per cubic meter ($\mu g/m^3$).

National Ambient Air Quality Standards

The Clean Air Act of 1970 empowered the Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public health and welfare. Since that time, standards have been set for: carbon monoxide, sulfur dioxide, nitrogen dioxide, lead, particulate matter ("dust" or "soot") and ozone. The NAAQS is expressed as a pollutant concentration averaged over a fixed amount of time. For example, the NAAQS for carbon monoxide (CO) is:

- Nine parts of carbon monoxide per million parts of air averaged over a time period of eight hours.

In 2012, Philadelphia was considered to be in attainment for all pollutants, with the exception of ozone and particulate matter less than 2.5 micrometers in diameter.

The Pollutants We Measure

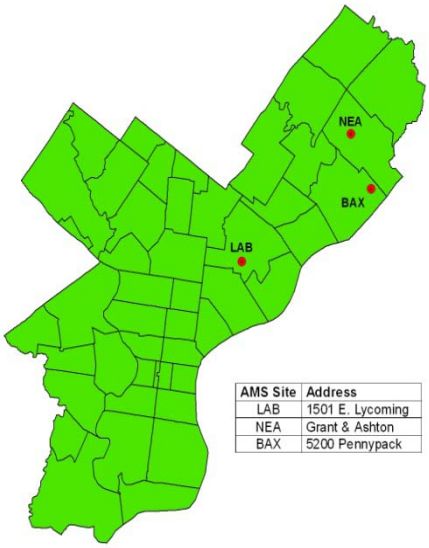
Pages 13-38 provide information on the health effects, sources and trends of pollutants measured in Philadelphia. Included are the six pollutants—commonly called criteria pollutants—for which EPA has established National Ambient Air Quality Standards (NAAQS), as well as pollutants identified as being toxic or hazardous. Each of the criteria pollutants are graphed to show the historical trend compared with national standards. The graphs also identify the sites of the "worst" levels, the "best" levels, and with a solid circle, the mean of all recorded levels. It is important to note the mean, as it factors out extreme levels, and thereby provides a better indication of the average for air quality.

Ozone (O_3)

NAAQS:

- The 3-year average of the annual fourth-highest daily maximum 8-hour average O_3 concentration is less than or equal to 0.075 ppm.

Figure 4.1 - Ozone Monitoring Map



Ground level ozone (the primary constituent of smog) is the pollutant most often responsible for unhealthy air quality in the Philadelphia region. Ozone is not emitted into the atmosphere directly but is formed by chemical reactions between other pollutants. Volatile Organic Compounds (VOCs) and Nitrogen Oxides (NO_x) react to create ozone in the presence of heat and sunlight. Ozone levels are consistently higher during the summer months.

There are four categories of emission sources from human activity that produce VOC and NO_x. The four categories are: **Point sources** – the largest utilities, industries, and other operations; **Area Sources** – commercial, solvent use, waste disposal, and other categories; **Non-road Engine Sources** – construction and agricultural equipment, recreational boats, lawnmowers and other sources; **Highway Vehicle Sources** – cars, trucks, buses, and motorcycles. Emissions of VOC and NO_x may be carried by wind currents while reacting to produce high ozone levels hundreds of miles from their sources. In the eastern United States during the summer months, ground level ozone is frequently high over wide areas containing several states. This phenomenon is caused by ozone and its precursors traveling via wind currents across great distances.

Unlike the oxygen that we breathe, which has only two atoms of oxygen (O_2), ozone (O_3) has an additional unstable oxygen atom, making it very reactive. This is why ozone is said to burn or irritate the lungs. People who are very young or very old, or who have chronic lung problems such as asthma are particularly sensitive to ground level ozone, or smog. In the lower atmosphere, free radicals (molecules with unpaired electrons) are produced by the chemical reaction of nitrogen dioxide (NO_2) to give an oxygen (O_2) atom and nitric oxide (NO), which contributes to ozone formation or smog.

In any discussion of ozone, it is important to distinguish between the effects of ozone at the ground and ozone high in the atmosphere, several miles above our heads. An advertisement might use the slogan “good up high, bad nearby,” to describe ozone.

Regardless of where it is, no one would want to breathe it. However, up high in what's called the ozone layer, ozone is essential to the health of nearly every living thing, since it protects the Earth from harmful ultraviolet (UV) light. If not for this natural layer, UV light would sterilize the Earth's surface, and life as we know it would cease to exist.

Near the ground, ozone reacts with buildings, plants, animals, and people, and is one of the most irritating, harmful components of smog. Smog refers to the whole mixture of air pollution in an area, and may include ozone, a whole host of other gases, as well as fine particles and the hazy conditions they cause.

VOCs are organic (i.e. carbon-containing) compounds that evaporate readily, such as gasoline vapors and paint fumes. NO_x stands for two compounds, nitric oxide (NO) and nitrogen dioxide (NO_2). VOCs that come from human activities are called anthropogenic VOCs. Some anthropogenic VOCs, such as benzene, are themselves toxic and may increase risks of cancer or lead to other adverse health effects in addition to helping form ozone. Some VOCs are considerably more reactive in the atmosphere than others, and the reactivity of a VOC influences how quickly ozone forms. A compound that reacts in a few minutes to produce ozone will have a much greater impact near its source than one that reacts more slowly. Thus, ozone can form at various distances downwind of a VOC source due to the speed of these chemical reactions.

On July 18, 1997, the EPA promulgated a revision to the National Ambient Air Quality Standard for ozone which came into effect on July 1, 1999. Previously, the standard was based on the number of times that the daily maximum hourly ozone concentration was greater than 0.12 parts per million (ppm) over a 3-year period. The revised NAAQS is based on an 8-hour average ozone concentration. EPA revoked the 1-hour standard on June 15, 2005. The latest ozone standard of 0.075 ppm for the 8-hour average ozone concentration has been effective since May 27, 2008. This standard replaced the 1997 standard of 0.08 ppm.

In 2012, Philadelphia and the surrounding counties were in nonattainment for the 8-hour ozone standard. This means that the standard set by the EPA for ozone was exceeded, and in fact in 2012 there were nineteen days when air pollution exceeded federal standards. AMS, along with other local and regional air quality agencies, continues to work towards compliance with ozone standards.

A State Implementation Plan (SIP) is a plan which identifies how a state will attain the standard. Each state is required to have a SIP which contains control measures and strategies that demonstrate how each area will attain and maintain the NAAQS. These plans are developed through a public process, formally adopted by the state, and submitted by the Governor's designee to the EPA.

Currently, as seen in Figure 4.1, there are three ozone monitoring sites: LAB, NEA and BAX.

Figure 4.2 shows the trends for the ozone 8-hour concentration in Philadelphia.

Figure 4.2 - Ozone Trends (Minimum, Maximum, Average) for the 4th Highest Daily Maximum 8-Hour Average Concentration

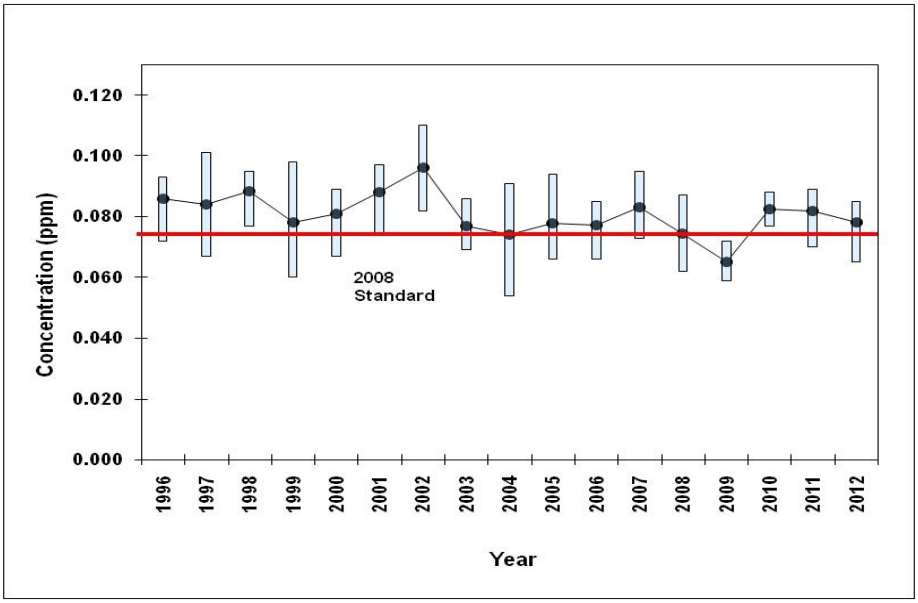
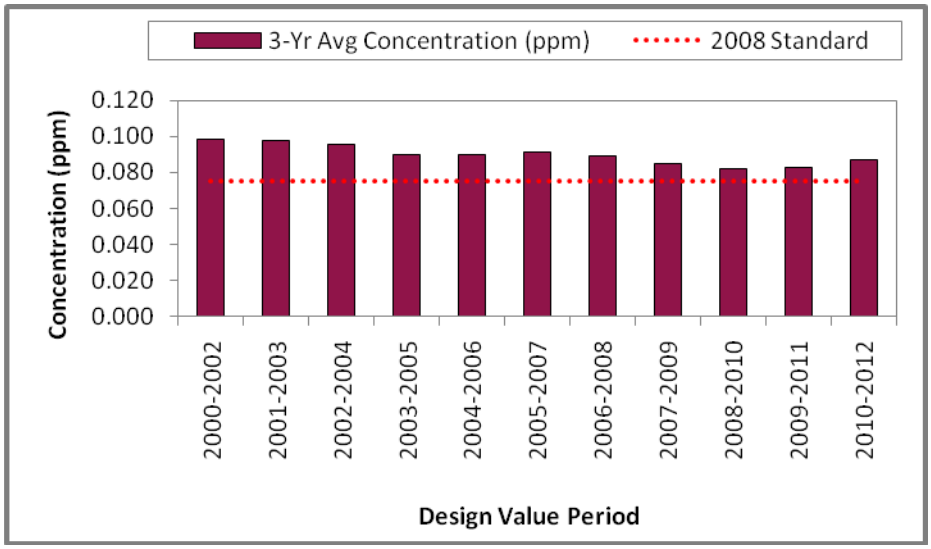


Figure 4.3 - Ozone 8-Hour Design Value for NEA Monitoring Site (AQS ID 421010024)

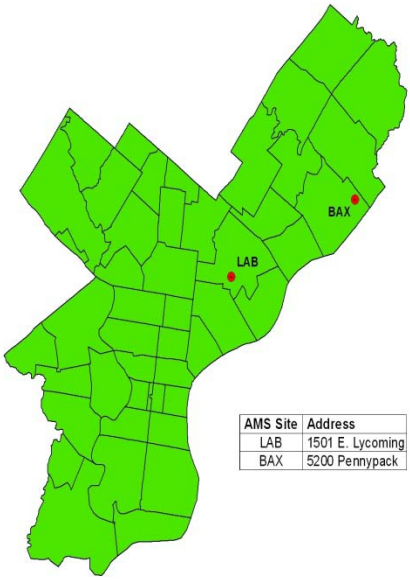


Carbon Monoxide (CO)

NAAQS:

- 9 parts per million for an 8-hour average concentration (2nd highest) not to be exceeded more than once per year.
- 35 parts per million for a 1-hour average concentration not to be exceeded more than once per year.

Figure 5.1 - CO Monitoring Map



Carbon monoxide (CO) is colorless, odorless, and at high concentrations is a poisonous gas. It is formed when carbon in fuels are not burned completely. The major source of CO is motor vehicle emissions. Other sources of CO include residential, industrial, and natural processes. Weather greatly affects CO levels, and peak CO concentrations typically occur during the colder months of the year.

Carbon monoxide enters the bloodstream and reduces oxygen delivery to the body's organs and tissues. The health threat from carbon monoxide is most serious for those who suffer from cardiovascular disease. Exposure to elevated CO levels is associated with impairment of vision, reduced work capacity, reduced manual dexterity, poor learning ability, and difficulty in performing complex tasks. At very high levels, carbon monoxide can be fatal.

Over a twenty year period, there has been a continued reduction in carbon monoxide levels. This is mainly the result of federal requirements for cleaner automobiles and fuel and state inspection/maintenance programs. Currently, the LAB is operating as the monitoring site for CO. The BAX site NCore station is also monitoring CO for its trace level.

Figure 5.2 and 5.3, on the following page, show the trends for the CO 8-hour concentration and 1-hour concentration, respectively, in Philadelphia.

Figure 5.2 - CO Trends (Minimum, Maximum, Average) for the 2nd Highest 8-Hour Average Concentration

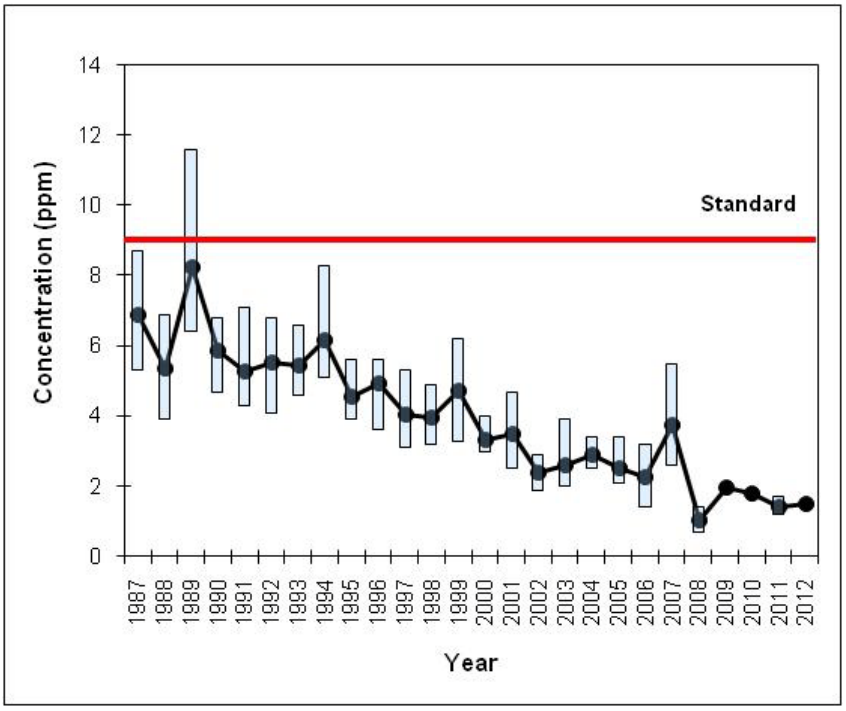
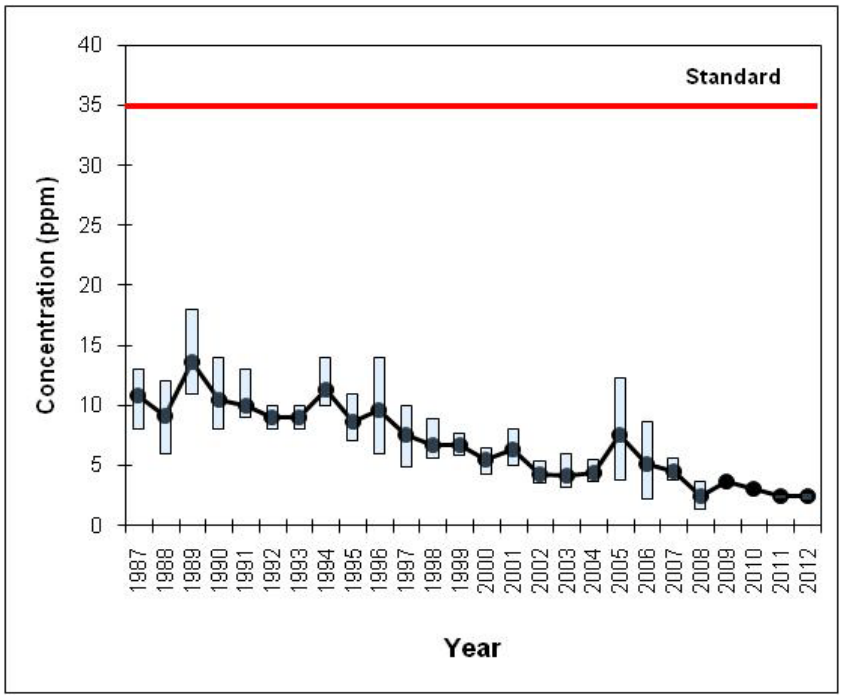


Figure 5.3 - CO Trends (Minimum, Maximum, Average) for the Highest 1-Hour Average Concentration

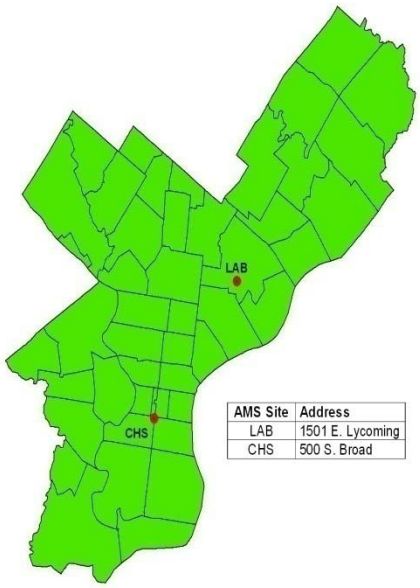


Nitrogen Dioxide (NO_2)

NAAQS:

- The annual average concentration is less than or equal to 53 ppb.
- The 3-year average of the annual 98th percentile of the daily maximum 1-hour average concentration is less than or equal to 100 ppb.

Figure 6.1 - NO_2 Monitoring Map



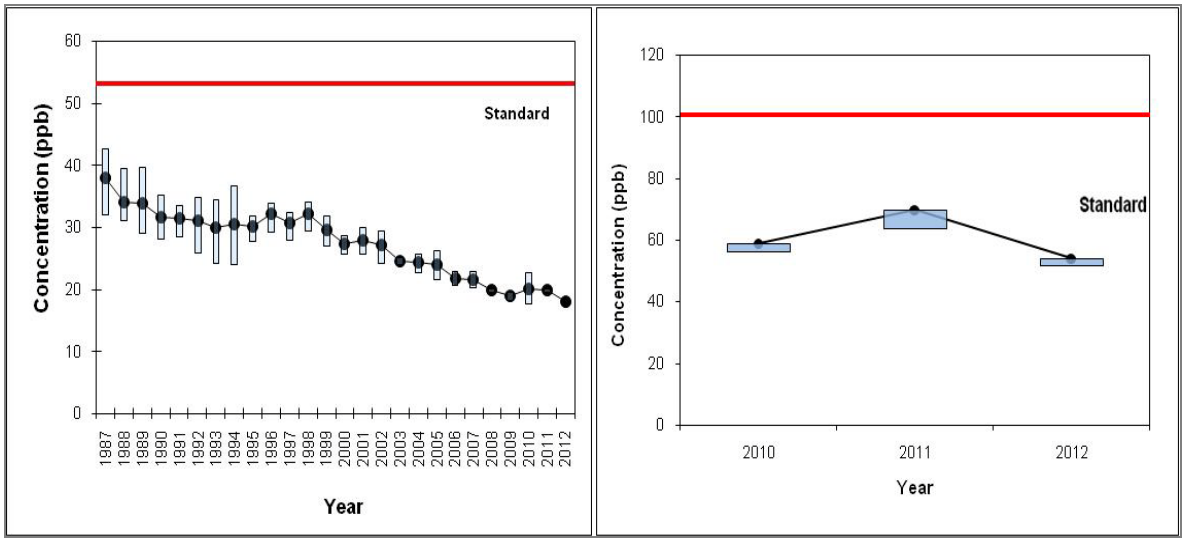
Nitrogen dioxide is a light brown gas that is an important component of urban haze. The compound is created primarily from fuel combustion in motor vehicles, utilities, and industrial sources.

Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. Nitrogen oxides (NO_X) are an important precursor to both ozone and acid rain and can affect both land and water ecosystems. They contribute to the formation of fine particulate matter, haze and reductions in visibility.

Ambient levels of nitrogen dioxide in Philadelphia are better than the NAAQS, showing a sustained downward trend over time.

On January 22, 2010, EPA added a one-hour standard of 100 ppb for Nitrogen Dioxide (NO_2).

Figure 6.2 - NO_2 Trends (Minimum, Maximum, Average) for Annual Concentration (Left) and 98th Percentile Daily Maximum 1-Hour Average Concentration (Right)

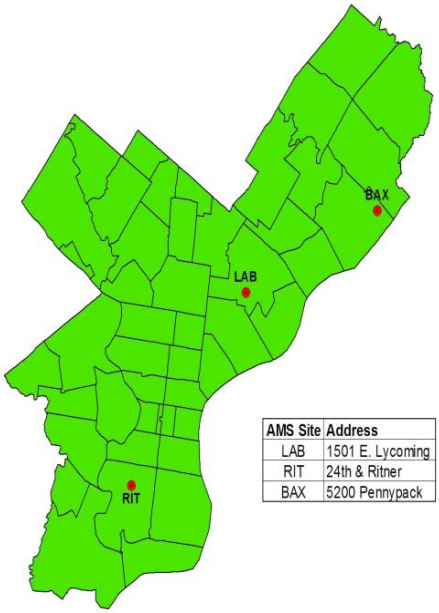


Sulfur Dioxide (SO_2)

NAAQS:

- The 3-year average of the annual 99th percentile of the daily maximum 1-hour average concentrations is less than or equal to 75 ppb.

Figure 7.1 - SO_2 Monitoring Map



SO_2 is emitted from the burning of fuels that contain sulfur. Industrial grade fuel oils are the primary source in Philadelphia.

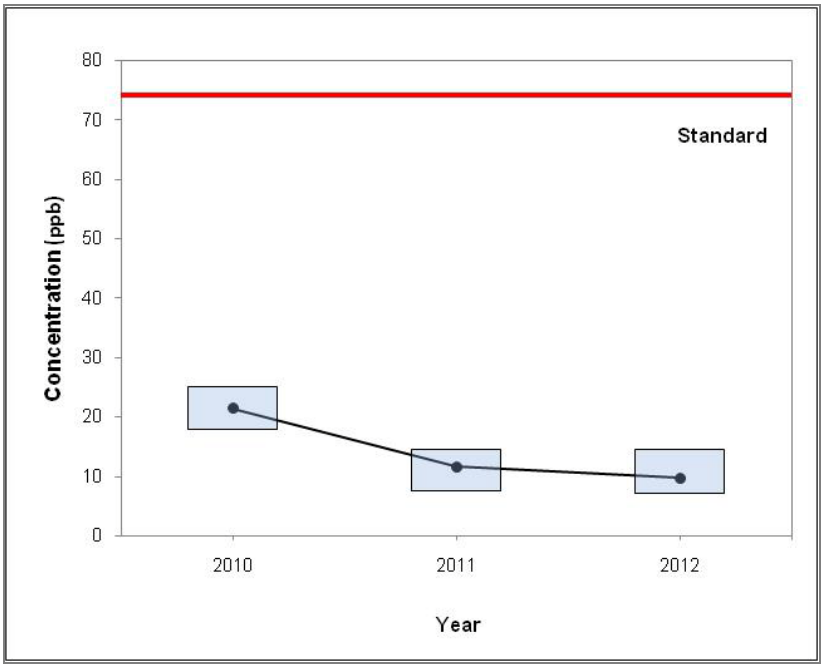
The major health concerns associated with exposure to high concentrations of SO_2 include effects on breathing, respiratory illness, alterations in the lungs' defenses, and aggravation of existing respiratory and cardiovascular disease. Together, SO_2 and NO_X are the major ingredients of acid rain. SO_2 also plays a significant role in the formation of fine particulate matter.

SO_2 levels are well within air quality standards and show a slow, continued improvement over time. This is mainly due to industry, businesses, and homes changing to fuels with lower sulfur content such as natural gas.

Currently, LAB, RIT and BAX sites are operating as the monitoring sites for SO_2 as seen in Figure 7.1. The BAX site is monitoring trace level of SO_2.

The following graph, Figure 7.2 shows the trends for the one-hour SO_2 concentration for Philadelphia.

Figure 7.2 - SO_2 Trends (Minimum, Maximum, Average) for 99th Percentile Daily Maximum 1-Hour Average Concentration

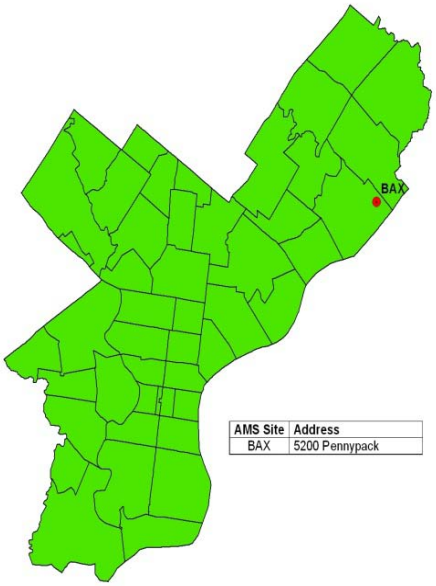


Lead (Pb)

NAAQS:

- The maximum arithmetic rolling 3-month mean concentration for a 3-year period is less than or equal to 0.15 µg/m^3 micrograms per cubic meter.

Figure 8.1 - Lead Monitoring Map



The processing of metals is the major source of lead emissions to the atmosphere. Lead does not travel over great distances in the air and so concentrations vary, with the highest levels near specific industrial sites.

Lead is a metal that is highly toxic when inhaled or ingested. Lead accumulates in the blood, bone, and soft tissue and may affect the kidneys, liver, nervous system and other organs. It also can cause learning difficulties in children.

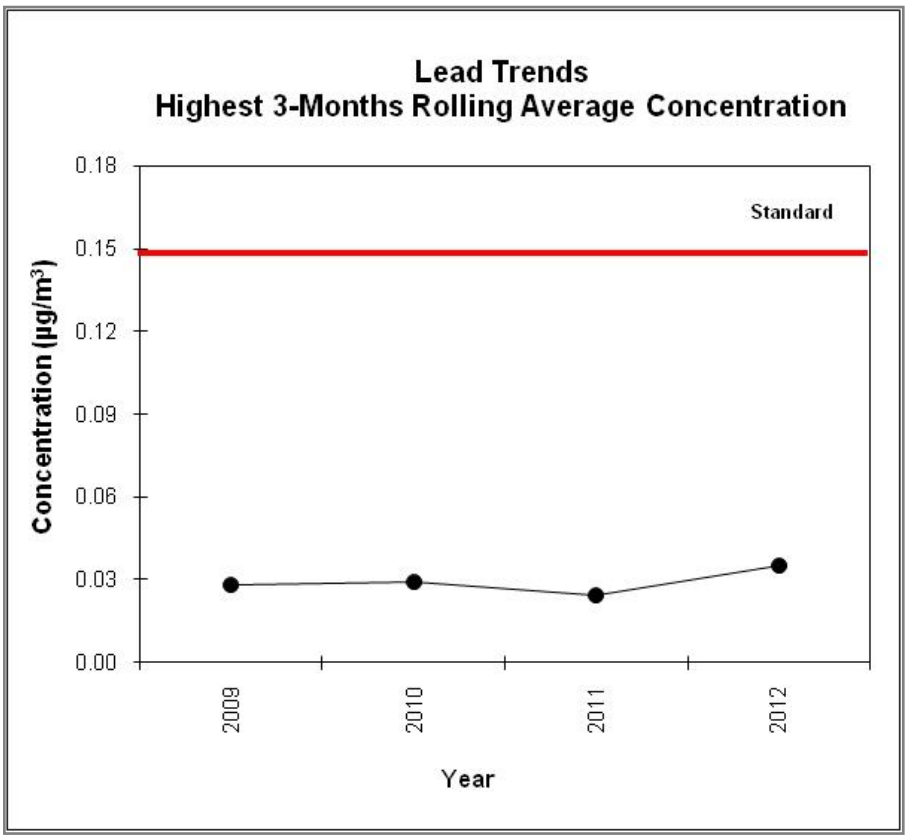
Ambient lead levels have been decreasing throughout the city due to the elimination of leaded gasoline and greater control of emissions from companies that produce or process lead compounds.

Lead levels in certain parts of the city were once extremely high due to the concentration of particular industries in the area, and this is reflected in the high readings for monitors near Castor and Delaware Avenues before 1998. The levels of lead in these areas have drastically improved, and are now comparable to the rest of the city.

On October 15, 2008, the EPA strengthened its regulation for lead. The standard was revised from the 1978 standard of 1.5 µg/m^3 to a level that is 10 times more stringent, 0.15 µg/m^3, with a different averaging time. For the previous standard, the averaging time used a quarterly average while the new standard uses a rolling 3-month average. The revision is based on more than 6000 studies performed since 1990 on the health effects of high lead concentrations in the bloodstream. The studies show that adverse effects from lead in the blood occur at a much lower level than previously thought.

There is no change in the status of attainment for Philadelphia regarding the new regulation. AMS used to measure for ambient lead at the historically highest location, ITO, but since January 1, 2011, AMS measures for ambient lead only at the NCore station, BAX.

Figure 8.2 - Lead Trends Maximum Rolling 3-Month Average (The 2008 Standard)



Particulate Matter (PM_{10}, $PM_{2.5}$)

Particulate matter is the general term used for a mixture of solid particles and liquid droplets found in the air. These particles come in a wide range of sizes and originate from stationary, mobile, and natural sources.

PM_{10} and $PM_{2.5}$ refer to small particulates that measure less than 10 micrometers (0.00001 meters) and 2.5 micrometers (0.0000025 meters) in diameter, respectively. In addition to health problems, particulate matter can cause reduced visibility, soiling, and damage to materials such as buildings. Particles of this size remain airborne for long periods of time and disperse in uniform concentrations across wide areas, crossing geographic boundaries.

In 1997, the EPA set a separate standard for $PM_{2.5}$. Particles in the $PM_{2.5}$ size range are able to travel deeply into the respiratory tract, reaching the lungs. Exposure to fine particles can cause short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Exposure to fine particles can also affect lung function and worsen medical conditions such as asthma and heart disease. Scientific studies have linked increases in daily $PM_{2.5}$ exposure with increased respiratory and cardiovascular hospital admissions, emergency department visits and deaths. Recent studies suggest that long term exposure to particulate matter may be associated with increased rates of bronchitis and reduced lung function.

Particles come in a wide variety of shapes and sizes, which affect their impacts on the environment and human health. Bigger particles, such as dust, are easier to see and can cause problems, but smaller particles are likely to be worse for our health.

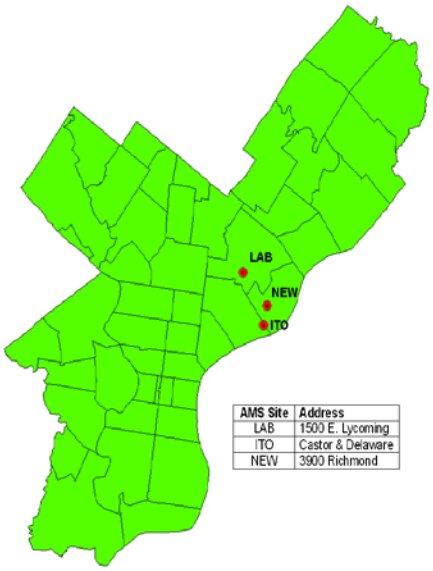
Fine particles are treated as though they are a single pollutant, but fine particles come from many different sources and are composed of thousands of different compounds. Fortunately, these compounds fall into a few dominant categories: sulfates, nitrates, ammonium compounds, soil, organic carbon compounds, and elemental carbon. Water is nearly always an important and variable part of PM, and sea salt is often significant near the coast. Given the complex composition of PM, it is no surprise that its chemistry is also complex. Particles may be dry or wet. When the wind blows hard enough, soil, silt, and sand can be lifted from the surface. Human activities such as mining, construction, plowing, and driving on unpaved roads, also lift particles into the air. Soot, also referred to as black carbon or elemental carbon, is emitted directly by diesel engines and forest fires, among other sources. Most individual particles are likely mixtures of different substances, the products of growing by collisions with other particles and by taking on gases.

PM_{10}

NAAQS:

- 150 µg/m^3 for a daily 24-hour average concentration not to be exceeded more than once per year on average over a 3-year period.

Figure 9.1 - PM_{10} Monitoring Map



Particulate matter levels have been decreasing due to regulations limiting the amount of emissions allowed and the change to cleaner fuels, for example, switching from oil to natural gas by industry, businesses and homes.

During the mid 1990s, particulate emissions from several sources in the area of Castor and Delaware Avenues caused extremely high localized measurements. In fact, the levels were many times higher than those measured at other city locations. Because the impact was not widespread, the additional charts are presented to highlight that fact. Specific actions to abate these sources have resulted in air quality that now meets the national standards and are now comparable to levels in the rest of the city.

The EPA has revoked the annual standard for PM_{10} since December 17, 2006 due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution.

Prior to 1998, a facility near Castor and Delaware Avenues called the Franklin Smelting and Refining Company (FS&R) generated significant dust from smelting activities. This facility has since shut down. The shutdown has improved air quality of the air in the area near the facility since that time. Currently, there are three PM_{10} monitoring sites: LAB, NEW and ITO.

On the following page, Figure 9.2 and Figure 9.3 show the trend for PM_{10} for its maximum 24-Hour concentrations for Areas Near and Excluding Castor and Delaware Avenues, respectively.

Figure 9.2 - PM_{10} Trends (Minimum, Maximum, Average) for the Highest 24-Hour Average Concentration for Areas Near Castor and Delaware Avenues

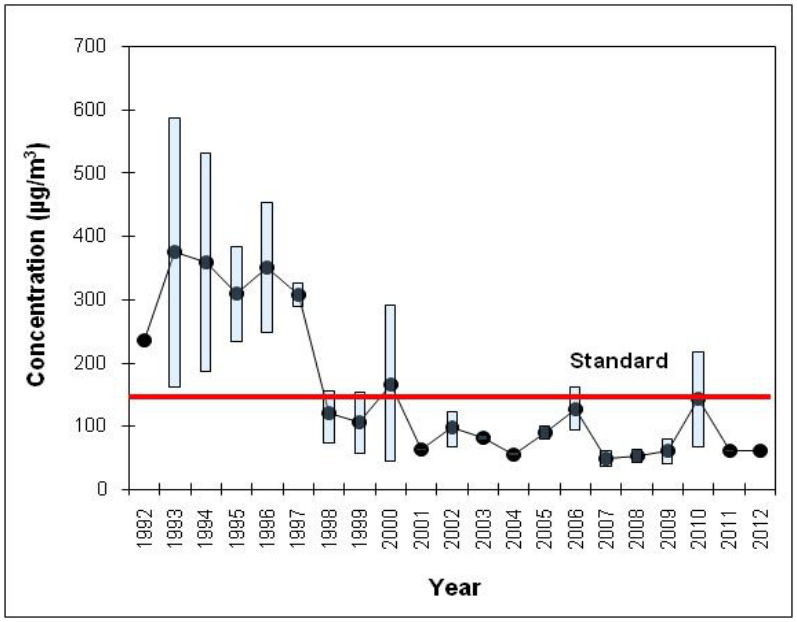
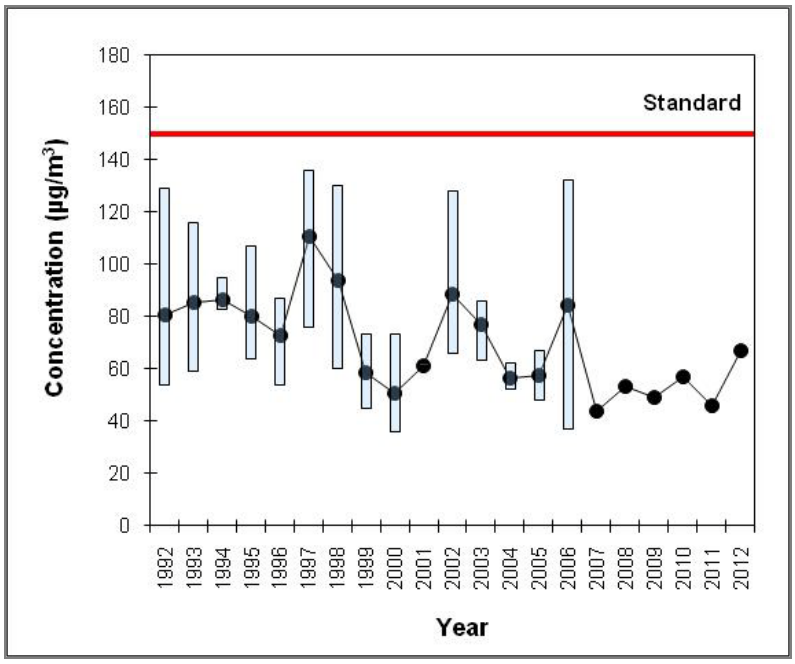


Figure 9.3 - PM_{10} Trends (Minimum, Maximum, Average) for the Highest 24-Hour Average Concentration for Areas Excluding Castor and Delaware Avenues

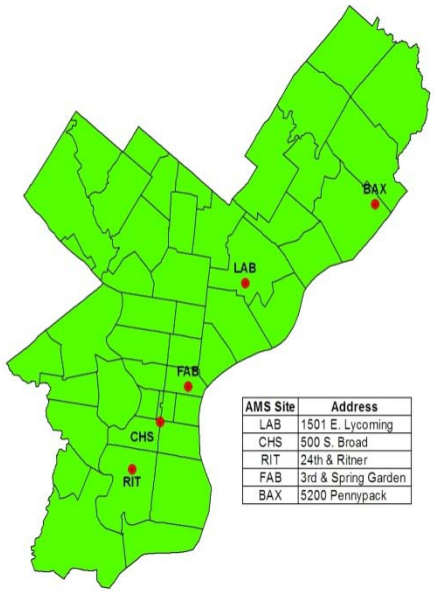


$PM_{2.5}$

NAAQS:

- The 3-year average of the annual arithmetic mean concentration is less than or equal to 15.0 µg/m^3.
- The 3-year average of the 98th percentile 24-hour concentration is less than or equal to 35 µg/m^3.

Figure 10.1 - $PM_{2.5}$ Monitoring Map



$PM_{2.5}$ consists of those particles that are less than 2.5 micrometers in diameter. They are also referred to as "fine" particles. Fine particles result from fuel combustion from motor vehicles, power generation, and industrial facilities, as well as from residential fireplaces and wood stoves. A significant amount of fine particles are also formed in the atmosphere by the transformation of gaseous emissions such as SO_2, NO_X, VOCs, and ammonia.

Fine particles can accumulate in the respiratory system and are associated with numerous health effects such as premature death, respiratory symptoms and disease, and decreased lung function. Sensitive groups that appear to be at the greatest risk for such effects include children, seniors, and individuals with cardiopulmonary disease or respiratory ailments such as asthma.

Revisions to the primary (health-based) NAAQS added two new $PM_{2.5}$ standards, set at 15 µg/m^3 (annual standard) and at 65 µg/m^3 (24-hour standard). The annual standard for $PM_{2.5}$ was revised in December 2012 to 12 micrograms per cubic meter (µg/m^3) from 15 micrograms per cubic meter (µg/m^3) but will not be implemented until March 2013.

On December 18, 2006 the 24-hour standard was strengthened to 35 µg/m^3. Measuring $PM_{2.5}$ requires highly sensitive equipment like special filters under tight temperature and humidity control. The charts on the next page show that the Philadelphia region is in nonattainment for the 24-hour standard of 35 µg/m^3 and is in attainment for the annual $PM_{2.5}$ standard. The design value is defined as the highest weighted annual average concentration at any monitoring site in Philadelphia. The 24-hour concentration is the highest concentration of 98th percentile values (EPA's standard) at any monitoring site in Philadelphia.

The FAB monitoring site located at 3rd and Spring Garden Streets, was established as an alternative to the CHS monitoring site which may be shut down in the near future.

The FAB site was selected to monitor $PM_{2.5}$ because it is in a high population area and is close to Interstate 95. The RIT site was established to study the impact of the Sunoco petroleum refinery on the local community. Currently, there are five $PM_{2.5}$ monitoring sites in the network: LAB, CHS, RIT, FAB and BAX (Figure 10.1).

Figure 10.2 is the design value for the CHS monitoring site. Historically, CHS site has monitored the highest $PM_{2.5}$ concentration throughout the City. However, since 2008, the design value for CHS site has been well below the NAAQS.

Figure 10.2 - $PM_{2.5}$ Annual Design Value for CHS Monitoring Site (421010047)

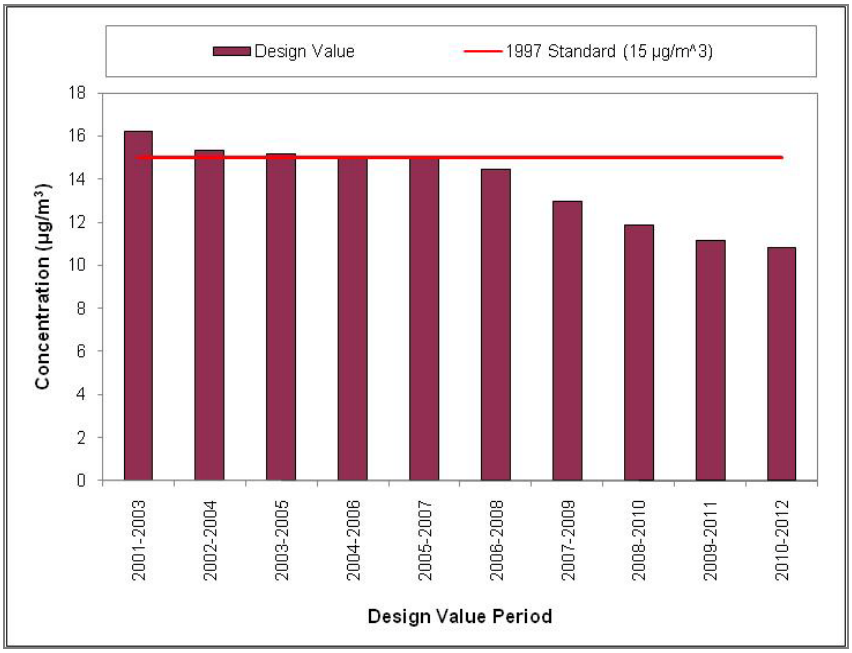
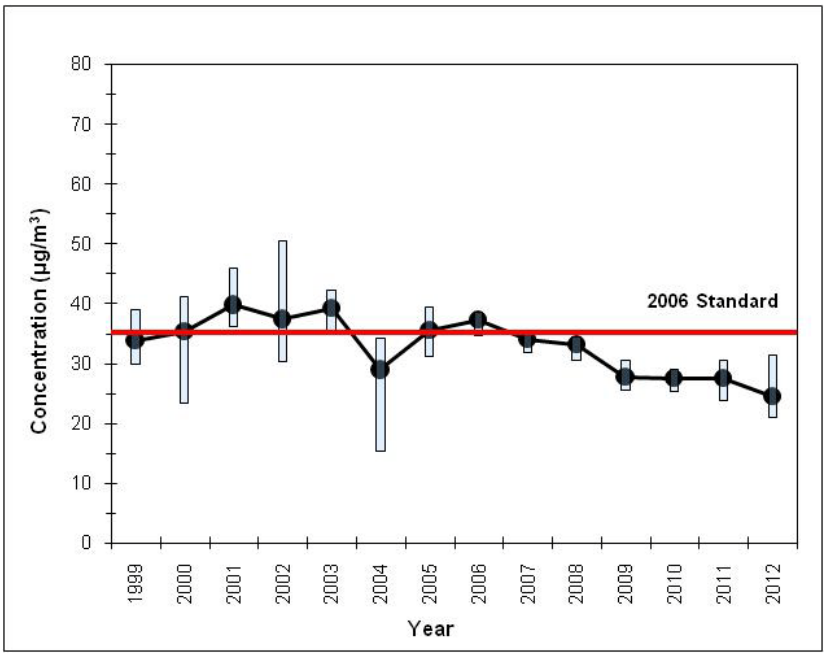
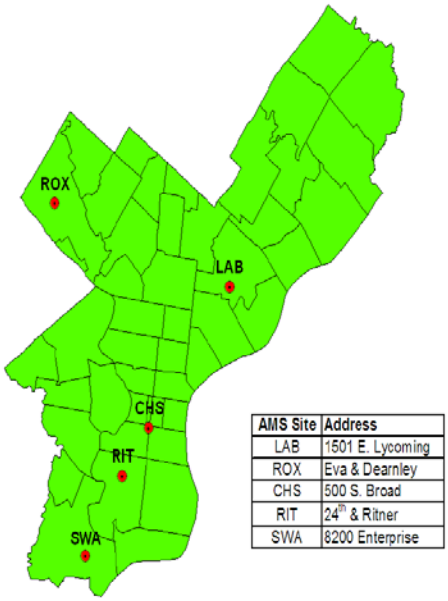


Figure 10.3 - $PM_{2.5}$ Trends (Minimum, Maximum, Average) for 98th Percentile 24-Hour Concentration



Air Toxics

Figure 11 - Air Toxics Monitoring Map



AMS Site	Address
LAB	1501 E. Lycoming
ROX	Eva & Dearnley
CHS	500 S. Broad
RIT	24th & Ritner
SWA	8200 Enterprise

Air toxics, also referred to as toxic air pollutants or hazardous air pollutants (HAPs), are substances that cause adverse health effects or environmental damage. The Federal Clean Air Act Amendments (CAAA) of 1990 list 187 pollutants or chemical groups as HAPs. Examples of air toxics include heavy metals (such as beryllium), organic chemicals (such as formaldehyde), polycyclic organic matter (POM, which are formed primarily by combustion), benzene (which is found in gasoline), pesticides, fine mineral fibers, and asbestos. HAPs are emitted from stationary sources (large industrial facilities), area sources (dry cleaners and household uses), as well as mobile sources (trucks and buses).

There is less information known about the health impact from the 187 HAPs than there are for criteria pollutants, and no national standards exist for them. However, a number of these pollutants are known or suspected to be carcinogenic, and there is no known “safe concentration.” The danger posed by toxics is often referred to in terms of risk. Risk is defined as the likelihood of a negative outcome from a certain level of a specific chemical, or the measure of a chance that health problems will occur. For example, many toxics cause cancer, while others cause respiratory problems, birth defects, neurological or immune response problems, and other health concerns. Toxics have varying degrees of danger, and some will cause harm with a very small amount of the substance while others require large amounts to have a negative effect. A cancer risk level of one in a million implies a likelihood that up to one person out of one million equally exposed people would contract cancer if exposed continuously (24 hours per day) to the specific concentration over 70 years (an assumed lifetime). This risk is calculated as additional to those cancer cases that would normally occur in an unexposed population of one million people.

AMS is helping to reduce HAPs in Philadelphia by enforcing Federal, State, and locally mandated programs that limit emissions from stationary and area sources. Many toxic emissions have been reduced by regulations designed to bring Philadelphia into compliance with the NAAQS for Ozone. In addition, Philadelphia enforces the National Emission Standards for Hazardous Air Pollutants (NESHAPs), a program designed to reduce emissions from existing major and area sources, as well as New Source Performance Standards (NSPS), which limit toxic emissions from new sources.

Since diesel emissions are a significant but unquantified contributing factor in determining health risks from toxic emissions, AMS continues working to promote voluntary emissions reductions from diesel vehicles and to bring clean diesel technology to the Philadelphia area. The Philadelphia Diesel Difference Working Group, a coalition of diverse stakeholders whose primary purpose is to reduce the air pollutants associated with diesel-powered engines in the greater Philadelphia area, meets on a monthly basis. More information on this program can be found at www.cleanair.org/program/transportation/diesel_campaign.

AMS has historically measured toxic pollutants at the Laboratory (LAB) and more recently at the Community Health Services (CHS), Southwest Airport (SWA), Roxborough (ROX), and Ritner (RIT) monitoring sites as seen on page 29.

As part of EPA's National Air Toxics Assessment (NATA) activities, 177 air pollutants were assessed for either lifetime cancer risk or non-cancer hazard due to inhalation. NATA is EPA's ongoing comprehensive evaluation of air toxics in the U.S. These activities include: expansion of air toxics monitoring, improving and periodically updating emission inventories, improving national- and local-scale modeling, continued research on health effects and exposures to both ambient and indoor air, and improvement of assessment tools.

The goal of NATA is to identify those air toxics which are of greatest potential concern, in terms of contribution to population risk. The results are used to establish strategies to reduce emissions and these set priorities or programs and the collection of additional air toxics data.

The assessment includes four steps that look at the year 2005, the latest year with a published NATA report:

1. Compiling a national emissions inventory of air toxics emissions from outdoor sources.
2. Estimating ambient concentrations of air toxics across the contiguous United States.
3. Estimating population exposures across the contiguous United States.
4. Characterizing potential public health risk due to inhalation of air toxics including both cancer and non-cancer effects.

The 2005 NATA identified certain health risks in the City. Philadelphia was ranked 87th in the country based on average total risk. To better understand the air toxic problem and promote actions to reduce the risks caused by these pollutants, the Philadelphia Air Toxic Project was initiated by EPA Region III and Air Management Services to develop a more accurate emissions inventory, develop modeling systems, identify sources, identify stakeholders and gather background information so a process can be developed to reduce emissions. Activities associated with the river ports and local airports appear to be significant sources of diesel particulate matter.

AMS has determined that there are health risks associated with the concentrations of air toxics measured at the City's air toxic monitoring sites. Annual averages for each of the compounds at each monitoring site were calculated and used to estimate the risk from inhalation exposure to ambient air for cancer and non-cancer health effects.

The risk calculation is based upon the standard method used by EPA. The excess lifetime cancer risk for each of the chemical compounds was calculated using unit risk factors (URFs). The URF is the measure of the probability of developing cancer from exposure over a lifetime to a specified concentration of a given chemical. Air toxics that are measured in Philadelphia that show an excess lifetime cancer risk of more than one in a million are:

1,1,2,2 –tetrachloroethane (Cas RN 79-34-5) – A colorless, dense liquid that does not burn easily. It is volatile and has a sweet odor. This chemical is no longer used much in the United States. It was once widely used as a solvent and as an intermediate in the production of other chemicals.
1,2-dibromoethane (Cas RN 106-93-4) – A colorless liquid with a sweet odor, used as pesticide and gasoline additive.
1,2-dichloroethane (Cas RN 107-06-2) – A colorless liquid with a chloroform-like odor. It is primarily used in the production of vinyl chloride and other chemicals.
1,3-butadiene (Cas RN 106-99-0) - A colorless, non-corrosive gas with a mild aromatic or gasoline-like odor, used primarily as a monomer to manufacture many different types of polymers and copolymers.
1,4-dichlorobenzene (Cas RN 106-46-7) – A colorless solid with strong odor, used mainly as fumigant and as a space deodorants for toilets. It is also used as intermediate in the production of other chemicals.
acetaldehyde (Cas RN 75-07-0) - A colorless liquid or gas with a fruity odor. It is used to manufacture many other chemicals.
acrylonitrile (Cas RN 107-13-1) – A colorless liquid that often appears yellow due to impurities, used primarily as a monomer to manufacture acrylic and modacrylic fibers. It also used as a raw materials in the manufacture of plastics.

benzene (Cas RN 71-43-2) - A colorless liquid with a pleasant odor. It is used mainly in making other chemicals and plastics, as a solvent, and is found in trace amounts of gasoline.
carbon tetrachloride (Cas RN 56-23-5) - A colorless liquid with an ether-like odor. It is used as a solvent and in making fire extinguishers, refrigerants, and aerosols.
chloroform (Cas RN 67-66-3) – A colorless, dense liquid with sweet odor. It is primarily used to manufacture other chemical. It is also used as common solvent in the laboratory. It was once used as anesthetic.
formaldehyde (Cas RN 50-00-0) - A colorless, flammable gas that has a distinct, pungent smell. It is used in the production of fertilizer, paper, plywood and urea-formaldehyde resins.

The measured ambient concentrations of these toxic pollutants through 2012 are shown by the graphs on the following pages (Figures 12 – 22)*. **Major** sources are large stationary sources such as refineries, power generating stations, and facilities with large boilers. **Area** sources are small stationary sources not included in the major source inventory such as dry cleaners and auto body shops. **On-road** sources are automobiles, trucks, etc. that operate on roads and highways. **Non-road** sources are equipment such as lawn & garden, construction, and airport support. If zero emissions are identified from major, area, on-road, and non-road sources, it is assumed all emissions are from background sources.

* Data were downloaded from AQS on September 16, 2013

Figure 12 - 1,1,2,2-Tetrachloroethane Average Concentration for Five Monitoring Sites

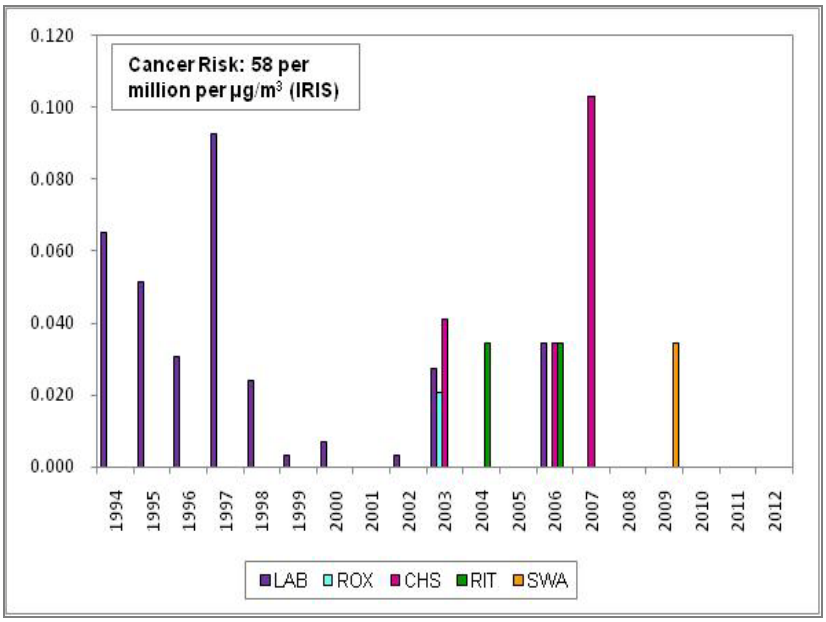


Figure 13 - 1,2-Dibromoethane Average Concentration for Five Monitoring Sites

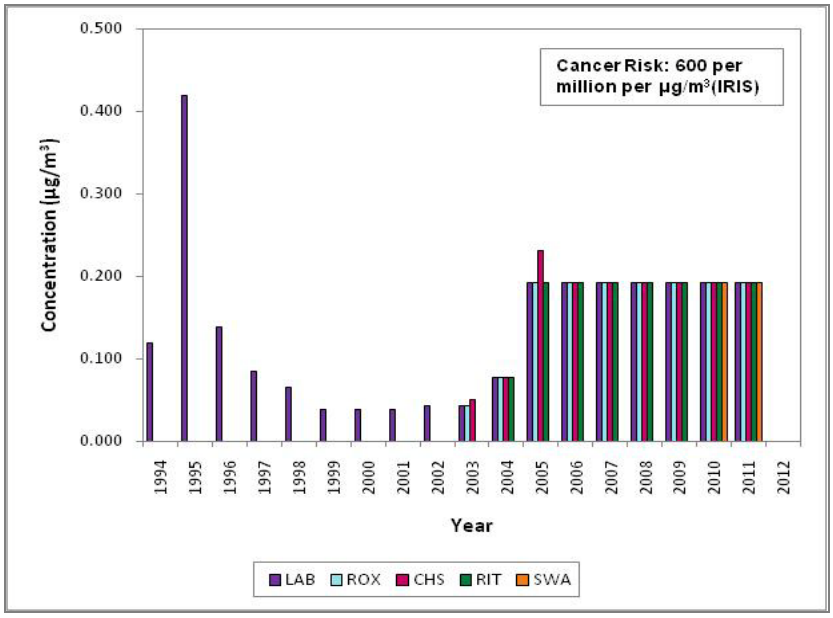


Figure 14 - 1,2-Dichloroethane Average Concentration for Five Monitoring Sites

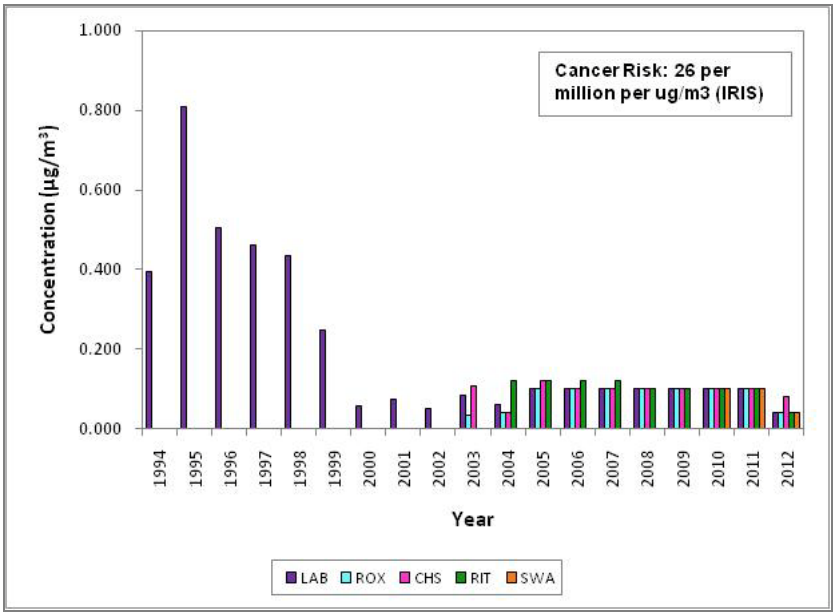


Figure 15 - 1,3-Butadiene Average Concentration for Five Monitoring Sites

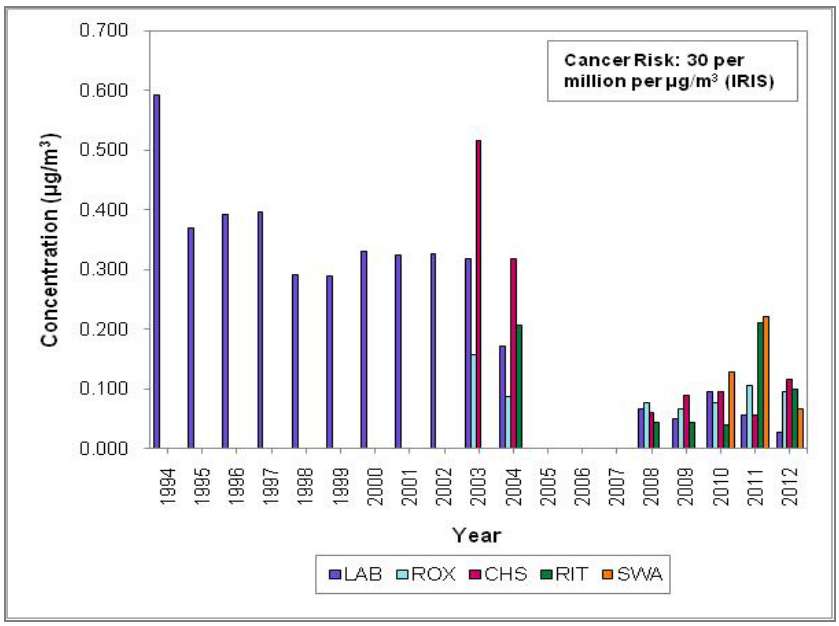


Figure 16 - 1,4-Dichlorobenzene Average Concentration for Five Monitoring Sites

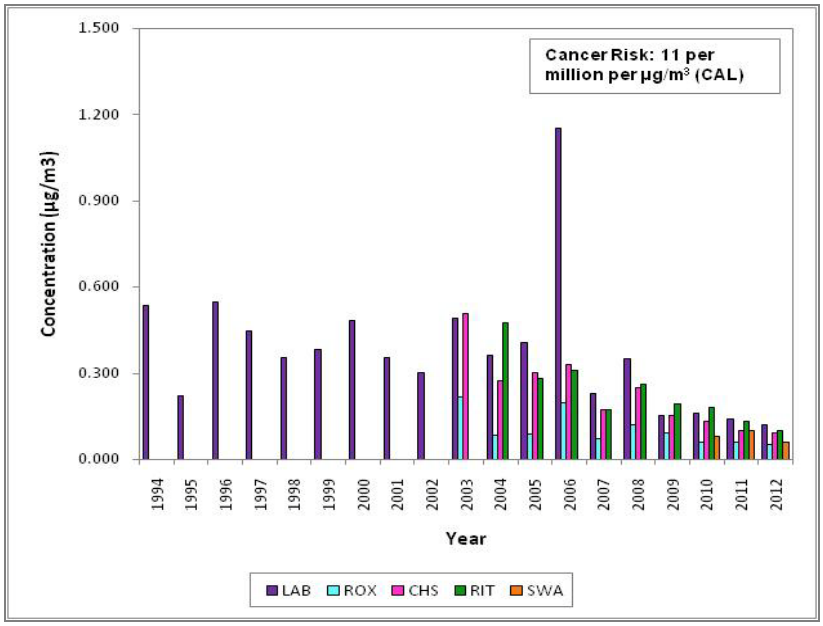


Figure 17 - Acetaldehyde Average Concentration for Five Monitoring Sites

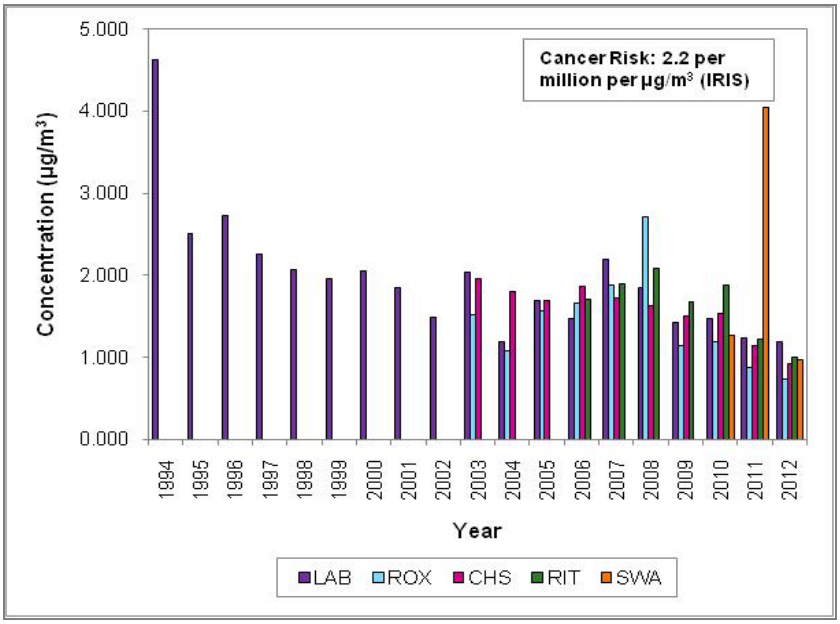


Figure 18 - Acrylonitrile Average Concentration for Five Monitoring Sites

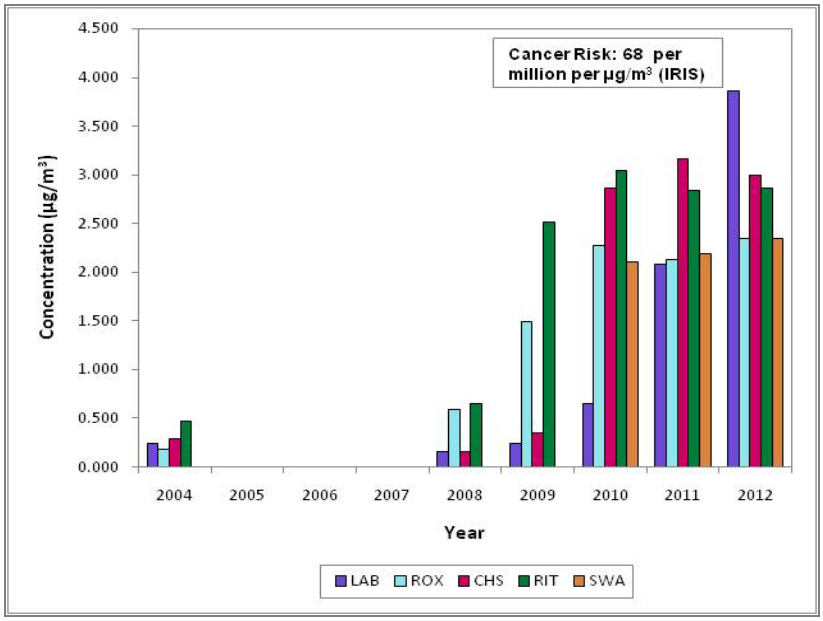


Figure 19 - Benzene Average Concentration for Five Monitoring Sites

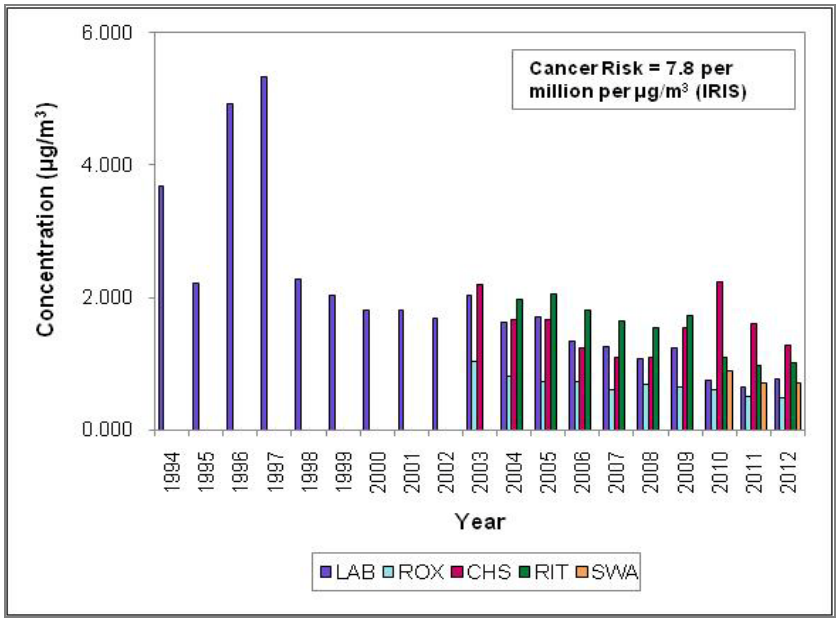


Figure 20 - Carbon Tetrachloride Average Concentration for Five Monitoring Sites

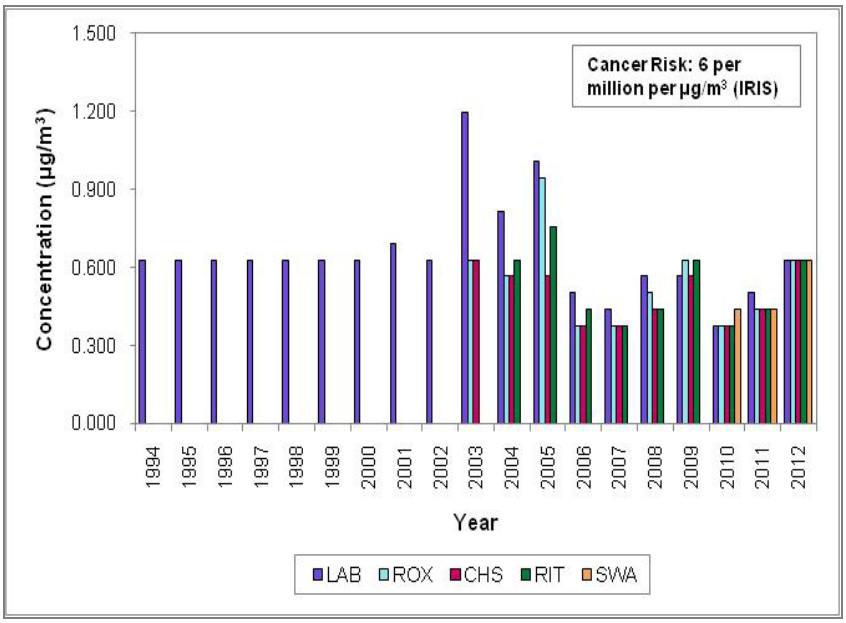


Figure 21 - Chloroform Average Concentration for Five Monitoring Sites

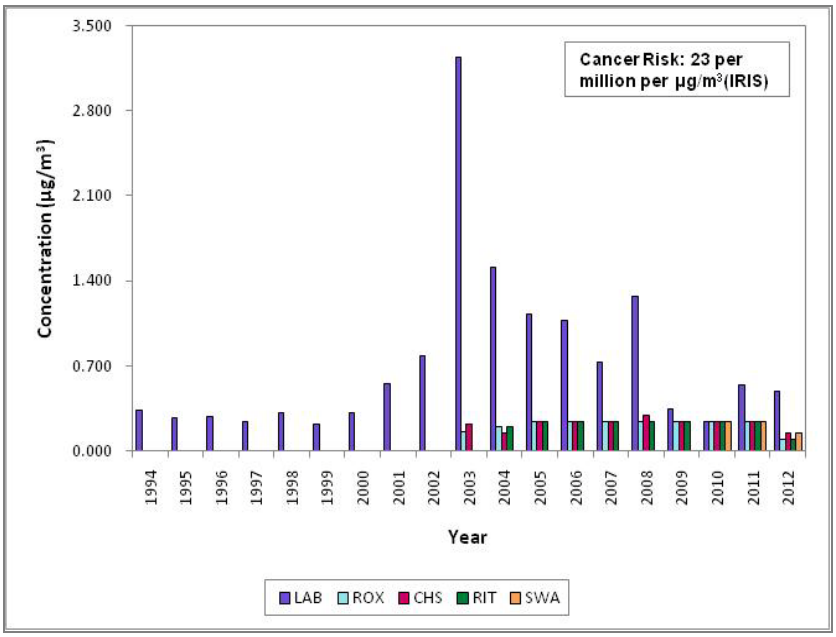


Figure 22 - Formaldehyde Average Concentration for Five Monitoring Sites

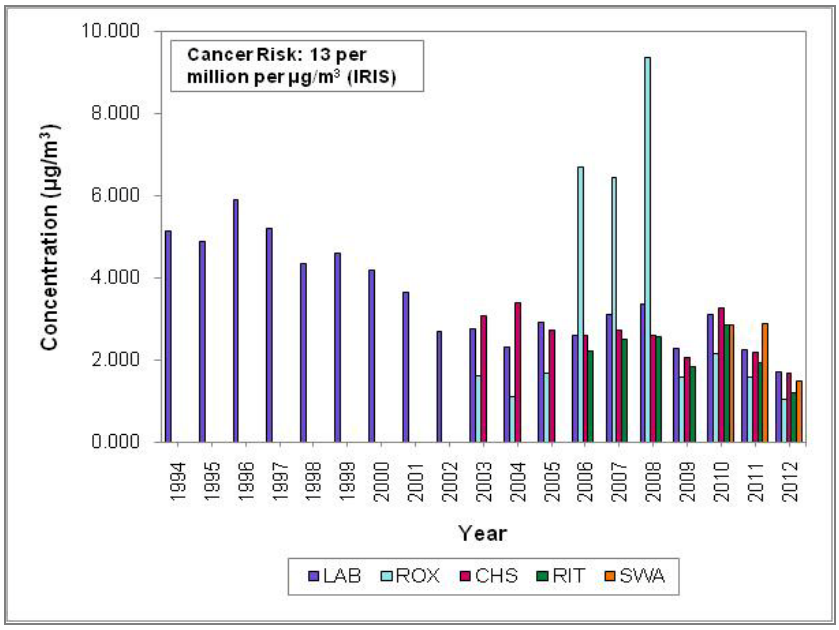


Figure 23 - Air Toxic Pollutants and Pollutants Specific Contribution to Total Cancer Risk Based on EPA 2005 NATA for Philadelphia County

Pollutants Specific Contribution to Total Cancer Risk			Cancer Risk - Source Contributions - Pollutants Specific					
Pollutant Name	Total Cancer Risk	Contribution to Total Risk	Point (Major) Cancer Risk	Nonpoint Cancer Risk	Onroad Cancer Risk	Nonroad Cancer Risk	Background Cancer Risk	Secondary Cancer Risk
FORMALDEHYDE	2.5E-05	44.3%	4.8E-08	6.8E-07	3.4E-06	1.7E-06	0	2.0E-05
BENZENE (INCLUDING BENZENE FROM GASOLINE)	8.9E-06	15.4%	8.3E-08	1.4E-06	3.2E-06	1.2E-06	3.0E-06	0
ACETALDEHYDE	3.5E-06	6.1%	2.0E-09	1.3E-07	1.9E-07	1.1E-07	0	3.1E-06
1,3-BUTADIENE	3.0E-06	5.2%	4.5E-10	3.3E-10	1.5E-06	5.2E-07	9.9E-07	0
CARBON TETRACHLORIDE	2.9E-06	5.0%	1.0E-13	4.8E-09	0	0	2.9E-06	0
1,4-DICHLOROBENZENE	2.9E-07	0.5%	2.9E-09	6.3E-08	0	0	2.3E-07	0
ETHYLENE DIBROMIDE (DIBROMOETHANE)	1.9E-07	0.3%	1.0E-09	6.2E-13	0	0	1.9E-07	0
ACRYLONITRILE	1.8E-07	0.3%	2.0E-09	1.8E-08	0	0	1.6E-07	0
1,1,2,2-TETRACHLOROETHANE	1.5E-07	0.3%	2.3E-10	9.4E-11	0	0	1.5E-07	0
ETHYLENE DICHLORIDE (1,2-DICHLOROETHANE)	1.0E-07	0.2%	3.3E-10	1.4E-08	0	0	8.7E-08	0
TOTAL	4.5E-05	77.5%	1.4E-07	2.3E-06	8.3E-06	3.5E-06	7.7E-06	2.3E-05

Appendix A: Glossary

1. **1-Hour Standard**: The maximum hourly average concentration of a pollutant in a calendar year not to exceed EPA's National Ambient Air Quality Standards codified at part 50 of 40 CFR (Code of Federal Regulations).

2. **24-Hour Standard**: The maximum 24-hour average concentration of a pollutant (averaged from hourly measurements or measured from midnight to midnight) in a calendar year not to exceed EPA's National Ambient Air Quality Standards codified at part 50 of 40 CFR (Code of Federal Regulations).

3. **75% Data Capture:** When 75 of every 100 possible data measurements are available for a given pollutant. This is the minimum amount of data required to satisfy data completeness.

4. **8-Hour Average:** The rolling average of eight hourly pollutant concentrations.

5. **Action Day**: When the Air Quality Index (AQI) is forecast to be Unhealthy for Sensitive Groups, Unhealthy, or greater, or Code Orange, Red, or greater.

6. **Air Quality Index (AQI)**: EPA's color-coded tool designed to inform the public about daily air pollution levels in their communities and what associated health effects might be a concern.

7. **Ambient Air:** The portion of the atmosphere, external to buildings, to which the general public has access.

8. **Annual Arithmetic Mean Concentration**: The weighted average of four quarterly calendar means.

9. **Annual Standard:** The maximum 365-day average concentration of a pollutant (averaged from daily measurements) in a calendar year not to exceed EPA's National Ambient Air Quality Standards codified at part 50 of 40 CFR (Code of Federal Regulations).

10. **Anthropogenic Volatile Organic Compounds (VOCs):** VOCs that come from human activities.

11. **Area Sources**: Sources that emit less than 10 tons annually of a single hazardous air pollutant or less than 25 tons annually of a combination of

hazardous air pollutants. This can include groups of stationary sources (such as dry cleaners and gas stations).

12. **Asbestos:** A mineral fiber that has been used commonly in a variety of building construction materials for insulation and as a fire-retardant. When Asbestos is disturbed, it can release dust into the air. Inhalation can result in asbestosis, lung cancer, or mesothelioma.

13. **Assessment Tools:** The methods of gathering data, performance and understanding, checklists and analyzing scales for projects.

14. **Benzene:** A colorless liquid with a pleasant odor. It is used mainly in making other chemicals and plastics, as a solvent, and is found in trace amounts of gasoline.

15. **Benzo [a] pyrene (BAP):** Part of a class of chemicals called polycyclic aromatic hydrocarbons.

16. **Breakpoints:** Ranges or categories. These are pollutant concentration cut-offs for the Air Quality Index (AQI) to determine the Air Quality Category from Good to Unhealthy.

17. **Carbon Monoxide (CO)**: A colorless, odorless, and (at much higher levels) poisonous gas, formed when carbon in fuels is not burned completely. CO is a criteria pollutant – a substance for which EPA has set health-based standards.

18. **Clean Air Act Amendments (CAAA)**: The law that defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer, as amended, 42 U.S.C. §7401 et seq.

19. **Criteria Pollutants:** Substances for which EPA has set health-based standards. There are six "criteria pollutants" of air quality: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

20. **Design Value:** The calculated concentration according to the applicable appendix of part 50 of 40 CFR (Code of Federal Regulations) for the highest site in an attainment or nonattainment area.

21. **Emission Inventories**: A listing, by source, of the amount of air pollutants discharged into the atmosphere of a community during a given time period.

22. **Environmental Protection Agency (EPA)**: A federal agency that was established to consolidate a variety of federal research, monitoring, standard-setting and enforcement activities to ensure environmental protection.

23. **Excess Lifetime Cancer Risk**: The additional or extra risk of developing cancer due to exposure to a toxic substance incurred over the lifetime of an individual (over 70 years).

24. **Federal equivalent method (FEM):** A method for measuring the concentration of an air pollutant in the ambient air that has been designated as an equivalent method in accordance with 40 CFR part 53; it does not include a method for which an equivalent method designation has been canceled in accordance with 40 CFR part 53.11 or 40 CFR part 53.16.

25. **Federal reference method (FRM)**: A method of sampling and analyzing the ambient air for an air pollutant that is specified as a reference method in an appendix to 40 CFR part 50, or a method that has been designated as a reference method in accordance with this part; it does not include a method for which a reference method designation has been canceled in accordance with 40 CFR part 53.11 or 40 CFR part 53.16.

26. **Fine Mineral Fibers**: Glasswool, rockwool, slagwool, glass filaments, and ceramic fibers.

27. **Gaseous Emissions:** Pollutant emissions in gas form.

28. **Ground-level Ozone**: Ozone at ground-level created by a chemical reaction between oxides of nitrogen (NO_x) and Volatile Organic Compounds (VOC) in the presence of sunlight, also known as smog or “bad” ozone.

29. **Hazardous Air Pollutants (HAPs):** A list of 188 pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. These are codified at Section 112 of the Clean Air Act.

30. **Heavy Metals**: Individual metals and metal compounds that negatively affect people's health. In very small amounts, many of these metals are necessary to support life. However, in larger amounts, they become toxic.

31. **Highest 2nd Maximum 24-Hour Concentration:** The second-highest daily maximum 24-hour average concentration of a pollutant (averaged from hourly measurements or measured from midnight to midnight) in a calendar year not to exceed EPA's National Ambient Air Quality Standards codified at part 50 of 40 CFR (Code of Federal Regulations).

32. **Highest 4th Daily Maximum 8-Hour Concentration:** The fourth highest daily value of a pollutant, calculated rolling 8-hour average, in a calendar year.

33. **Highway Vehicle Sources:** Emissions that originate from a highway vehicle, any self-propelled vehicle, or any trailer or semi-trailer, designed to perform a function of transporting a load over highways, whether or not also designed to perform other functions.

34. **Indoor Air**: Air within a building occupied for at least one hour by people of varying states of health.

35. **Industrial Grade Fuel Oils:** Industrial techniques such as addition of heat and/or chemicals, the evaporation of water content, filtration, sedimentation, centrifuge separation, and vacuum distillation applied to used fuel oil, which is a fraction obtained from petroleum distillation, either as a distillate or a residue, to prepare it for blending with virgin oil.

36. **Lead:** A metal found naturally in the environment as well as in manufactured products. Lead is a criteria pollutant – a substance for which EPA has set health-based standards.

37. **Lifetime Cancer Risk:** The risk of developing cancer due to exposure to a toxic substance incurred over the lifetime of an individual.

38. **Major Source:** A stationary facility that emits a regulated pollutant in an amount exceeding the threshold level depending on the location of the facility and attainment with regard to air quality status. In Philadelphia these levels are: 25 tons of Volatile Organic Compounds (VOC) or Nitrogen Oxides (NO_x) per year, 100 tons of Carbon Monoxide (CO), Sulfur Oxides (SO_x), or Particulate Matter less than 10 microns (PM_{10}) per year, 10 tons of an individual Hazardous Air Pollutant (HAP) per year, or 25 tons of all HAPs combined per year.

39. **Meteorology (MET)**: Winds, air temperature, atmospheric stability, mixed layer heights, etc.

40. **Microns:** One millionth (10^{-6}) of a meter.

41. **Mobile Sources:** A wide variety of vehicles, engines, and equipment that generate air pollution and that move, or can be moved, from place to place.

42. **Modeling:** The mathematical simulation of how air pollutants disperse in the ambient atmosphere. It is performed with computer programs that solve the mathematical equations and algorithms which simulate the pollutant dispersion. The dispersion models are used to estimate or to predict the downwind concentration of air pollutants or toxins emitted from sources such as industrial plants, vehicular traffic or accidental chemical releases.

43. **National Ambient Air Quality Standards (NAAQS):** Those primary and secondary ambient air quality standards which are promulgated by the Administrator of the United States Environmental Protection Agency.

44. **National Emissions Standards for Hazardous Air Pollutants (NESHAPs):** Emissions standards set by the EPA for an air pollutant not covered by National Ambient Air Quality Standards (NAAQS) that may cause an increase in fatalities or in serious, irreversible, or incapacitating illness.

45. **New Source Performance Standards (NSPS):** Technology based standards set by the EPA which apply to specific categories of stationary sources.

46. **Nitric Oxide (NO):** Precursor of ozone; nitric oxide is usually emitted from combustion processes. Nitric oxide is converted to nitrogen dioxide (NO_2) in the atmosphere, and then becomes involved in the photochemical processes and/or particulate formation.

47. **Nitrogen Dioxide (NO_2):** A light brown gas that is an important component of urban haze. The compound is created primarily from fuel combustion in motor vehicles, utilities, and industrial sources.

48. **Nitrogen Oxides:** A general term pertaining to compounds of nitric oxide (NO), nitrogen dioxide (NO_2) and other oxides of nitrogen. Nitrogen oxides are typically created during combustion processes, and are major contributors to smog formation and acid deposition.

49. **Non-Cancer Hazard:** Chemicals that cause non-cancer health effects, which may include birth defects, organ damage, morbidity, and death.

50. **Non-Road Engine Sources:** Sources emitted by internal combustion engines (including the fuel system) that is not used in a motor vehicle or a vehicle used solely for competition.

51. **Non-Road Sources:** A wide variety of sources including industrial, lawn and garden, construction, recreational, and farm equipment.

52. **On-Road Sources:** Sources that emit pollution on road. On-road vehicles include cars, vans, trucks, motorcycles, and buses.

53. **Organic Chemicals:** Chemical compounds of carbon excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbonates, metallic carbides and ammonium carbonates.

54. **Ozone (O_3):** A highly reactive gas composed of three oxygen atoms. Ozone occurs both in the earth's upper atmosphere and at ground level.

55. **Particulate Matter (PM):** A mixture of solid particles and liquid droplets found in air. These solid and liquid particles come in a wide range of sizes.

56. **Parts Per Billion (ppb):** Parts per billion by volume in air or by weight in water.

57. **Parts Per Million (ppm):** Parts per million by volume in air or by weight in water.

58. **Permit:** A document giving permission to do something; a license.

59. **Pesticides:** Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.

60. **Photochemical Assessment Monitoring Stations (PAMS):** Enhanced ambient air monitoring for volatile organic ozone precursors via Gas Chromatograph (GC-FID) analysis.

61. **Point Sources:** A single identifiable localized source.

62. **Polycyclic Organic Matter (POM):** A broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAHs), of which benzo[a]pyrene is a member.

63. **Primary (health-based) National Ambient Air Quality Standards (NAAQS):** Limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.

64. **Quarterly Average Concentration:** Average concentration for each calendar quarter.

65. **Quartz Filter:** High-purity microfibers for collecting particulates.

66. **Respiratory and Cardiovascular Disease:** Disease affecting the respiratory system, the heart or blood vessels.

67. **Rolling 3-Month Average Concentration:** Average pollutant concentration in a 3-month rolling fashion.

68. **Sensitive Groups:** People with heart and lung disease, older adults and children that are at a greater risk from exposure to a pollutant.

69. **Size Selective Sampler (SSI):** PM_{10} Quartz Filter Measurement.

70. **Smog:** Air pollution, characterized by low visibility and an assortment of human health problems. Smog occurs when emissions from industry, motor vehicles, incinerators, open burning and other sources accumulate under certain climatic conditions.

71. **Speciated $PM_{2.5}$**: Fine particulate components including elements, radicals, elemental carbon, and organic carbon.

72. **State Implementation Plan (SIP):** A federally approved and enforceable plan by which each state identifies how it will attain and/or maintain the health-related primary and welfare-related secondary NAAQS.

73. **Stationary Sources:** Any building, structure, facility, or installation which is fixed in a certain place or position which emits or may emit any air contaminants.

74. **Sulfur Content:** The quantity of sulfur in a substance to meet EPA requirements in a substance.

75. **Sulfur Dioxide (SO_2):** A colorless toxic gas that occurs in the gases from volcanoes; used in many manufacturing processes and present in industrial emissions; causes acid rain.

76. **Total Suspended Particles (TSP)**: Particles of solid or liquid matter such as soot, dust, aerosols, fumes, and mist – up to approximately 30 micrometers in size.

77. **Toxics:** Substances that cause adverse health effects or environmental damage.

78. **Ultraviolet (UV) Light:** Electromagnetic radiation with a wavelength shorter than that of visible light, but longer than x-rays, in the range 10 nm to 400 nm, and energies from 3 eV to 124 eV.

79. **Unit Risk Factors (URFs):** Toxicity values used for carcinogens that estimate the increased risk of getting cancer that is associated with the concentration of the chemical in air that you are breathing. A cancer risk of less than one in a million is usually considered to be negligible.

80. **Vapor Recovery**: The process of recovering the vapors of gasoline or other fuels, so that they do not escape into the atmosphere.

81. **Volatile Organic Compounds (VOCs):** Any compound of carbon, other than those organic compounds that the Administrator has excluded in 40 CFR (Code of Federal Regulations) Part 51, Section 51.100.

82. **Weighted Annual Average:** A yearly average in which each quantity to be averaged is assigned a weight. These weightings determine the relative importance of each quantity on the average. Weightings are the equivalent of having that many like items with the same value involved in the average.

83. **$\mu g/m^3$:** The concentration of an air pollutant in one-millionth of a gram per cubic meter air.

Appendix B: Consequences of Air Pollution

Health Effects
Air pollution contributes to health problems such as asthma, lung disease, and respiratory tract infections. It also can aggravate cardiovascular disease. This concern is greatest in sensitive populations, especially those with lung disorders, young children, and the elderly.

Acid Rain
Acid rain occurs when sulfur dioxide and nitrogen oxides are released into the air, and combine with rain, snow or fog. Acid rain's effects include harm to fish, plants, animals, and crops, and eroding building surfaces and national monuments. The effects of acid rain can be offset by reducing the amount of sulfur dioxide released into the air.

Visibility
Haze is caused when particles and gases in the atmosphere scatter or absorb light. The same particles that affect our health also limit our ability to see our surroundings. This affects our quality of living and the beauty of the City of Philadelphia by obscuring many of the national treasures and landmarks that we value.

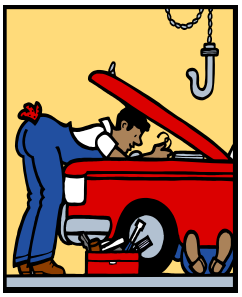
Climate Change
Global warming refers to an increase in the Earth's temperature, which has the effect of causing climate change. The emission of certain pollutants into the atmosphere which absorb heat energy have sped this process along. Some of the expected long-term changes are a rise in sea level, damage to coastal areas, a variation in precipitation, and other local climate changes. These changes have the potential for altering forests, crop yields, wild life, and water supplies. In 2009, the Mayor's Office of Sustainability, was charged with improving energy efficiency and reducing operating costs in City-owned facilities.

Appendix C: What AMS is Doing to Reduce Air Pollution

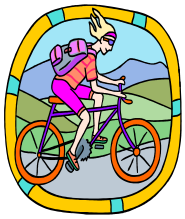
- AMS monitors the air for pollutants at many stations throughout the City.
- AMS requires operators of facilities that install or modify sources of air pollution to obtain an air permit from AMS prior to installation. A permit is a list of requirements that includes emission limits and work practice standards as well as testing, monitoring, recordkeeping, and reporting requirements. Sometimes AMS will perform modeling as part of the permit review to assess the impact of new equipment on air quality. A list of recent permit applications received by AMS can be found on our website at http://www.phila.gov/health/AirManagement/index.html. In addition, permits are available to the public. You may contact AMS for information on access to these documents.
- AMS inventories stationary sources of emissions such as factories and other businesses to obtain a current, comprehensive listing of air pollutant emissions for a specific time interval.
- AMS inspects facilities that may cause air pollution or create an air pollution nuisance, meets with and assists facility personnel to achieve compliance, investigates noise and vibration nuisance sources, and responds to citizen complaints and requests for information.
- AMS issues Notices of Violation (NOVs) for sources that are not in compliance, assesses and collects penalties in response to NOVs, initiates orders to abate sources of air pollution, negotiates compliance schedules and agreements to achieve compliance, and refers cases to the Law Department for additional legal remedies including injunctive actions, court orders and consent decrees.
- AMS provides information on economic incentives for cleaning up pollution.
- AMS conducts industry workshops on permitting and emission inventory submittals, provides assistance and training to owners and operators of auto body shops on reducing emissions, and trains asbestos contractors on workplace standards. AMS also provides outreach to educate the public about air quality. Staff members attend community fairs, speak at meetings, and visit schools throughout the City.
- AMS is also active in non-regulatory (voluntary) programs. The Philadelphia Diesel Difference is a program that educates owners and operators of diesel engine vehicles about clean diesel technologies such as alternative fuels, anti-idling equipment and diesel engine retrofit devices.

Appendix D: Protecting Yourself and the Environment

If you care about your health, and the health of your neighbors and loved ones, you should also care about the health of the environment. What you do everyday can have a significant impact on the air.



- Avoid overfilling, or "topping off" your car's gas tank.
- Keep your car's engine tuned up and maintain proper tire pressure.
- When you need to drive, plan ahead so you don't make extra trips.
- Avoid high speeds - fuel efficiency decreases significantly at speeds over 55 mph.
- Drive smoothly to save gas and reduce vehicle emissions.
- Avoid lengthy idling - idling wastes gas.
- Don't rev the engine - this also wastes gas.
- Minimize drag - heavy tow loads, and even driving with the windows open, can create "drag'" which reduces fuel efficiency.
- Keep tires properly inflated - under inflated tires decrease gas mileage and shorten tire life. Check the tire pressure in all four tires every two weeks.
- Avoid rough roads and potholes. They are hard on tire and wheel alignment and can also reduce fuel efficiency.



- Use alternative forms of transportation whenever possible, such as carpooling, biking, mass transit, or walking.
- Avoid oil-based paints. Latex paints are much friendlier to the environment, and usually work just as well.

- Conserve energy.
- Don't overheat or overcool your home.
- Turn off lights and appliances when not in use.
- Wash clothes and dishes in full loads.
- Choose Energy Star appliances whenever possible.
- Recycle – Glass, Metals, and Plastics, and other items.
- Report air pollution violations when you become aware of them.
- Take part/respond to hearings/public notices for cleaning up air pollution.
- Learn about local air quality efforts and issues and consider becoming involved in a group that addresses these issues.
- Let your government representatives know that you care about the quality of our City's air.
- Consider switching to wind power or using green building technologies like high-efficiency lighting.

Appendix E: Frequently Asked Questions About Air Quality

What is a criteria pollutant?

A criteria pollutant is one of the six pollutants that are regulated under standards provided by the US Environmental Protection Agency (EPA) to protect the public health and welfare. The criteria pollutants are: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead.

Where and how is air quality measured?

The city's air is sampled at stations located throughout Philadelphia. Every minute, monitoring instruments at these stations record the air quality. The data is uploaded to the department's computer system at the AMS Laboratory located at 1501 E. Lycoming Street every 15 minutes. This is called a "real time" system, because the measurements show pollution levels as they are occurring, not after the fact. It allows AMS to evaluate air quality almost continuously. This constant monitoring ensures that no episodes of high pollution are missed and that there are no pollution risks to the public's health.

What does nonattainment mean?

Nonattainment is a designation given to an area that persistently exceeds the ambient air quality standards set for a criteria pollutant. The final designation for nonattainment is given by the EPA after it reviews the recommendations of the State's governor and looks at air quality data for an area. A designation of nonattainment obligates the state or local air agency to identify the causes of pollution, create and implement a strategy that will improve air quality to the point that it meets the standard.

What is an air toxic?

Air toxics or toxic air pollutants, commonly referred to as Hazardous Air Pollutants (HAPs), are air pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects. The Federal Clean Air Act Amendments of 1990 list 187 pollutants or chemical groups as HAPs.

How do I report an air pollution problem?

For Philadelphia, call 215-685-7580 during AMS office hours from 8 AM to 4:30 PM on weekdays. At all other times, call 311. By calling immediately at the time of the problem, AMS will have a better chance of observing the problem directly and developing an appropriate and timely response.

What information should I report for air pollution problems?

The date, time, location, responsible party (if known) and a description of the problem is requested. A callback name and telephone number is helpful in the event that we are unable to identify the problem. Anonymous calls are also accepted.

What do I do if there's carbon monoxide in my house?

Seek fresh air and dial 911 for rescue if someone is unconscious or needs help. Otherwise, contact 311. The operator will assist in contacting AMS and other responders as needed.

What should I do if there is unhealthy air quality?

Consider limiting strenuous activity outdoors, especially if you are a member of a sensitive group (the elderly, children, and those with heart or lung problems). Limit the use of your car during daylight hours, and avoid using lawn or garden equipment that requires gasoline.

Why is the ozone layer in the atmosphere considered good, and ozone at ground level considered a health risk?

High in the atmosphere, ozone provides a protective covering for the earth from the sun's ultraviolet (UV) rays, which are harmful. However, ozone low to the ground is formed when certain chemicals and sunlight interact, and is the chief ingredient in smog. It is a strong irritant to the upper respiratory system and eyes, and can cause damage to crops.

Has the air quality in Philadelphia been improving over the years?

Overall Philadelphia's air quality is good and improving. Since 1979, while fluctuating from year to year, the trend of unhealthy and very unhealthy days has steadily declined, especially since 1988. In 1999, the 1997 national standard for 8-hour ozone was incorporated into the AQI, and in 2004, the 1997 national $PM_{2.5}$ standard was added. In 2008, the 8-hour ozone and lead standards became more stringent. In 2010, EPA added a one-hour standard of 100 ppb for Nitrogen Dioxide (NO_2) and a one-hour standard of 75 ppb for Sulfur Dioxide (SO_2). In 2012, EPA revised the annual $PM_{2.5}$ standard to 12 $\mu g/m^3$.

How was Philadelphia's air quality in 2012?

In 2012, Philadelphia's air quality was rated "good" on 81 days, "moderate" on 265 days, and "unhealthy" on 20 days. These ratings are based on the Air Quality Index (AQI), a system used by cities throughout the country to describe the quality of the air. Air Management Services (AMS) monitors the air quality and enforces the air pollution regulations in the city.

How do I find out more about the air quality in Philadelphia?

The Air Quality Index (AQI) tells you how clean the air is and whether it will affect your health. Philadelphia's Real-Time Air Quality Website is located at www.phila.gov/aqi and provides the most up-to-date information about the air quality in Philadelphia. It lets you know what you should do to protect your health if the air quality is unhealthy. To obtain general air quality information for Philadelphia, arrange for a school or group based presentation or to request a speaker or information booth for a health or environmental fair, contact Air Management Services at 215-685-7586.

Appendix F: Websites

www.aafa.org - Asthma and Allergy Foundation of America.
www.airnow.gov - The AQI (Air Quality Index) tells you how clean the air is and whether it will affect your health. Through AIRNow, EPA, NOAA, NPS, state, and local agencies work together to report current and forecast conditions for ozone and particle pollution.
www.airqualitypartnership.org - Ground Level Ozone and Particle Pollution Forecasts
www.atsdr.cdc.gov - Agency for Toxic Substances and Disease Registry: Public health statements on specific toxics and the effects of exposure.
www.cleanair.org - Clean Air Council
www.cleanair.org/program/transportation/diesel_campaign- Philadelphia Diesel Difference
www.delawarevalley.enviroflash.info/about.cfm- Sign up for Air Quality Forecasts
www.depweb.state.pa.us/ - Pennsylvania Department of Environmental Protection
www.dieselforum.org - Diesel Technology Forum
www.dvgbc.org - Delaware Valley Green Building Council
www.ecasavesenergy.org/- Energy Coordinating Agency
www.epa.gov - U.S. Environmental Protection Agency
www.epa.gov/airdata/ - AirData presents annual summaries of air pollution data from two EPA databases: the AQS (Air Quality System) database provides air monitoring data - ambient concentrations of criteria air pollutants at monitoring sites, primarily in cities and towns and the NEI (National Emission Inventory) database provides estimates of annual emissions of criteria and hazardous air pollutants from all types of sources.
www.epa.gov/echo - Use ECHO (Enforcement & Compliance History Online) to determine whether compliance inspections have been conducted by EPA or state/local government, violations were detected, enforcement actions were taken, and penalties were assessed in response to environmental law violations.
www.howstuffworks.com - For simple to read answers to a wide variety of science questions, including air pollution, acid rain, and ozone.
www.ipcc.ch/ - Intergovernmental Panel on Climate Change.
www.lungusa.org - American Lung Association website: Information on lung health, air pollution, and related matters.
www.pennfuture.org - For Pennsylvanians to breathe easier.
www.phila.gov/health/AirManagement/ - Philadelphia Department of Public Health, Air Management Services.
www.phila.gov/aqi - Philadelphia's Air Quality Website, provides the most up-to-date information about the air quality in Philadelphia and lets you know what you should do to protect your health if the air quality is unhealthy. The tool used to show this is the Air Quality Index (AQI) developed by the Environmental Protection Agency (EPA).
www.scorecard.org - Detailed information on toxics.

Appendix G: Contacts

Philadelphia Department of Public Health, Air Management Services	215-685-7580
U.S. Environmental Protection Agency, Region III	215-814-5000
Pennsylvania Department of Environmental Protection	484-250-5900
Asthma and Allergy Foundation of America	1-800-476-5536
Clean Air Council	215-567-4004

For further information, please visit the Air Management Services website at:

http://www.phila.gov/health/AirManagement/index.html