# 2013-2014
# Air Monitoring Network Plan

City of Philadelphia
Department of Public Health
Air Management Services

July 1, 2013

# Executive Summary

Philadelphia has an air monitoring network of ten air monitoring stations that house instruments that measure ambient levels of gaseous, solid and liquid aerosol pollutants. It is operated by the City of Philadelphia's Department of Public Health, Air Management Services (AMS), the local air pollution control agency for the City of Philadelphia. This network is part of a broader network of air monitoring operated by our local states of Pennsylvania, New Jersey, Delaware and Maryland that make up the Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD Metropolitan Statistical Area (MSA).

The United States Environmental Protection Agency (US EPA) created regulations on how the air monitoring network is to be set up. These regulations can be found in Title 40 - Protection of Environment in the Code of Federal Regulations (CFR) Part 58 – Ambient Air Quality Surveillance, located online at: http://www.epa.gov/ttnamti1/40cfr53.html.

Beginning July 1, 2007, and each year thereafter, AMS has submitted to EPA Region III, an Air Monitoring Network Plan (Plan) which assures that the network stations continue to meet the criteria established by federal regulations.

Air monitoring provides critical information on the quality of air in Philadelphia. The objective for much of our network is to measure pollutants in areas that represent high levels of contaminants and high population exposure. Some monitoring is also done to determine the difference in pollutant levels in various parts of the City, provide long term trends, help bring facilities into compliance, provide real-time monitoring and provide the public with information on air quality.

The proper siting of a monitor requires the specification of the monitoring objective, the types of sites necessary to meet the objective, and the desired spatial scale of representativeness. These are discussed in the section entitled "Definitions".

This Plan is composed of fourteen sections plus Appendices A - D:

1. **Announcement of Future Changes to the Network -** This section provides information on how the public is made aware of the Plan and where it is available for review.

2. **Definitions -** This section describes the terms used for air monitoring programs, measurement methods, monitoring objectives, spatial scales, air monitoring areas, pollutants, collection methods, and analysis methods.

3. **Philadelphia's Meteorology and Topography -** This section describes the general meteorology relative to wind and air stagnation and the impact of topography on Philadelphia's meteorology

4. **Current Network at a Glance -** This section shows the location of the monitoring sites and the pollutants measured at each site.

5. **Current Sites Summary -** This section provides information applicable to our overall network such as population. It also provides a brief overall purpose for each monitoring site.

6. **Direction of Future Air Monitoring -** This section gives a perspective of the major areas and initiatives AMS will be considering during the next few years.

7. **Potential Changes to the Network -** This section describes changes that may occur within the next 18 months that would modify the network from how it is currently described in the Plan.

8. **$NO_2$ Monitoring Network -** Per 40 CFR Part 58.10(a)(5), this section documents how AMS will establish $NO_2$ monitoring sites in response to the new 1-hour standard.

9. **CO Monitoring Network -** Per 40 CFR Part 58 Appendix D 4.2.1, this section documents the minimum requirements for CO monitors.

10. **Changes to a Violating $PM_{2.5}$ Monitor -** Per 40 CFR Part 58.10(c), this section documents changes to the $PM_{2.5}$ monitoring network that impact the location of a violating $PM_{2.5}$ monitor.

11. **Exclusion of Certain $PM_{2.5}$ Continuous FEM Data from Comparison to the NAAQS -** Per 40 CFR Part 58.10 (b) and Part 58.11 (e), this section documents the request to exclude $PM_{2.5}$ Continuous FEM Data from the LAB site for NAAQS and AQI purposes.

12. **NCore Monitoring Site – Relocation from BAX to ROX -**This section describes the current status of and the reasoning behind the involuntary relocation of the current NCore monitoring station (BAX).

13. **Detailed Information on Each Site -** This is the largest section of the Plan. Each monitoring site is separately described in a table, complete with pictures and maps. The material is presented as:
    - A table providing information on the pollutants measured, sampling type, operating schedule, collection method, analysis method, spatial scale, monitoring objective, probe height, and begin date of each monitor;
    - Pictures taken at ground level of the monitoring station;
    - A map of the monitoring site complete with major cross streets and major air emission sources within 3000 meters (almost 2 miles); and
    - An aerial picture providing a north view of the site.

14. **Detailed Information by Pollutant -** The report is completed with detailed information for each the following pollutants: Ozone, Carbon Monoxide, Nitrogen Dioxide, Sulfur Dioxide, Lead, Particulate Matter, and Toxics. The monitoring of each pollutant is described by a map showing where the pollutant is monitored, National Ambient Air Quality Standard (if there is one) and a text description and trend graphs showing the concentration of the pollutant over a number of years.

15. **Appendices**

- **Siting Criteria -** Appendix A summarizes the probe and monitoring path siting criteria.

- **Request to Exclude $PM_{2.5}$ Continuous FEM Data –** Appendix B provides information regarding the request to exclude data from $PM_{2.5}$ Continuous FEM from the LAB site.

- **Torresdale Near-road Monitoring Station –** Appendix C provides information regarding the new Torresdale (TOR) near-road $NO_2$ and CO monitoring station.

- **Comment from Natural Resources Defense Council (NRDC) and Clean Air Council (CAC) –** Appendix D provides comment from NRDC/CAC and response from AMS.

AMS has provided a copy of the Plan for public inspection on the City's website at: http://www.phila.gov/health/airmanagement/index.html.

Comments or questions concerning the air monitoring network or this Plan can be directed to:

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# Announcement of Future Changes to the Network

Beginning July 1, 2007, and each year thereafter, AMS has submitted to EPA Region III, a Plan assuring that the network stations continue to meet the criteria established by federal regulations. At least 30 days prior to July 1 of each year, AMS announces to the public the availability of the Plan through notices published in the *Philadelphia Daily News* and the *Pennsylvania Bulletin*. Copies of the Plan are available for public inspection on the City's website under the Department of Public Health, Air Management Services at:

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

and at the AMS office:

Air Management Services
321 University Avenue, 2nd Floor
Philadelphia, PA 19104
Phone – 215-685-7586

Provisions will be made to accommodate comments and questions concerning the air monitoring network or the Plan. If comments are received, they will be considered for incorporation into the Plan.

# Definitions

## Air Monitoring Programs

EPA has established various air monitoring programs for the measurement of pollutants. Some of these are briefly described below. Later in this Plan, air monitoring sites and monitoring equipment are specifically identified relative to these air monitoring programs:

- **NAMS** - National Air Monitoring Stations. This network provides ambient levels of criteria air pollutants (carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, particulate and lead). These sites are established with the intent that they will operate over many years and provide both current and historical information.
- **NATTS** - National Air Toxics Trends Stations. This network provides ambient levels of hazardous air pollutants. These sites are established with the intent that they will operate over many years and provide both current and historical information.
- **NCore** - National Core multi-pollutant monitoring stations. Monitors at these sites are required to measure particles ($PM_{2.5}$, speciated $PM_{2.5}$, $PM_{10-2.5}$), $O_3$, $SO_2$, CO, nitrogen oxides ($NO/NO_2/NO_y$), Pb, and basic meteorology. They principally support research in air pollution control.
- **SLAMS** - State or Local Air Monitoring Stations. The SLAMS make up the ambient air quality monitoring sites that are primarily needed for NAAQS comparisons, but may serve other data purposes. SLAMS exclude special purpose monitor (SPM) stations and include NCore, PAMS, Near-road $NO_2$/CO and all other State or locally operated stations that have not been designated as SPM stations.
- **PAMS** - Photochemical Assessment Monitoring Stations.
- **STN -** A $PM_{2.5}$ speciation station designated to be part of the Speciation Trends Network. This network provides chemical species data of fine particulate. These sites are established with the intent that they will operate over many years and provide both current and historical information.
- **State speciation site -** A supplemental $PM_{2.5}$ speciation station that is not part of the speciation trends network.
- **SPM** - Special Purpose Monitor. As the name implies these monitors are placed for purposes of interest to the city of Philadelphia. Often this monitoring is performed over a limited amount of time. Data is reported to the federal Air Quality System (AQS) and is not counted when showing compliance with the minimum requirements of the air monitoring regulations for the number and siting of monitors of various types. The agency may designate a monitor as an SPM after January 1, 2007 only if it is a new monitor or for a monitor included in the monitoring plan prior to January 1, 2007, if the Regional Administrator has approved the discontinuation of the monitor as a SLAMS site.

## Measurement Methods

- **Approved Regional Method (ARM)** - A continuous $PM_{2.5}$ method that has been approved specifically within a State or Local air monitoring network for purposes of comparison to the NAAQS and to meet other monitoring objectives.
- **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.

- **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.

## Monitoring Objectives

The ambient air monitoring networks must be designed to meet three basic monitoring objectives:

- Provide air pollution data to the general public in a timely manner.
- Support compliance with ambient air quality standards and emissions strategy development.
- Assist in the evaluation of regional air quality models used in developing emission strategies, and to track trends in air pollution abatement control measures' impact on improving air quality.

In order to support the air quality management work indicated in the three basic air monitoring objectives, a network must be designed with a variety of different monitoring sites. Monitoring sites must be capable of informing managers about many things including the peak air pollution levels, typical levels in populated areas, air pollution transported into and outside of a city or region, and air pollution levels near specific sources.

## Spatial Scales

The physical siting of the air monitoring station must be consistent with the objectives, site type and the physical location of a particular monitor.

The goal in locating monitors is to correctly match the spatial scale represented by the sample of monitored air with the spatial scale most appropriate for the monitoring site type, air pollutant to be measured, and the monitoring objective.

The spatial scale results from the physical location of the site with respect to the pollutant sources and categories. It estimates the size of the area surrounding the monitoring site that experiences uniform pollutant concentrations. The categories of spatial scale are:

- **Microscale** - Defines concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.
- **Middle scale** - Defines concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.
- **Neighborhood scale** - Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants.
- **Urban scale** - Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale.
- **Regional scale –** Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers.

- **National and global scales –** These measurement scales represent concentrations characterizing the nation and the globe as a whole.

## Air Monitoring Area

- **Core-Based Statistical Area (CBSA)** - Defined by the U.S. Office of Management and Budget, as a statistical geographic entity consisting of the county or counties associated with at least one urbanized area/urban cluster of at least a population of 10,000 people, plus adjacent counties having a high degree of social and economic integration.
- **Metropolitan Statistical Area (MSA)** - A Core-Based Statistical Area (CBSA) associated with at least one urbanized area of a population of 50,000 people or more. The central county plus adjacent counties with a high degree of integration comprise the area.

## Pollutants

Air Management Services monitors for a wide range of air pollutants:

- **Criteria Pollutants** are measured to assess if and how well we are meeting the National Ambient Air Quality Standards (NAAQS) that have been set for each of these pollutants. These standards are set to protect the public's health and welfare.
  - **Ozone ($O_3$)**
  - **Sulfur Dioxide ($SO_2$)**
  - **Carbon Monoxide (CO)**
  - **Nitrogen Dioxide ($NO_2$)**
    - NO means nitrogen oxide.
    - $NO_X$ means oxides of nitrogen and is defined as the sum of the concentrations of $NO_2$ and NO.
    - $NO_y$ means the sum of all total *reactive* nitrogen oxides, including NO, $NO_2$, and other nitrogen oxides referred to as $NO_Z$.
  - **Particulate**
    - $PM_{2.5}$ means particulate matter with an aerodynamic diameter less than or equal to a nominal 2.5 micrometers.
    - $PM_{10}$ means particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.
  - **Lead (Pb)**
- **Volatile Organic Compounds** (VOC) - Approximately 57 of these compounds are monitored to assist in understanding the formation of ozone and how to control this pollutant.
- **Toxics** - Approximately 44 compounds, Carbonyls – 7 compounds, and metals - 7 elements are toxic and are measured to assess the risk of cancer and non cancer caused by these pollutants.
- **Speciated $PM_{2.5}$** - $PM_{2.5}$ particles are analyzed to identify their makeup (60 components including elements, radicals, elemental carbon, and organic carbon) and help assess the level of health risk and identify sources that are contributing to the levels of $PM_{2.5}$ being measured.

## Collection Methods

### Particulate samples

- **BAM-Beta Attenuation Monitor Met One BAM-1020** - This instrument provides concentration values of particulate each hour. The BAM -1020 uses the principle of beta ray attenuation to provide a simple determination of mass concentration. Beta ray attenuation: A small $^{14}C$ element emits a constant source of high-energy electrons, also known as beta particles. These beta particles are efficiently detected by an ultra-sensitive scintillation counter placed nearby. An external pump pulls a measured amount of air through a filter tape. Filter tape, impregnated with ambient dust is placed between the source and the detector thereby causing the attenuation of the measured beta-particle signal. The degree of attenuation of the beta-particle signal may be used to determine the mass concentration of particulate matter on the filter tape and hence the volumetric concentration of particulate matter in ambient air.

**The following instruments provide concentration values of particulate over a 24-hour period. Laboratory analysis is required before the concentration of particulate can be determined.**

- **Hi-Vol -** High-Volume Air Samplers (HVAS) are used to determine the concentration of particulate matter in the air. Without a size-selective inlet (SSI), all collected material is defined as total suspended (in the air) particulates (TSP), including lead (Pb) and other metals. A size-selective inlet is added for $PM_{10}$ measurement. A Hi-Volume sampler consists of two basic components: a motor similar to those used in vacuum cleaners and an air flow control system.
- **Hi-Vol-SA/GMW-321-B -** High Volume Sierra Anderson or General Metal Works (GMW) model 321-B $PM_{10}$ is a high volume air sampler system which has a selective inlet 203 cm x 254 cm filter.
- **Met One SASS -** Filters used to collect PM measurement of total mass by gravimetry, elements by x-ray fluorescence.
- **R & P $PM_{2.5}$** - Rupprecht & Potashnick $PM_{2.5}$ monitors an air sample drawn through a Teflon filter for 24 hours.

**Gaseous / criteria pollutants**

- **Instrumental - Data from these instruments is telemetered to a central computer system and values are available in near "real time".** An analyzer used to measure pollutants such as: carbon monoxide, sulfur dioxide, nitrogen oxides and ozone.

**Toxic and organic (VOC) pollutants**

- **SS Canister Pressurized -** Ambient air is collected in stainless-steel canisters, cryogenically concentrated using liquid nitrogen and analyzed for target VOCs and other organic components by GC-FID.
- **Canister Sub Ambient Pressure -** Collection of ambient air into an evacuated canister with a final canister pressure below atmospheric pressure.
- **DNPH-Coated Cartridges -** Cartridges are coated with 2,4-dinitrophenylhydrazine (DNPH). This is used for carbonyl determination in ambient air. High Performance Liquid Chromatography (HPLC) measures the carbonyl.

## Analysis Methods

### Particulate concentration

- **Gravimetric -** The determination of the quantities of the constituents of a compound, describes a set of methods for the quantitative determination of an analyte based on the weight of a solid. Laboratory analysis is needed.
- **BAM-Beta Attenuation -** The principle of beta ray attenuation to provide a simple determination of mass concentration. Instrumental – data is available in near real time.

### Composition/make-up of particulates

- **Atomic Absorption -** This analysis measures the intensity of radiation of a specific wavelength that is absorbed by an atomic vapor.

- **Energy Dispersive XRF -** Energy dispersive x-Ray Fluorescence Spectrometer for the determination of metals including Lead concentration in ambient particulate matter. The method is collected on $PM_{2.5}$ filter samples.

**Gaseous / criteria pollutants**

- **Nitrogen Oxides – Chemiluminescence -** Emission of light as a result of a chemical reaction at environmental temperatures. This analysis is used for NO, $NO_x$, and $NO_y$. $NO_2$ is calculated as $NO_x$- NO.
- **Carbon monoxide - Nondispersive infrared -** A nondispersive infrared (NDIR) gas analyzer is an instrument that measures air samples for CO content.
- **Sulfur dioxide - Pulsed Fluorescent -** Pulsed fluorescence sulfur dioxide monitor where air is drawn from the outside and passes through the analysis cell, and a high intensity burst of UV light is emitted. The sulfur dioxide responds to the specific UV wavelength generated by absorbing the energy. When the flash lamp shuts off (in a fraction of a second) the $SO_2$ fluoresces giving off an amount of photons directly proportional to the concentration of sulfur dioxide in the air.
- **Ozone - Ultra Violet -** A light, which supplies energy to a molecule being analyzed. Ozone is analyzed with UV.

**Toxic and Volatile Organic pollutants**

- **Cryogenic Preconcentration GC/FID -** Cryogenic Preconcentration Gas Chromatograph/Flame Ionization Detector - air injection volume for capillary GC combined with low concentrations of analyte require that samples be preconcentrated prior to GC analysis. Sample preconcentration is accomplished by passing a known volume of the air sample through a trap filled with fine glass beads that is cooled to -180$^o$C. With this technique, the volatile hydrocarbons of interest are quantitatively retained in the trap, whereas the bulk constituents of air (nitrogen, oxygen, etc.) are not. The air sample is collected in a vessel of known volume. A portion of this volume is analyzed and used to calculate concentration of each compound in the original air sample after Gas Chromatographic (Flame Ionization Detector, GC-FID) analysis. The sample trapped cryogenically on the glass beads is thermally desorbed into a stream of ultra-pure helium and re-trapped on the surface of a fine stainless steel capillary cooled to -180 $^o$C. This second cryogenic trapping stage "focuses" the sample into a small linear section of tubing. The cold stainless steel capillary is ballistically heated (by electrical resistance) and the focused sample quickly desorbs into the helium stream and is transferred to the chromatographic column. Cryogen (liquid nitrogen, $LN_2$) is used to obtain sub ambient temperatures in the VOC concentration and GC. This analysis is used to determine the concentration of Benzene and other organic compounds and VOC in the atmosphere.
- **GC/MS -** Gas Chromatograph/Mass Spectrometer**.** Analysis of organic or VOC are conducted using a gas chromatograph (GC) with a mass spectrometer (MS) attached as the detector. Cryogenic preconcentration with liquid nitrogen ($LN_2$) is also used to trap and concentrate sample components.
- **Thin Layer Chromatography (TLC) -** TLC is a widely used chromatography technique used to separate chemical compounds. It involves a stationary phase consisting of a thin layer of adsorbent material, usually silica gel, aluminum oxide, or cellulose immobilized onto a flat, inert carrier sheet.
- **High Pressure Liquid Chromatography (HPLC)**. The analytical method used to analyze carbonyl compounds such as acetaldehyde and formaldehyde. Carbonyl compounds are collected on the sampling media as their 2,4-dinitrohydrazine derivatives. The derivatives are separated by liquid chromatography (LC) on a packed column by

means of a solvent mixture under high pressure (HPLC) followed by UV detection of each carbonyl derivative.

# Philadelphia's Meteorology and Topography

Although Philadelphia is located less than 100 miles from the Atlantic Ocean, its climate is predominantly influenced by air masses and prevailing winds from an inland direction. The weather is highly variable, characterized by a succession of alternate high and low pressure systems moving, in general, from west to east with average velocities of 30 to 35 miles per hour (mph) in winter and 20 to 25 mph in summer.

The normal paths of practically all low pressure systems affecting weather in the United States are toward the northeast corner of the nation. About 40 percent of the low centers pass very close to Philadelphia and most of the others approach closely enough to exert some influence on Philadelphia weather, resulting in a regular change in weather patterns without any consistent periods of stagnation. The movement of high pressure centers is slowest in summer and early fall and, because the lower edge of the prevailing westerlies aloft is farthest north at the same time, high pressure centers sometimes become stationary for periods of several days near the Philadelphia area. The result is increasing atmospheric stability at such times. This condition is frequently broken up diurnally in the summer because of the length and intensity of the sun's heating during the day, but strongly stable conditions may persist for a number of successive days in almost any month. Persistent stability, lasting ten days or more, occurs infrequently: on the average, perhaps once in ten years, but it may possibly happen in successive years or more than once in the same year.

Stagnating high pressure systems which result in winds of less than seven mph for a period of seven or more days occurs seldomly. Stagnation lasting four or more days occurred much more frequently and reached a maximum in fall.

During the spring, fall and winter, the weather is dominated by cold air masses of the continental Arctic or continental polar types. These air masses are extremely stable at their source, but are subjected to heating from below as they move across the land, thus generally becoming unstable in the lower few thousand feet by the time they reach Philadelphia. In the summer, the maritime tropical air mass plays as great a part in the weather as the continental air masses. Nocturnal cooling from below produces a high frequency of temperature inversions during the summer, but these are most often broken up or weakened by heating during the day, with ensuing turbulence and mixing at the atmosphere.

Philadelphia is located on the Atlantic Coastal Plain, some 50 miles or more from the nearest mountains (Appalachian) and large bodies of water (Atlantic Ocean and Delaware Bay). The land and sea breeze effect is practically never felt at Philadelphia and the mountain-valley circulation is non-existent.

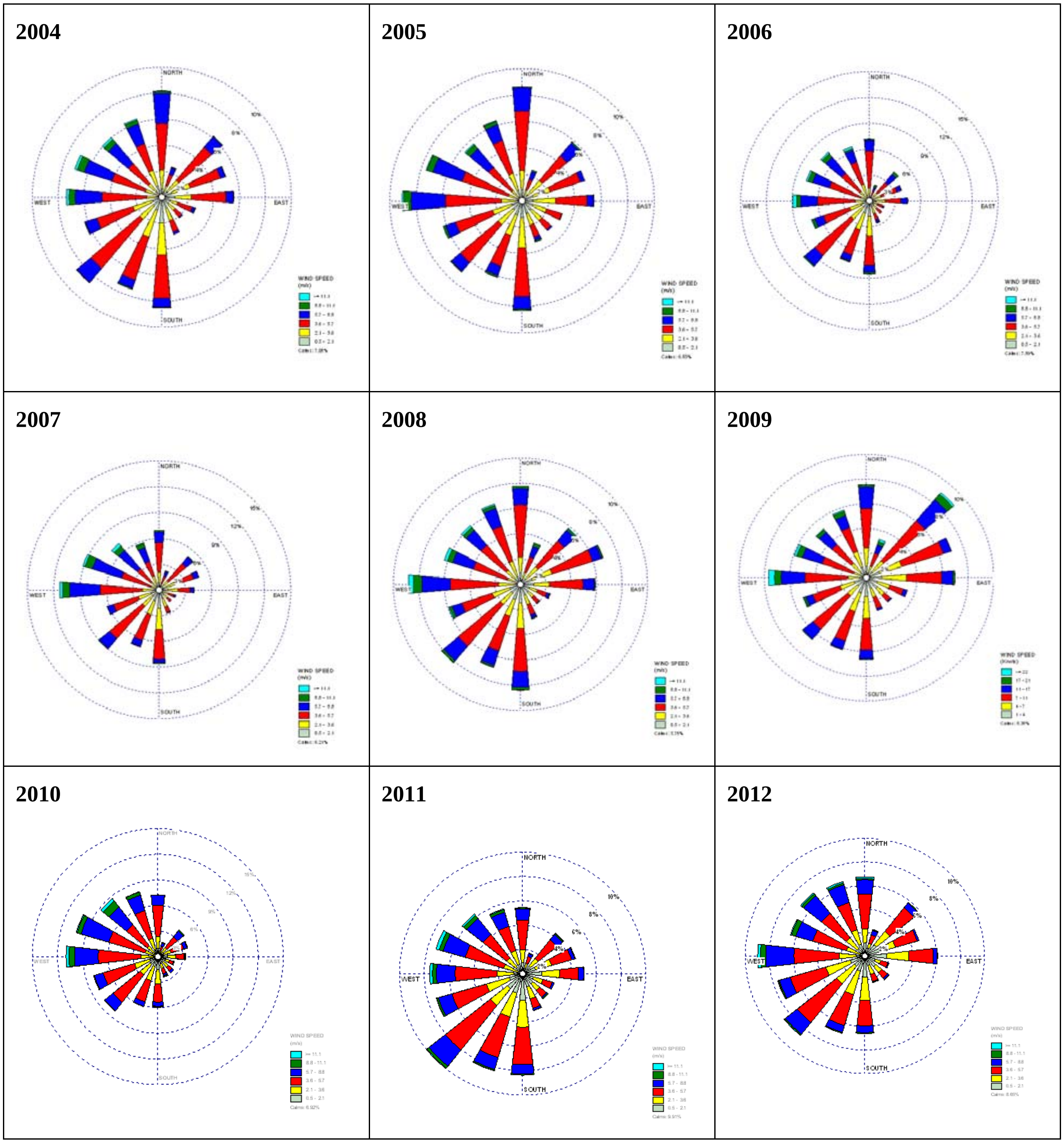
Within the City itself there are very few marked extremes in topography. Elevations range from sea level at the southern and southwestern extremities of the City to 400 to 450 feet above sea level in the northwestern section (Chestnut Hill), about ten miles away. The Wissahickon Creek and the Schuylkill River flow through the northwestern part of the City, however, and along these two streams there are some rather sharp rises in elevation, as much as 100 to 200 feet in a horizontal distance of 500 feet. Such extremes are quite limited and would not influence the meteorological patterns which affect the City as a whole. They could, of course, contribute to increased air pollution problems in a small local area within the City under certain circumstances.

In general, the topography of the City and the immediate surrounding area is such that it would make no significant contribution to increased air stagnation and stability over and above that produced by the meteorological pattern.

(Taken from “The Atmosphere over Philadelphia, Its Behavior and Its Contamination” by Francis K. Davis Jr. Ph.D., Professor of Physics, Drexel Institute of Technology October, 1960)

Figure 1 on the next page - Philadelphia Wind Rose Plots (2004 – 2012) provides information on the frequency and strength of wind in Philadelphia over a nine year period. The “rays” that make up the graph point to the direction the wind comes from. For example, wind blows most often from West to East and least often from the Southeast.

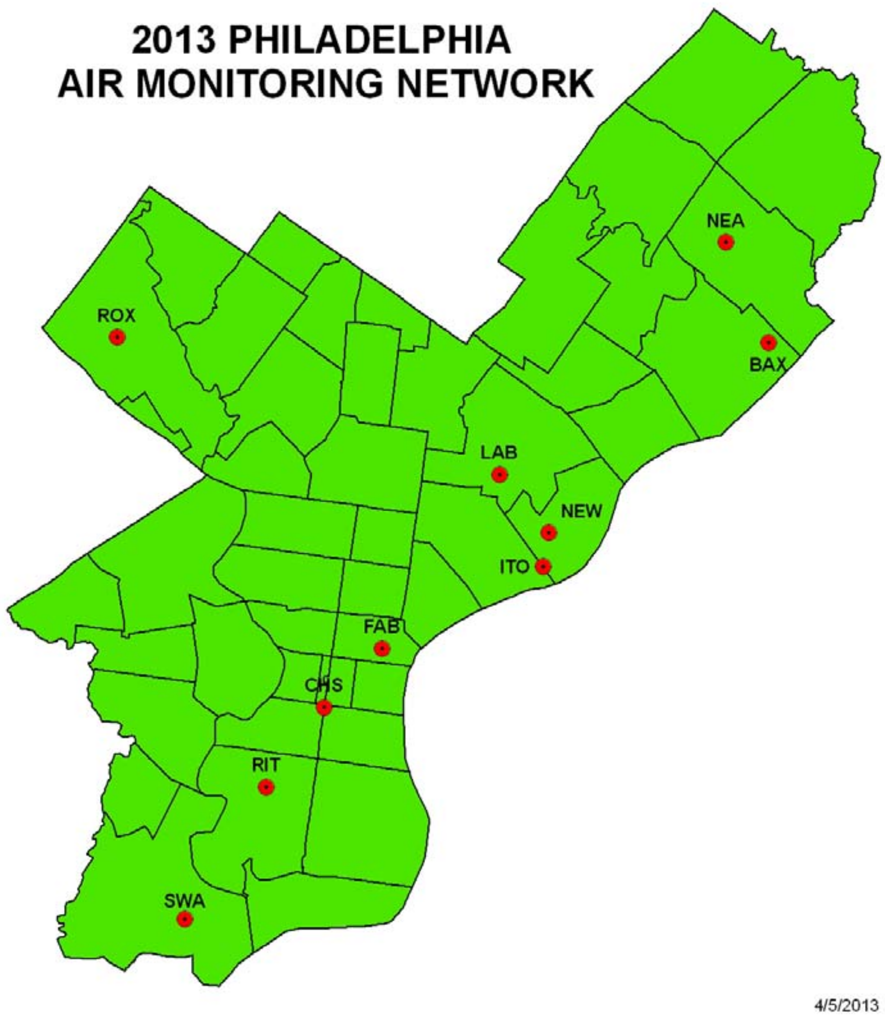
**Figure 1 - Philadelphia Wind Rose Plots (2004-2012)**



# Current Network at a Glance

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 benzene, acetaldehyde, and formaldehyde. The map below shows the location of air monitors and the pollutants measured at each monitor location.

**Figure 2 - 2013 Philadelphia Air Monitoring Network as of April 5, 2013**




| | | | 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 |

# Summary of Current Sites

All of our ten monitoring sites are located in Philadelphia, PA:

State: Pennsylvania
City: Philadelphia
County: Philadelphia
Metropolitan Statistical Area (MSA): Philadelphia-Wilmington-Atlantic City, PA-NJ-DE-MD-
MSA number: 6160
Population: 4,030,926 as of 2011 annual estimate
EPA Region: III, Philadelphia
Class 1 area: Brigantine Natural Wildlife Preserve near Atlantic City, NJ
City population: 1,526,006 as of 2010 census
Time zone: EST
UTM zone: 18

**Table 1 - Site Summary Table**

| AQS Site Code | AMS Site | Address | Statement of Purpose |
|---|---|---|---|
| **42101 0004** | **LAB** | 1501 E. Lycoming | Built in 1964, a good site for the assessment of the City's impact on precursors to the formation of ozone and is a designated PAMS site. It is a good site to test new or complex monitoring methods as laboratory staff are readily available. |
| **42101 0014** | **ROX** | Fowler & Dearnley | Periphery site |
| **42101 0024** | **NEA** | Grant & Ashton | Periphery site<br>High Ozone |
| **42101 0047** | **CHS** | 500 S. Broad | Traffic related, a site that indicates the impact of street traffic and pollutants that are transported into Center City |
| **42101 0048** | **NEW** | 3900 Richmond | This site was located to measure the impact of the facilities Franklin Smelting and Refining and MDC, which are now closed and the waste water treatment plant.<br>$PM_{10}$ levels are continuously being monitored at this site which is used in reporting the Air Quality Index (AQI). |
| **42101 0449** | **ITO** | Castor & Delaware | This site was located to measure the impact of the facilities Franklin Smelting and Refining and MDC, which are now closed.<br>Monitoring of lead has been discontinued at this site while $PM_{10}$ FRM and BaP are still being monitored. |
| **42101 0055** | **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. |
| **42101 0057** | **FAB** | 3rd & Spring Garden | This site was established to represent the highest levels of $PM_{2.5}$ in the City based on EPA Region III's air quality modeling of air toxics in Philadelphia. It shows high levels of $PM_{2.5}$ created by vehicle traffic. |
| **42101 0063** | **SWA** | 8200 Enterprise | This site was established to measure toxics, carbonyls, and metals. EPA Region III modeling analysis showed areas near the airport to have high levels of aldehydes. |
| **42101 1002** | **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 $PM_{2.5}$ FRM, speciation, and 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. |

# Direction of Future Air Monitoring

The agency will study and assess the overall monitoring program within the City to determine the course of future changes to the air monitoring network.

The agency will focus on improving the understanding of particulate and air toxic pollutants in Philadelphia. Model results from the EPA Region III Philadelphia Air Toxics Project were provided to AMS. The Philadelphia river ports and International Airport were identified as potential major contributors to health risk associated with air toxic emissions. The agency plans to pursue negotiations with the port entities in order to implement monitoring and emission inventory efforts in this location.

The agency will utilize funds received from the EPA for its Near-Road $NO_2$ Monitoring Grant to finalize the installation of the monitoring shelter at the Torresdale train station and begin the data collection/analysis phase. The utilization of this local air monitoring station will ensure compliance with the minimum $NO_2$ monitoring requirements as outlined by 40 CFR Part 58 Appendix D.

The agency will re-locate the NCore station due to property issues with the current location (BAX).

The agency will continue to utilize $PM_{2.5}$ FEMs as replacements for FRMs.

The agency will utilize the funds received from the EPA for its Community Scale Air Toxics Monitoring grant to finalize the installation of the monitors. This will enable the agency to continuously monitor air toxic pollutants such as benzene and hydrogen fluoride (HF) in the South Philadelphia community. This 3-year project will help the agency to take appropriate actions in protecting the community and to evaluate the open path monitoring method.

# Proposed Changes to the Network

Below are changes that are anticipated to occur over the next 18 months to the existing air monitoring network:

- LAB $PM_{2.5}$ FEM data: Request exclusion of 2011, 2012, and 2013 Q1 data from comparison to NAAQS and AQI (see Section "Exclusion of Certain $PM_{2.5}$ Continuous FEM Data From Comparison to the NAAQS")
- Calendar Year 2013 – June 2014
  - The NCore monitoring station at BAX will be re-located to NEW (or another approved location) before the end of 2013.
  - AMS plans to utilize $PM_{2.5}$ FEMs as replacements for FRMs.
    - RIT: $PM_{2.5}$ FEM monitor installed on June 1, 2011. The FEM was designated the primary monitor on April 1, 2013. There will be no co-located $PM_{2.5}$ FRM monitor.
    - CHS: $PM_{2.5}$ FEM monitor installed on September 4, 2011. The FEM was designated the primary monitor on April 1, 2013. A co-located $PM_{2.5}$ FRM will be operating on a 1 in 3 day schedule.
    - FAB: $PM_{2.5}$ FEM monitor installed on September 16, 2012. The projected date for designating the FEM as the primary monitor is July 1, 2013. There will be no co-located $PM_{2.5}$ FRM monitor.
  - AMS will establish and operate one Near-road $NO_2$ monitor (TOR) by January 1, 2014 (See Appendix C).
    - A CO monitor will also be established at the same location by January 1, 2014.
  - AMS plans to establish a monitoring site (PAC) near Washington Ave & S. Columbus Blvd (behind Steel Worker's Union building) or an alternative location (parking lot of Walmart at Pier 70 Blvd).
    - A monitor to measure $PM_{2.5}$, $PM_{10}$, toxics, carbonyls, and metals will be placed to assess the river port.
    - When the PAC site is established:
      - Toxics, carbonyls, and metals will no longer be monitored at ROX and will be moved to PAC.
      - $PM_{10}$ and BaP will no longer be monitored at ITO and will be moved to PAC.
        - The ITO site will be shut down.
  - AMS plans to install 2 open path monitors in South Philadelphia to continuously monitor selected air toxics at or near the Sunoco Refinery. See Appendix E of the 2012 – 2013 Air Monitoring Network Plan for additional information.
  - CHS may shut down. Based on EPA Region III modeling results, FAB was established as an alternative site to CHS.
    - If CHS is shut down, $NO_2$ and NO will be moved to RIT.

# $NO_2$ Monitoring Network

Per 40 CFR Part 58.10(a)(5), the Plan must document how AMS will establish $NO_2$ monitoring sites in accordance with the requirements of 40 CFR Part 58 Appendix D by July 1, 2012.

On January 22, 2010, EPA strengthened the health-based National Ambient Air Quality Standard (NAAQS) for nitrogen dioxide ($NO_2$) by setting a new 1-hour $NO_2$ standard at the level of 100 parts per billion (ppb). EPA is also retaining, with no change, the current annual average $NO_2$ standard of 53 ppb.

EPA also set new requirements for the placement of new $NO_2$ monitors in urban areas. The requirements are codified in 40 CFR Part 58 Appendix D 4.3.2. The final rule requires:

- 1 microscale near-road $NO_2$ monitoring station in CBSAs with population of 500,000 persons or more.
- 2 microscale near-road $NO_2$ monitoring stations in CBSAs with population of 2,500,000 persons or more, or in any CBSA with a population of 500,000 or more persons and one or more road segments with 250,000 or greater AADT counts.
- 1 $NO_2$ monitoring station in each CBSA with a population of 1,000,000 or more persons to assess community-wide concentrations.
- Monitors must be operational between January 1, 2014 and January 1, 2017.

Based on the final rule, the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD CBSA is required to have 2 near-road $NO_2$ monitoring stations.

On March 7, 2013, the EPA issued a final rule amending the implementation approach, allowing for additional time to install and operate the near-road $NO_2$ monitors. One required near-road monitor must be installed and operational by January 1, 2014, for CBSAs with 1,000,000 or more persons. The second required monitor must be installed and operational by January 1, 2015, for a CBSA with 2,500,000 or more persons, or with 500,000 or more persons that has one or more road segments of 250,000 or greater annual average daily traffic counts. This revision replaces the 2010 rule requirement that all $NO_2$ monitors be operational by January 1, 2013. AMS currently operates an $NO_2$ monitor that meets the area-wide monitoring requirements.

# CO Monitoring Network

On August 12, 2011, EPA issued a decision to retain the existing National Ambient Air Quality Standards (NAAQS) for carbon monoxide (CO). The existing primary standards are 9 parts per million (ppm) measured over 8 hours, and 35 ppm measured over 1 hour.

EPA is revising minimum requirements for CO monitoring by requiring CO monitors to be sited near roads in certain urban areas. The requirements are codified in 40 CFR Part 58 Appendix D 4.2.1. In summary, EPA is requiring one CO monitor to be collocated with a near-road $NO_2$ monitor in CBSAs having populations of 1 million or more. EPA is specifying that monitors required in CBSAs of 2.5 million or more persons are to be operational by January 1, 2015. Other CO monitors required in CBSAs having 1 million or more persons are required to be operational by January 1, 2017. The Philadelphia-Camden-Wilmington, PA-NJ-DE-MD CBSA will have a CO monitor collocated with the near-road $NO_2$ monitor and be operational by January 1, 2014.

# Changes to a Violating $PM_{2.5}$ Monitor

Per 40 CFR Part 58.10(c), the Plan must document how AMS will provide for the review of changes to a $PM_{2.5}$ monitoring network that impact the location of a violating $PM_{2.5}$ monitor or the creation/change to a community monitoring zone, including a description of the proposed use of spatial averaging for purposes of making comparisons to the annual $PM_{2.5}$ NAAQS as set forth in appendix N to 40 CFR Part 50. AMS must document the process for obtaining public comment and include any comments received through the public notification process within their submitted Plan.

On May 31, 2008, a network plan was made available for public inspection and was also posted on the City of Philadelphia website. The 2008 plan documented changes to the $PM_{2.5}$ monitoring network that impacted the location of a violating $PM_{2.5}$ monitor at 500 S. Broad Street (CHS). FAB was established as an alternative to CHS, but CHS was not shutdown.

AMS plans to replace all primary $PM_{2.5}$ FRMs with $PM_{2.5}$ continuous FEMs, starting with RIT, CHS, and FAB. As of April 1, 2013, RIT and CHS have designated the FEM monitor as the primary monitor. The projected date for designating the FEM as the primary monitor at FAB is July 1, 2013.

# Exclusion of Certain $PM_{2.5}$ Continuous FEM Data from Comparison to the NAAQS

40 CFR Part 58.11(e) documents the process for excluding $PM_{2.5}$ FEM data from comparison to the NAAQS and/or AQI if the performance criteria described in Table C-4 of Subpart C are not met when assessed with a collocated FRM monitor.

AMS is requesting $PM_{2.5}$ FEM data from 2011through the first quarter of 2013 at the LAB monitoring site (AQS ID 421010004) be excluded from comparison to the NAAQS and AQI. The request to exclude data and the assessment generated to determine FEM incomparability to a collocated FRM is located in Appendix B.

# NCore Monitoring Site – Relocation from BAX to NEW

AMS has been advised that the City of Philadelphia Water Department (PWD) is planning to construct a new underground clear well basin on the property where the current NCore station (BAX) is located. BAX must therefore be relocated prior to November 1, 2013, as construction is projected to commence on or around this date.

Due to the nature of PWD's notification and its proximity to the Air Monitoring Network Plan submittal date, AMS is unable to identify a final site for the NCore station relocation. However, AMS is currently working in conjunction with EPA Region III to analyze the possibility of relocating the NCore site to the NEW station, which is already an established monitoring station within the network.

In our 2010 – 2011 Air Monitoring Network Plan, AMS provided information regarding the NCore monitoring station at BAX.

# Detailed Information on Each Site

## LAB

**Table 2 - Detailed LAB Information with Monitoring Station Picture**

**AMS SITE ID: LAB**
**AQS Site ID: 421010004**
**Street Address: 1501 E. Lycoming Street, 19124**
**Geographical Coordinates**
**Latitude: 40.008889**
**Longitude: -75.09778**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | NAMS | Continuous | Instrumental | Nondispersive infrared | | 093 | Neighborhood | Population Exposure | 7 | 2/1/1966 |
| $SO_2$ | NAMS | Continuous | Instrumental | Pulsed Fluorescent | | 100 | Neighborhood | Population Exposure | 7 | 2/1/1966 |
| Ozone | PAMS | Continuous | Instrumental | Ultra Violet | | 87 | Neighborhood | Population Exposure | 7 | 1/1/1974 |
| $NO_2$ | NAMS, PAMS | Continuous | Instrumental | Chemiluminescence | | 99 | Urban | Population Exposure | 7 | 1/1/1977 |
| NOx | SLAMS | | Instrumental | Chemiluminescence | | 74 | Urban | Population Exposure | 7 | 1/1/1977 |
| NOy | SLAMS | Continuous | Low Level Nox Instrumental | TECO 42S Chemiluminescence | | 599 | Neighborhood | Population Exposure | | |
| NO | PAMS | | | | | | | | | |
| $PM_{2.5}$ Continuous | SLAMS | Continuous | | BAM =Beta Attenuation Monitor Met One BAM -1020 | | 170 | Neighborhood | Population Exposure | | |
| PM2.5 FRM | SPM | 1/3 days | R&P $PM_{2.5}$ | Gravimetric | | 145 | Neighborhood | Population Exposure | | |
| $PM_{10}$ SSI | NAMS | 1/6 days | Hi-Vol-SA/ GMW-321-B | Gravimetric | Analysis by EPA | 063 | Neighborhood | Population Exposure | 7 | 1/1/1999 |
| Metals (TSP Filters) | SPM | 1/6 days | Hi-Vol | Atomic Absorption | Analysis by WV (TSP sampler with quartz) | 92/89 | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| PAMS VOC | PAMS, 24 hr Real Time | 1/6 days (April, May, Sept, and Oct) | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | 101 | Middle | Highest Concentration | | |
| | PAMS, 24-hr Colocated | 1/6 days (April-Oct) | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | 101 | Middle | Highest Concentration | | |
| | PAMS, 3-hr RealTime | Daily from June-Aug, with sample every 3 hrs | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | Continuous PAMS 3 hr, samples during summer | 101 | Middle | Highest Concentration | | |
| | PAMS, 3-hr Colocated | 1/6 days (Jun -Aug) | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | 101 | Middle | Highest Concentration | | |
| Carbonyls | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | HPLC | Sampled for four 3-hour periods every 3rd day during PAMS season | 102 | Neighborhood | Population Exposure | | |
| Toxics | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | 150 | Neighborhood | Population Exposure | | |
| BaP | Urban Air Toxics | 1/6 days | Hi-Vol | Thin Layer Chromatography | | 91 | | | | |

**Figure 3 - LAB Monitoring Site Map with Major Streets and Major Emission Sources**

## AMS LABORATORY - 1501 E. LYCOMING ST.
## EPA AIRS CODE: 421010004


| PLID | NAME | STREET | 2011 EMISSIONS (in TONS/YR) CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 01551 | HONEYWELL/FRANKFORD PLT | 4700 BERMUDA STREET | 61.69 | 183.15 | 0.00 | 73.42 | 57.73 | 27.85 | 129.89 |
| 04922 | PHILA GAS WORKS/RICHMOND PLT | 3100 E VENANGO ST | 1.93 | 4.53 | 0.00 | 0.17 | 0.14 | 0.01 | 0.16 |
| 05004 | CONOCOPHILLIPS/PHILA TERM | 4210 G ST | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 34.46 |
| 09513 | NORTHEAST WPCP/PHILA | 3899 RICHMOND ST | 32.21 | 9.50 | 0.00 | 1.65 | 1.65 | 6.17 | 14.62 |
| | | **TOTAL** | **95.83** | **197.18** | **0.00** | **75.24** | **59.53** | **34.04** | **179.13** |

**Figure 4- LAB North Aerial View**

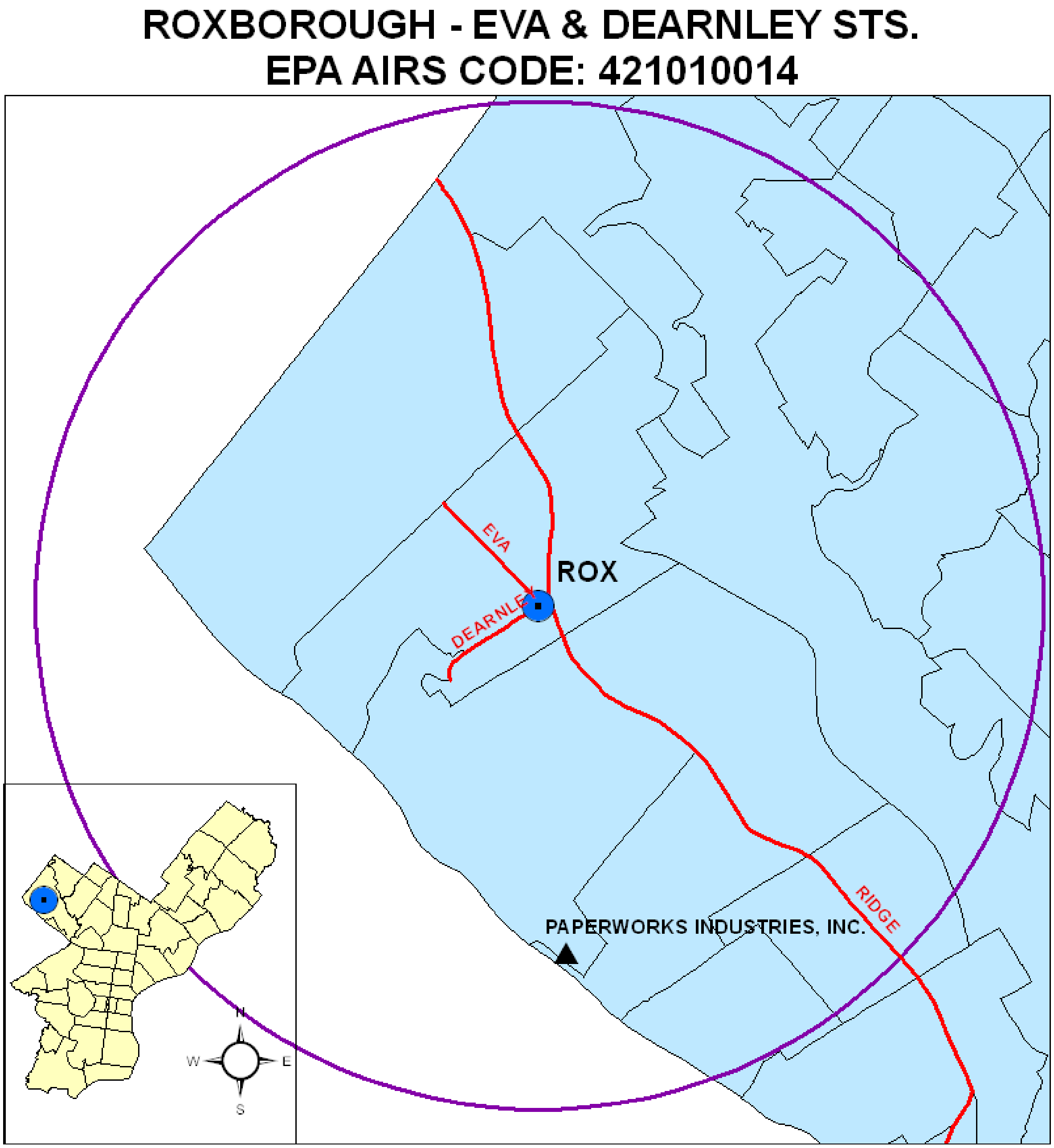
# ROX

**Table 3 – Detailed ROX Information with Monitoring Station Picture**

**AMS SITE ID: ROX**
**AQS Site ID: 421010014**
**Street Address: Fowler & Dearnley Streets**
**Geographical Coordinates**
**Latitude: 40.050000**
**Longitude: -75.240556**

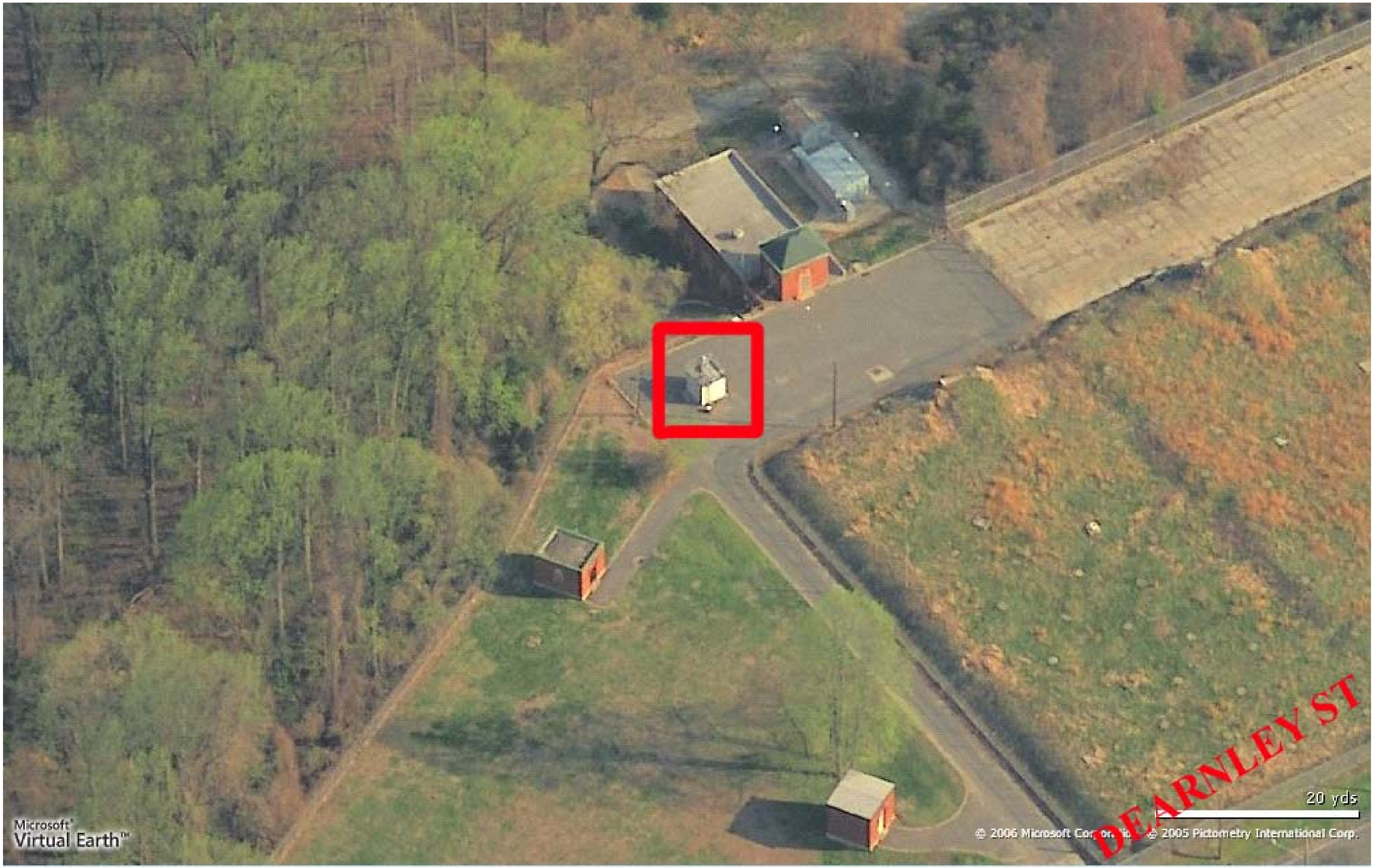
| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| Metals | SPM | 1/6 days | Hi-Vol | Atomic Absorption | Analysis by WV (TSP sampler with quartz) | 92 /89 | Neighborhood | Population Exposure | | |
| Carbonyls | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | | | 102 | Neighborhood | Population Exposure | | |
| Toxics | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | 150 | Neighborhood | Population Exposure | | |

**Figure 5 - ROX Monitoring Site Map with Major Streets and Major Emission Sources**




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 01566 | PAPERWORKS IND INC/MILL DIV | 5000 FLAT ROCK RD. | 40.30 | 127.50 | 0.00 | 0.90 | 0.90 | 0.30 | 19.74 |

**Figure 6 - ROX North Aerial View**



# NEA

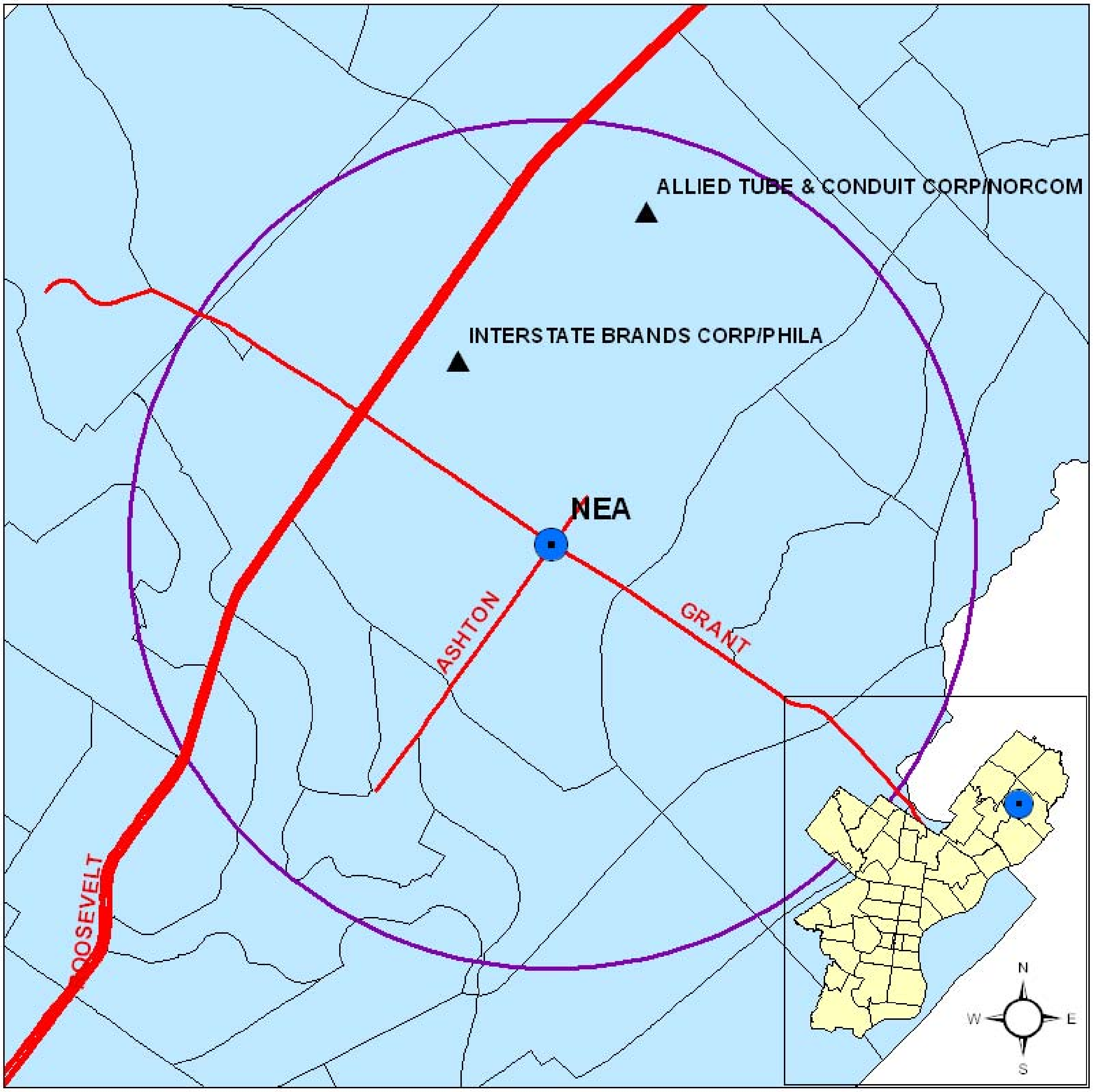
**Table 4 – Detailed NEA Information with Monitoring Station Picture**

**AMS SITE ID: NEA**
**AQS Site ID: 421010024**
**Street Address: Grant & Ashton Roads Phila NE Airport**
**Geographical Coordinates**
**Latitude: 40.076389**
**Longitude: -75.011944**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| Ozone | NAMS | Continuous | Instrumental | Ultra Violet | | 87 | Neighborhood/Middle | Population Exposure/Highest Concentration | 6 | 1/1/1974 |
| Meteorological (MET) | SLAMS | Continuous | | | | | | | | |

**Figure 7 - NEA Monitoring Site Map with Major Streets and Major Emission Sources**

# NORTHEAST AIRPORT - GRANT & ASHTON AVES.
# EPA AIRS CODE: 421010024




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 03363 | ALLIED TUBE & CONDUIT CORP/NORCOM | 11350 NORCOM RD | 0.11 | 0.13 | 0.00 | 1.88 | 0.01 | 0.00 | 38.42 |
| 05811 | INTERSTATE BRANDS CORP/PHILA | 9801 BLUE GRASS RD | 5.30 | 6.48 | 0.00 | 0.19 | 0.19 | 0.04 | 18.56 |
| | | **TOTAL** | **5.41** | **6.60** | **0.00** | **2.07** | **0.20** | **0.04** | **56.98** |

**Figure 8 - NEA North Aerial View**

# CHS

**Table 5 - Detailed CHS Information with Monitoring Station Picture**

**AMS SITE ID: CHS**
**AQS Site ID: 421010047**
**Street Address: 500 S. Broad St**
**Geographical Coordinates**
**Latitude: 39.944722**
**Longitude: -75.166111**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| $NO_2$ | SLAMS | Continuous | Instrumental | Chemiluminescence | | 99 | Neighborhood | Population Exposure | 11 | 1/1/1982 |
| NO | SPM | | | | | | | | | |
| PM2.5 FRM-D | Designated | Daily | R&P PM2.5 | Gravimetric | NAAQS Compliance Monitoring - Annual and 24 hr | 145 | Middle | Highest Concentration | 4 | 1/1/1999 |
| PM2.5 FRM-C | Colocated | Daily | | | | 145 | Middle | Highest Concentration | | |
| $PM_{2.5}$ Continuous | SPM | Continuous | | BAM =Beta Attenuation Monitor Met One BAM -1020 | | 731 | Middle | Highest Concentration | | |
| Metals | SPM | 1/6 days | Hi-Vol | Atomic Absorption | Analysis by WV (TSP sampler with quartz) | 92/89 | Neighborhood | Population Exposure | | |
| Carbonyls | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | | | 102 | Neighborhood | Population Exposure | | |
| Toxics | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | 150 | Neighborhood | Population Exposure | | |

**Figure 9 - CHS Monitoring Site Map with Major Streets and Major Emission Sources**

# COMMUNITY HEALTH CENTER #1 - 500 S. BROAD ST.
# EPA AIRS CODE: 421010047


| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 04902 | VEOLIA ENERGY EDISON/PHILA | 908 SANSOM ST | 3.00 | 23.86 | 0.00 | 3.98 | 2.59 | 47.26 | 0.35 |
| 04904 | EXELON GENERATION CO/SCHUYLKILL STA | 2800 CHRISTIAN ST | 3.42 | 35.04 | 0.00 | 3.38 | 2.50 | 42.43 | 0.47 |
| 04942 | VEOLIA ENERGY/SCHUYLKILL STA | 2600 CHRISTIAN ST | 4.90 | 125.64 | 0.00 | 36.10 | 36.10 | 239.17 | 29.86 |
| 04944 | GRAYS FERRY COGEN PARTNERSHIP/PHILA | 2600 CHRISTIAN ST | 9.89 | 192.20 | 0.00 | 19.92 | 19.92 | 11.30 | 12.36 |
| 08069 | CHILDRENS HOSP OF PHILA/ PHILA | 34TH & CIVIC CENTER BLVD | 21.14 | 23.68 | 0.00 | 2.30 | 2.30 | 0.70 | 1.77 |
| 08912 | UNIV OF PA/PHILA | 3451 WALNUT ST | 2.13 | 8.07 | 0.00 | 0.54 | 0.00 | 0.49 | 0.43 |
| 09703 | US MINT/PHILA | 151 N INDEPENDENCE MALL EAST | 1.30 | 1.45 | 0.00 | 0.01 | 0.01 | 0.01 | 0.46 |
| | | TOTAL | 45.78 | 409.93 | 0.01 | 66.23 | 63.43 | 341.37 | 45.69 |

**Figure 10 - CHS North Aerial View**

# NEW

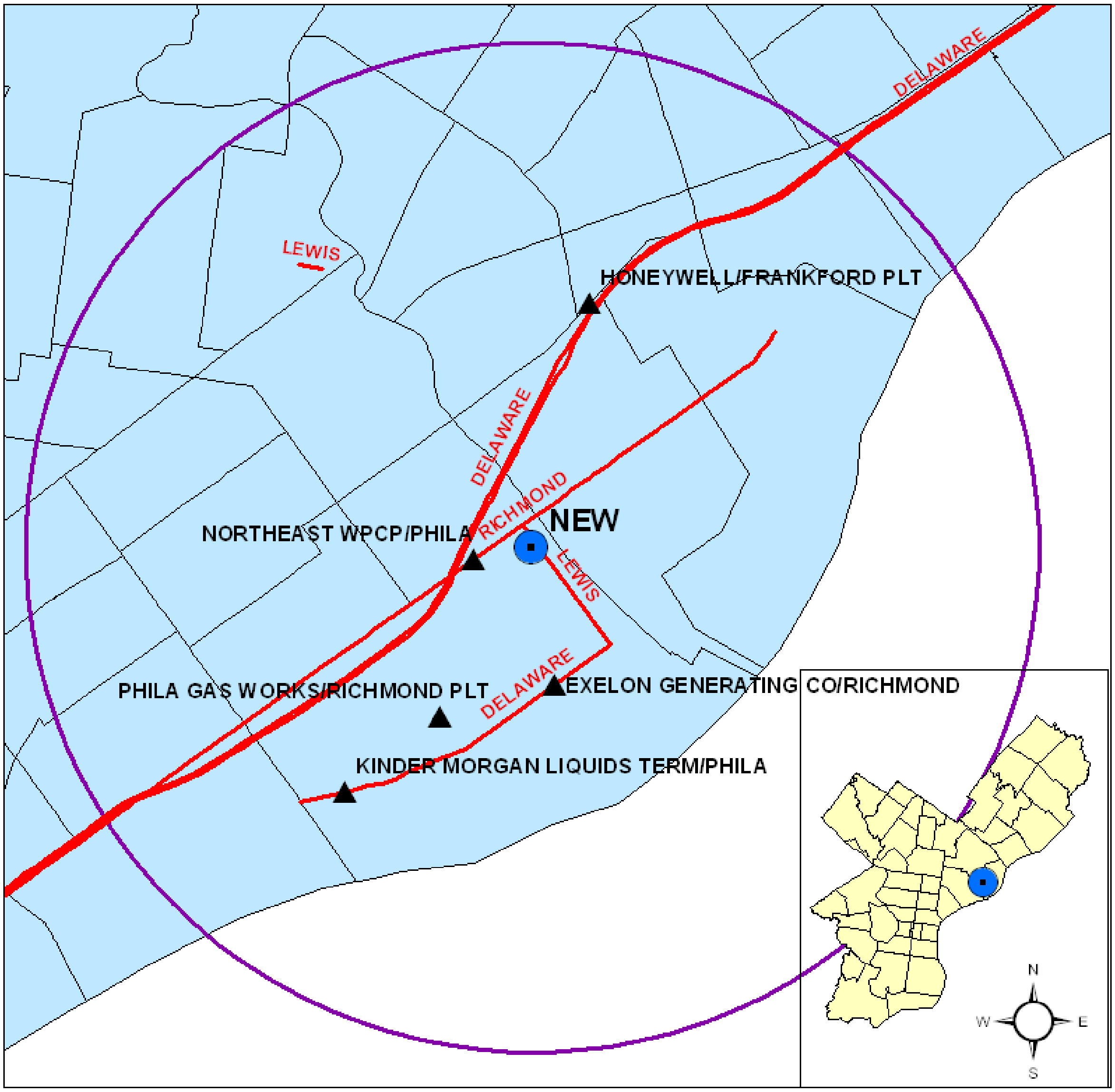
**Table 6 - Detailed NEW Information with Monitoring Station Picture**

**AMS SITE ID: NEW**
**AQS Site ID: 421010048**
**Street Address: 3900 Richmond Street**
**Geographical Coordinates**
**Latitude: 39.991389**
**Longitude: -75.080833**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| $PM_{10}$ Continuous | SPM | Continuous | | BAM =Beta Attenuation Monitor Met One BAM -1020 | Not reported to AQS | 731 | | | | 2/20/2007 |
| Meteorological (MET) | | | | | | | | | | |

**Figure 11 - NEW Monitoring Site Map with Major Streets and Major Emission Sources**

## NORTHEAST WASTE - LEWIS & RICHMOND STS.
## EPA AIRS CODE:421010048




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 01551 | HONEYWELL/FRANKFORD PLT | 4700 BERMUDA STREET | 61.69 | 183.15 | 0.00 | 73.42 | 57.73 | 27.85 | 129.89 |
| 04903 | EXELON GENERATING CO/RICHMOND | 3901 N DELAWARE AVE | 0.05 | 7.07 | 0.00 | 0.15 | 0.15 | 2.10 | 0.01 |
| 04922 | PHILA GAS WORKS/RICHMOND PLT | 3100 E VENANGO ST | 1.93 | 4.53 | 0.00 | 0.17 | 0.14 | 0.01 | 0.16 |
| 05003 | KINDER MORGAN LIQUIDS TERM/PHILA | 3300 N DELAWARE AVE | 2.49 | 4.56 | 0.00 | 0.42 | 0.37 | 1.94 | 41.24 |
| 09513 | NORTHEAST WPCP/PHILA | 3899 RICHMOND ST | 32.21 | 9.50 | 0.00 | 1.65 | 1.65 | 6.17 | 14.62 |
| | | **TOTAL** | **98.36** | **208.80** | **0.00** | **75.81** | **60.04** | **38.08** | **185.91** |

**Figure 12 - NEW North Aerial View**

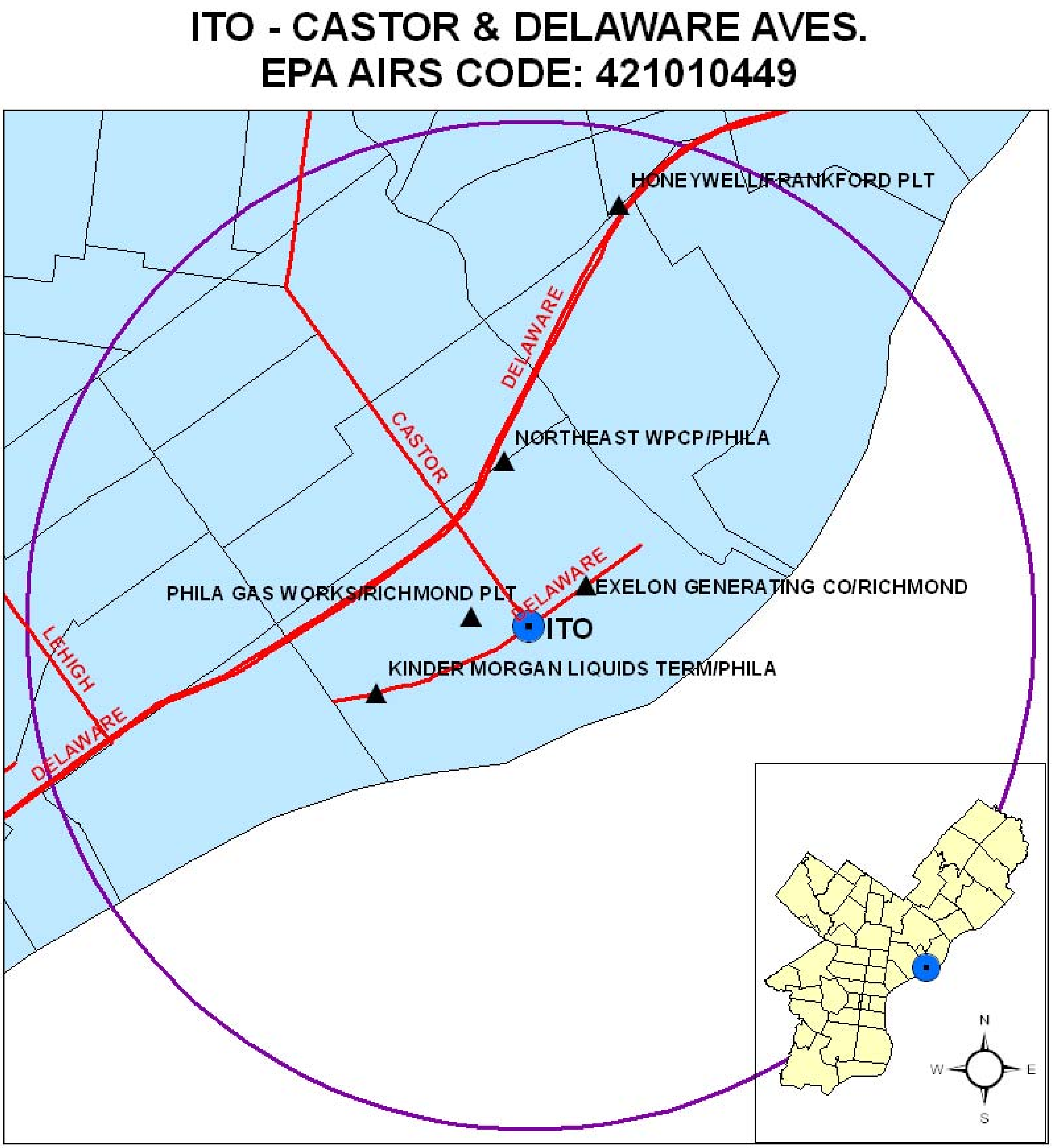
# ITO

**Table 7 - Detailed ITO Information with Monitoring Station Picture**

**AMS SITE ID: ITO**
**AQS Site ID: 421010449**
**Street Address: Castor & Delaware Avenues**
**Geographical Coordinates**
**Latitude: 39.982500**
**Longitude: -75.083056**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| ITO-S, SSI | SLAMS | 1/6 days | Hi-Vol-SA/GMW-321-B | Gravimetric | Quartz Filter | 64 | Neighborhood/Middle | Population Exposure /Highest Concentration | | |
| ITO-TC, TSP | SLAMS | 1/6 days | | | Weighed by AMS, Filter afterwards sent to Allegheny County, PA for BaP | 91 | Neighborhood/Middle | Population Exposure /Highest Concentration | | |
| BaP | Urban Air Toxics | 1/6 days | Hi-Vol | Thin Layer Chromatography | Analysis by Allegheny County, PA | 91 | Neighborhood/Middle | Population Exposure /Highest Concentration | | |

**Figure 13 - ITO Monitoring Site Map with Major Streets and Major Emission Sources**




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 01551 | HONEYWELL/FRANKFORD PLT | 4700 BERMUDA STREET | 61.69 | 183.15 | 0.00 | 73.42 | 57.73 | 27.85 | 129.89 |
| 04903 | EXELON GENERATING CO/RICHMOND | 3901 N DELAWARE AVE | 0.05 | 7.07 | 0.00 | 0.15 | 0.15 | 2.10 | 0.01 |
| 04922 | PHILA GAS WORKS/RICHMOND PLT | 3100 E VENANGO ST | 1.93 | 4.53 | 0.00 | 0.17 | 0.14 | 0.01 | 0.16 |
| 05003 | KINDER MORGAN LIQUIDS TERM/PHILA | 3300 N DELAWARE AVE | 2.49 | 4.56 | 0.00 | 0.42 | 0.37 | 1.94 | 41.24 |
| 09513 | NORTHEAST WPCP/PHILA | 3899 RICHMOND ST | 32.21 | 9.50 | 0.00 | 1.65 | 1.65 | 6.17 | 14.62 |
| | | **TOTAL** | **98.36** | **208.80** | **0.00** | **75.81** | **60.04** | **38.08** | **185.91** |

**Figure 14 - ITO North Aerial View**

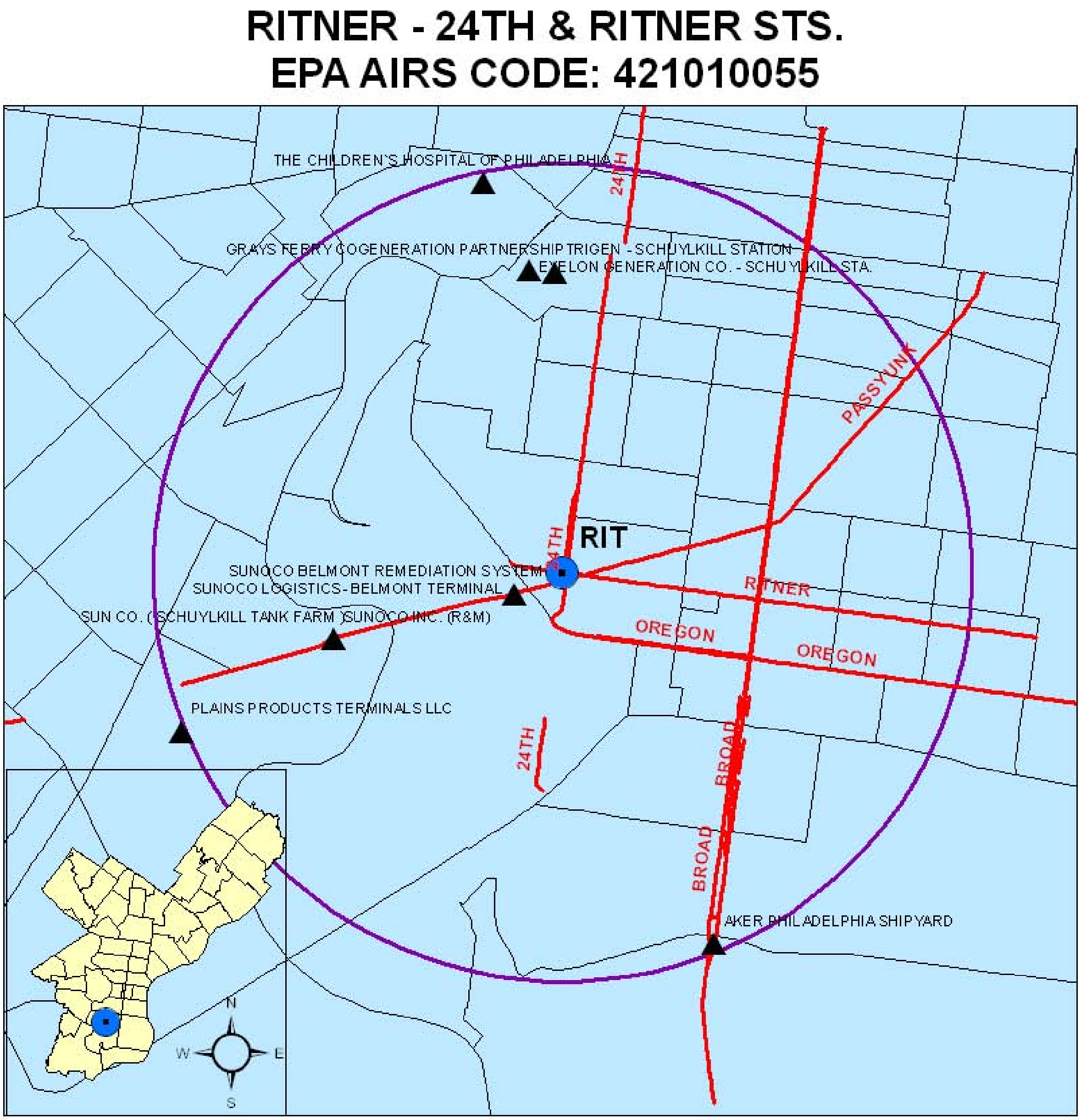
# RIT

**Table 8 - Detailed RIT Information with Monitoring Station Picture**

**AMS SITE ID: RIT**
**AQS Site ID: 421010055**
**Street Address: 24th & Ritner Streets**
**Geographical Coordinates**
**Latitude: 39.922517**
**Longitude: -75.186783**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| $SO_2$ | NAMS | Continuous | Instrumental | Pulsed Fluorescent | Very high levels momentarily exceeding 0.5 ppm, Expected to begin operation | 100 | Neighborhood | Population Exposure | 4 | 11/9/2004 |
| $PM_{2.5}$ Speciated | NAMS | Continuous | Met One SASS Teflon | Energy Dispersive XRF | Analysis by EPA | 811 | Neighborhood | Population Exposure | | |
| $PM_{2.5}$ FRM | Rover | Daily | R&P PM2.5 | Gravimetric | | 145 | Neighborhood | Population Exposure | | |
| $PM_{2.5}$ Continuous | SPM | Continuous | | BAM =Beta Attenuation Monitor Met One BAM -1020 | | 731 | Neighborhood | Population Exposure | | |
| Metals | SPM | 1/6 days | Hi-Vol | Atomic Absorption | Analysis by WV (TSP sampler with quartz) | 92 /89 | Neighborhood | Population Exposure | | |
| Carbonyls | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | | | 102 | Neighborhood | Population Exposure | | |
| Toxics | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | 150 | Neighborhood | Population Exposure | | |
| Meteorological (MET) | | Continuous | | Air quality measurements approved instrumentation for wind speed, wind direction, humidity, barometric pressure,rainfall and solar radiation | | | | | | |

**Figure 15 - RIT Monitoring Site Map with Major Streets and Major Emission Sources**




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 01501 | SUNOCO INC/ PHILA REFINERY R&M | 3144 PASSYUNK AVE | 1,772.62 | 1,315.05 | 0.00 | 385.73 | 0.00 | 297.11 | 749.36 |
| 01507 | SUNOCO LOGISTICS/BELMONT TERM | 2700 PASSYUNK AVE | 21.94 | 8.80 | 0.00 | 0.27 | 0.00 | 0.09 | 35.20 |
| 01517 | SUN CO/SCHUYLKILL TANK FARM | 3144 PASSYUNK AVE | 1.03 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 99.43 |
| 01569 | AKER PHILA SHIPYARD/SHIPBUILDING YARD | PHILA NAVAL BUS CTR | 0.92 | 0.55 | 0.00 | 4.66 | 4.61 | 0.01 | 16.31 |
| 04904 | EXELON GENERATION CO/SCHUYLKILL STA | 2800 CHRISTIAN ST | 3.42 | 35.04 | 0.00 | 3.38 | 2.50 | 42.43 | 0.47 |
| 04942 | VEOLIA ENERGY/SCHUYLKILL STA | 2600 CHRISTIAN ST | 4.90 | 125.64 | 0.00 | 36.10 | 36.10 | 239.17 | 29.86 |
| 04944 | GRAYS FERRY COGEN PARTNERSHIP/PHILA | 2600 CHRISTIAN ST | 9.89 | 192.20 | 0.00 | 19.92 | 19.92 | 11.30 | 12.36 |
| 05013 | PLAINS PROD TERM LLC/67TH ST | 3400 SOUTH 67TH STREET | 0.28 | 0.34 | 0.00 | 0.01 | 0.01 | 0.00 | 65.34 |
| 08069 | CHILDRENS HOSP OF PHILA/ PHILA | 34TH & CIVIC CENTER BLVD | 21.14 | 23.68 | 0.00 | 2.30 | 2.30 | 0.70 | 1.77 |
| | | TOTAL | 1,836.15 | 1,701.48 | 0.01 | 452.37 | 65.44 | 590.82 | 1,010.11 |

**Figure 16 - RIT North Aerial View**

# FAB

**Table 9 - Detailed FAB Information with Monitoring Station Picture**

**AMS SITE ID: FAB**
**AQS Site ID: 421010057**
**Street Address: 240 Spring Garden Street, 19123**
**Geographical Coordinates**
**Latitude: 39.960291**
**Longitude: -75.142388**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| $PM_{2.5}$ FRM | SPM | Daily | R&P PM2.5 | Gravimetric | NAAQS Compliance Monitoring - 24 hr | 145 | Neighborhood/Middle | Population Exposure/Highest Conc | 2 | 9/2007 - Rooftop 1/1/2008 - Ground Level |
| PM2.5 Continuous | SPM | Continuous | | BAM =Beta Attenuation Monitor Met One BAM -1020 | | 170 | Neighborhood/Middle | Population Exposure/Highest Conc | | 12-Oct |

**Figure 17 - FAB Monitoring Site Map with Major Streets and Major Emission Sources**

# FIRESTATION (FAB) - 3RD & SPRING GARDEN STS.
# EPA AIRS CODE: 421010057


| PLID | NAME | STREET | 2011 EMISSIONS (in TONS/YR) CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
|---|---|---|---|---|---|---|---|---|---|
| 04901 | EXELON GENERATION CO/DELAWARE STA | 1325 N BEACH ST | 0.72 | 4.76 | 0.00 | 0.29 | 0.29 | 1.36 | 0.02 |
| 04902 | VEOLIA ENERGY EDISON/PHILA | 908 SANSOM ST | 3.00 | 23.86 | 0.00 | 3.98 | 2.59 | 47.26 | 0.35 |
| 08905 | TEMPLE UNIV/ MAIN CAMPUS | 1009 W MONTGOMERY AVE | 18.21 | 26.51 | 0.00 | 1.08 | 1.08 | 0.35 | 4.38 |
| 09703 | US MINT/PHILA | 151 N INDEPENDENCE MALL EAST | 1.30 | 1.45 | 0.00 | 0.01 | 0.01 | 0.01 | 0.46 |
| | | TOTAL | **23.23** | **56.57** | **0.00** | **5.36** | **3.97** | **48.98** | **5.21** |

**Figure 18 - FAB North Aerial View**

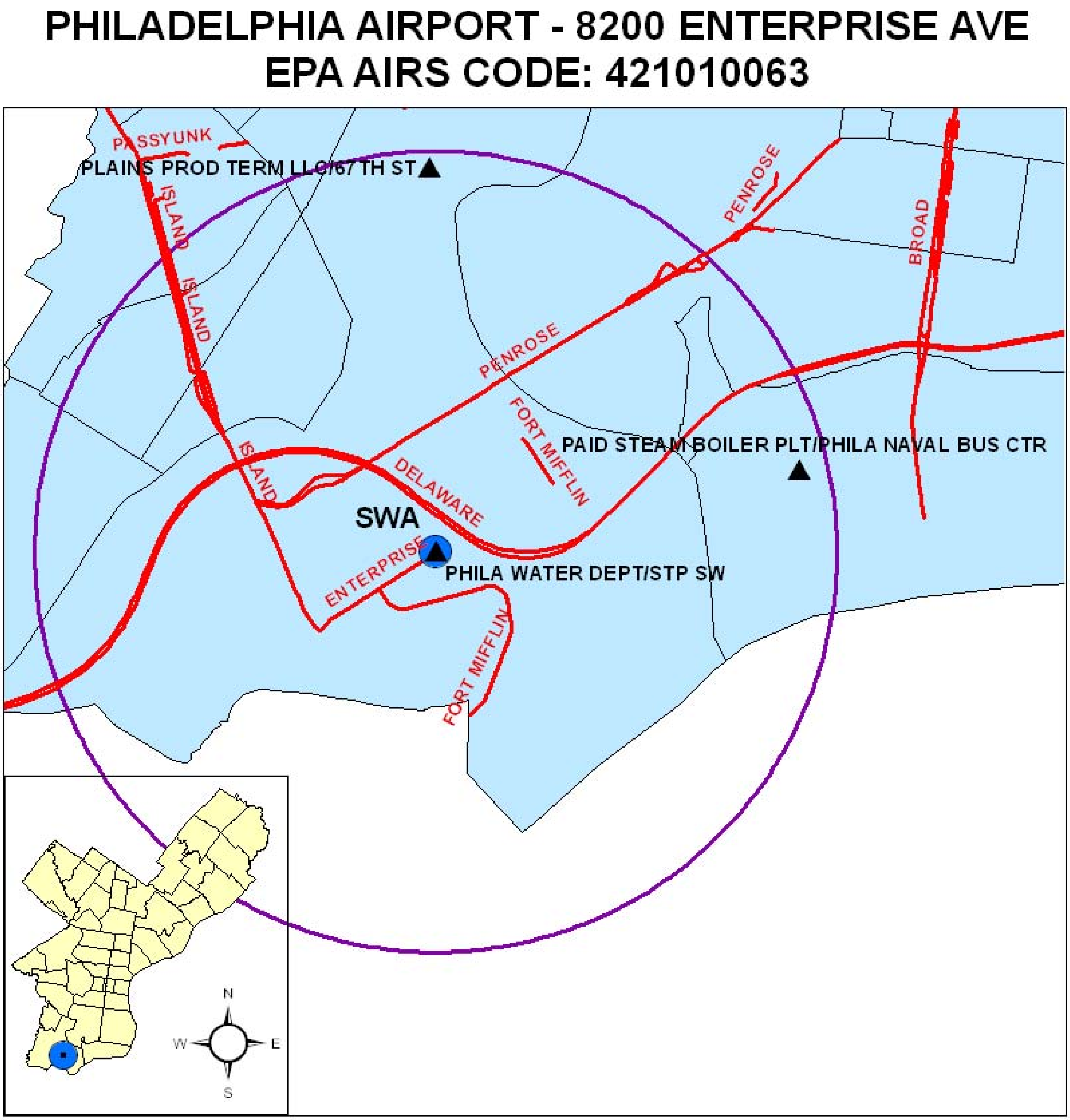
# SWA

**Table 10 - Detailed SWA Information with Monitoring Station Picture**

**AMS SITE ID: SWA**
**AQS Site ID: 421010063**
**Street Address: 8200 Enterprise Avenue, 19153**
**Geographical Coordinates**
**Latitude: 39.880115**
**Longitude: -75.222784**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| Metals | SPM | 1/6 days | Hi-Vol | ICP-MS | Analysis by WV (TSP sampler with quartz) | 92 /89 | Neighborhood | Population Exposure | | 9/10/2009 |
| Carbonyls | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | | | 102 | Neighborhood | Population Exposure | | 9/10/2009 |
| Toxics | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | 150 | Neighborhood | Population Exposure | | 9/10/2009 |

**Figure 19 - SWA Monitoring Site Map with Major Streets and Major Emission Sources**




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 05013 | PLAINS PROD TERM LLC/67TH ST | 3400 SOUTH 67TH STREET | 0.28 | 0.34 | 0.00 | 0.01 | 0.01 | 0.00 | 65.34 |
| 09515 | PHILA WATER DEPT/STP SW | 8200 ENTERPRISE AVENUE | 31.79 | 16.55 | 0.00 | 2.57 | 2.57 | 6.30 | 21.48 |
| 09715 | PAID STEAM BOILER PLT/PHILA NAVAL BUS CTR | 2000 CONSTITUTION AVENUE | 6.19 | 2.36 | 0.00 | 0.14 | 0.14 | 0.04 | 0.41 |
| | | TOTAL | 38.26 | 19.25 | 0.00 | 2.72 | 2.72 | 6.34 | 87.23 |

**Figure 20 - SWA Aerial View**

# BAX

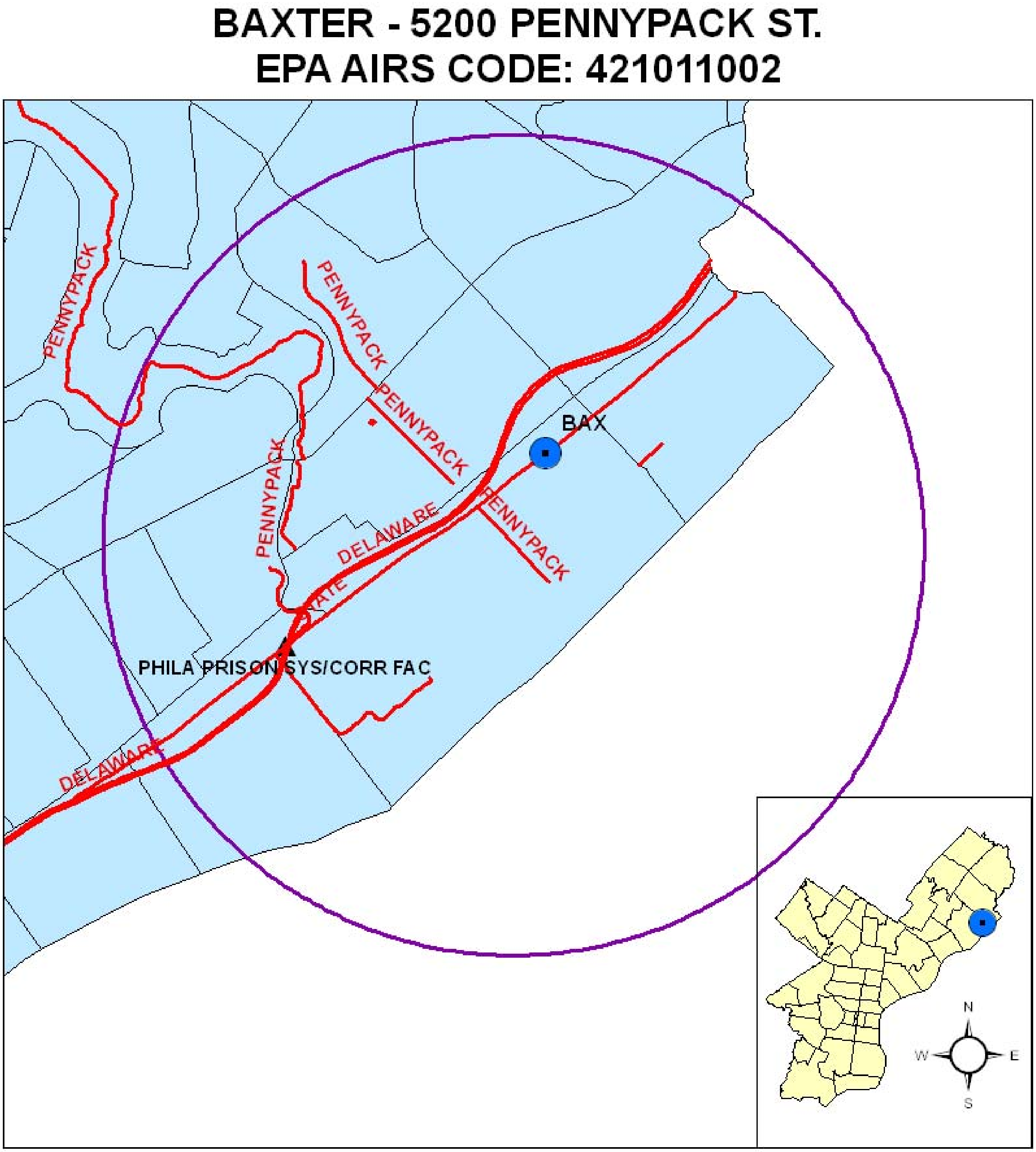
**Table 11 - Detailed BAX Information with Monitoring Station Picture**

**AMS SITE ID: BAX**
**AQS Site ID: 421011002**
**Street Address: 5200 Pennypack Park, 19136**
**Geographical Coordinates**
**Latitude: 40.035985**
**Longitude: -75.002405**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| CO (trace) | Ncore | Continuous | Instrumental | ARM utilizing trace level Non-dispersive infrared | High sensitivity | 093 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| $SO_2$ (trace) | NCore | Continuous | Instrumental | ARM utilizing trace level UV Flurorescence | High sensitivity | 100 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| Ozone | Ncore/AQI | Continuous | Instrumental | ARM utilizing Ultra Violet photomentry | Year-round operation | 087 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| NO (trace) | Ncore | | | | | | | | | |
| NOy (trace) | Ncore | Continuous | Instrumental | ARM utilizng chemiluminescence | High sensitivity external converter mounted at 10m | 599 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| $PM_{2.5}$ Continuous | Ncore/AQI | Continuous | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | FEM | 170 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| $PM_{2.5}$ Speciated | Ncore | 1/3 days | Met One SASS | Energy Dispersive XRF | Analysis by EPA | 811 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| $PM_{2.5}$ FRM | Ncore | 1/3 days | R&P $PM_{2.5}$ | Gravimetric | BAX D | 145 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| *PM10 - PM2.5 (PM Coarse) | Ncore | 1/3 days | Hi-Vol-SA/GMW-321-B | Gravimetric | BAX S (*BAX-S minus BAX D is PM Coarse) | 105 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |
| TSP-HVAS | Ncore | 1/6 days | Hi-Vol-SA/GMW-321-B | Gravimetric | Integrated samplers. Weighed by AMS | 91 | Neighborhood/ Urban | Population Exposure/Transport/Trend | | 1/1/2011 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| TSP - Lead Only | Ncore | 1/6 days | Hi-Vol | Atomic Absorption | TSP-HVAS sample collected and sent to InterMountain Laboratory (IML) | 43 | Neighborhood/ Urban | Population Exposure/Trans port/Trend | | 1/1/2011 |
| Meteorological (MET) | Ncore | Continuous | | Air quality measurements approved instrumentation for wind speed, wind direction, humidity, barometric pressure,rainfall and solar radiation | | | | | | 1/1/2011 |

**Figure 21 - BAX Monitoring Site Map with Major Streets and Major Emission Sources**




| | | | 2011 EMISSIONS (in TONS/YR) | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PLID | NAME | STREET | CO | NOX | PB | PM10 | PM2.5 | SO2 | VOC |
| 09519 | PHILA PRISON SYS/CORR FAC | 8001 STATE RD | 8.31 | 10.54 | 0.00 | 0.35 | 0.21 | 0.47 | 0.57 |

**Figure 22 - BAX Aerial View**

# Detailed Information by Pollutant

## Ozone ($O_3$)

*Principle of Operation*
The detection of ozone molecules is based on absorption of 254 nm UV light due to an internal electronic resonance of the $O_3$ molecule.

NAAQS:
Highest 4$^{th}$ daily maximum 8-Hour Concentration = 0.075 ppm

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 reactions of other pollutants. Volatile Organic Compounds (VOCs) and Nitrogen Oxides ($NO_x$) react to create ozone in the presence of heat and sunlight.

Unlike the oxygen that we breathe, which has only two atoms of oxygen ($O_2$), ozone has an additional 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.

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, and fine particles and the hazy conditions they cause. Ozone levels are consistently higher during the summer months.

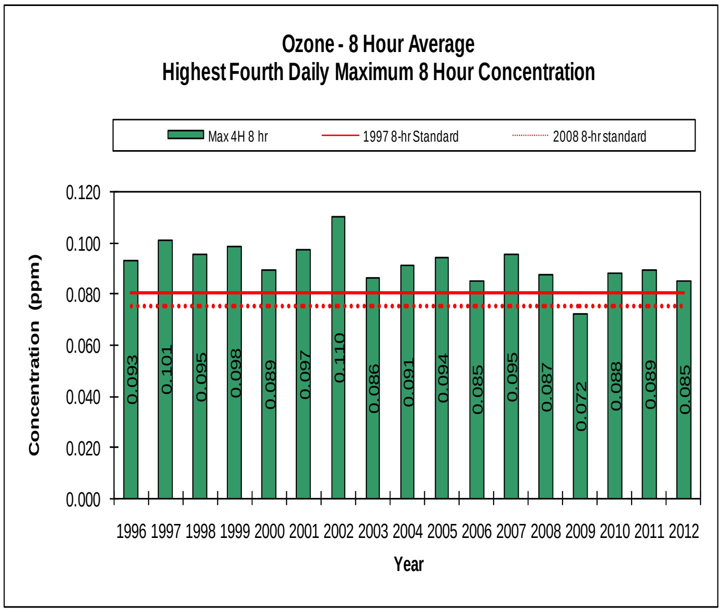
$NO_x$ are from burning of fuel in industry and motor vehicles. A significant amount of $NO_x$ that are emitted during fossil fuel combustion is Nitrogen Oxide (NO). NO reacts quickly with ozone to form oxygen ($O_2$) and nitrogen dioxide ($NO_2$). For this reason ozone levels are depressed in urban areas and increase downwind in more rural areas where there are emissions of NO. NEA was placed to indicate $O_3$ levels coming into the City and leaving the City.

VOCs are organic compounds that evaporate readily, such as gasoline vapors and paint fumes. 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 quickly to produce ozone will have a much greater impact near its source than one that reacts more slowly.

Philadelphia is in attainment for the 1997 8-hr ozone standard, but is in nonattainment for the 2008 8-hr standard. This means that the standards set by the EPA for ozone are being exceeded. AMS continues efforts with surrounding agencies to get into compliance for ozone. 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 which demonstrate how each area will attain and maintain the NAAQS. These plans are developed through a public process, formally adopted by the State, and submitted by the Governor's designee to EPA. The graph below shows ozone trends just for Philadelphia.

On March 12, 2008, EPA revised the level of the primary and secondary 8-hour ozone standards from 0.08 ppm to 0.075 ppm. EPA is reconsidering the level as the NAAQS is not as protective as recommended by EPA’s panel of science advisers, the Clean Air Scientific Advisory Committee, CASAC. In the NAAQS final rule, EPA committed to issue a separate rule to address monitoring requirements necessary to implement the new standards. On September 2, 2011, President Obama requested the Administrator Jackson to withdraw the draft Ozone NAAQS and did not support asking state and local governments to begin implementing a new standard that will soon be reconsidered since the work to revise the standard in 2013 has been underway. Presently, states are required to operate a minimum numbers of EPA-approved ozone monitors based on the population of each of their MSA and the most recently measured ozone levels for each area. States also operate additional ozone monitors to meet objectives including assessment of compliance with the NAAQS, investigation of ozone transport issues, calculations of the Air Quality Index, verification of photochemical modeling efforts, and assessment of ozone-related effects on ecosystems with natural plants sensitive to air pollution damage. EPA is lengthening the required ozone monitoring season in many states to account for the tightened level of the revised NAAQS and require ozone monitors operated as part of a new multi-pollutant network to operate on a year-round schedule when the network is fully operational in 2011. This does not affect Philadelphia because our ozone monitors run all year long.

**Figure 23 - $O_3$ Trends**




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. This standard was exceeded 19 times in 2012. AMS, along with other local and regional air quality agencies, continues to work towards compliance with ozone standards.

# Carbon Monoxide (CO)

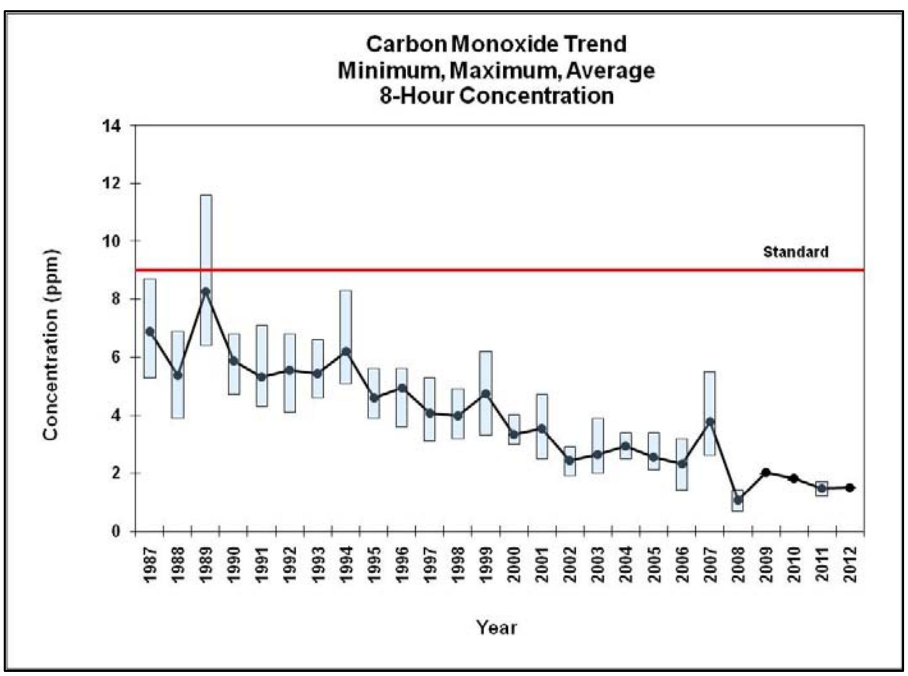
*Principle of Operation*
The basic principle by which the analyzer works is called Beer's Law. It defines the concentration of carbon monoxide by the amount of light of a specific wavelength that is absorbed by the carbon monoxide molecules over a fixed distance.

NAAQS:
Highest 2nd maximum 8-Hour Concentration = 9 ppm
Highest 2nd maximum 1-Hour Concentration = 35 ppm

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. By far the largest source of CO is motor vehicle emissions. It is for this reason an area-wide CO monitor is located at the LAB which is near roadways and per EPA promulgation in 75 FR 6474 regarding the near-road monitor requirement for $NO_2$, there will be a near-road $NO_2$ monitor that is operational by January 1, 2014 which is subsequently also used to monitor CO as codified in 40 CFR Part 58 Appendix D in Section 4.2.1. The near-road CO monitor is required to be operational by January 1, 2015 for CBSAs with 2.5 million or more persons or January 1, 2017 for CBSAs with population of 1 million or more persons, but less than 2.5 million persons. Weather greatly affects CO levels, and peak CO concentrations typically occur during the colder months of the year.

Over the last two decades, 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.

**Figure 24 - CO Trends**



# Nitrogen Dioxide ($NO_2$)

*Principle of Operation*
The concentration of nitric oxide [NO], total oxides of nitrogen [$NO_X$] and, by calculation, nitrogen dioxide [$NO_2$] is determined in a single instrument. The chemical reaction between nitric oxide [NO] and ozone [$O_3$] produces light (chemiluminescence). The concentration of nitric oxide is determined by the intensity of the light.

NAAQS:
Highest Annual Arithmetic Mean Concentration = 0.053 ppm
Highest 3-year average $98^{th}$ percentile daily 1-Hour Concentration = 100 ppb

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.

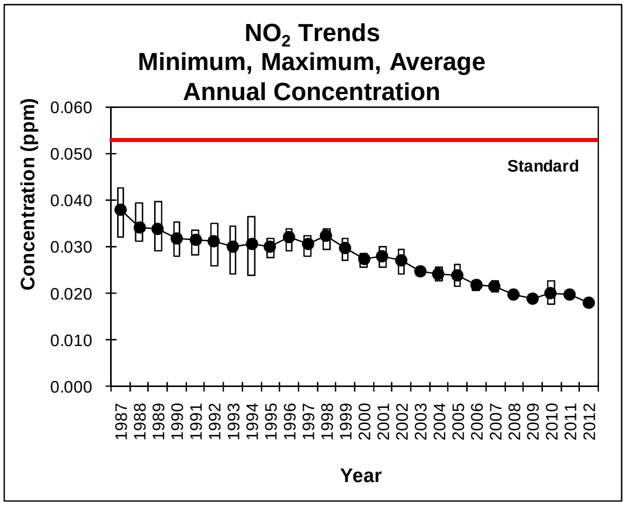
Nitrogen dioxide can irritate the lungs and lower resistance to respiratory infections such as influenza. Nitrogen oxides ($NO_X$) are an important precursor to both ozone and acid rain and can affect both land and water ecosystems. They contribute to the formation of fine particulate matter, haze and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

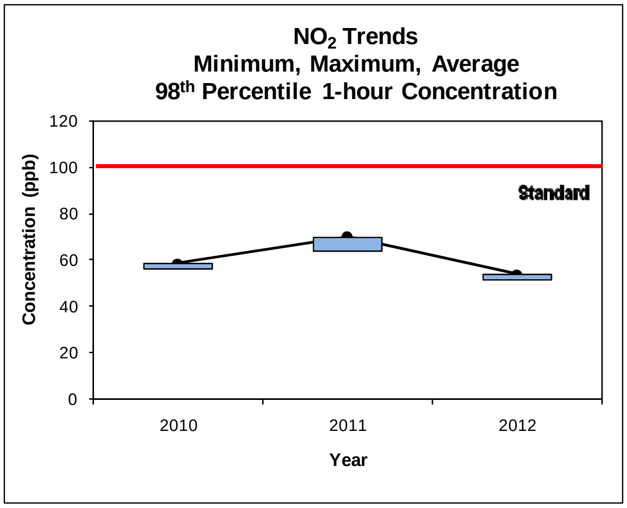
Ambient levels of nitrogen dioxide in Philadelphia are better than the NAAQS, showing a sustained downward trend over time for the annual standard.

On January 22, 2010, the EPA added the primary 1-hour $NO_2$ standard of 100 ppb, to protect against short-term exposures, typically near major roads. After careful review of the best available science, on March 20, 2012, the EPA retained the secondary annual $NO_2$ standard of 0.053 ppm to protect against environmental damage typically effecting plants, soils, lakes, and streams. Trends are shown below for Philadelphia over the last few years.

On March 7, 2013, the EPA issued a final rule establishing deadlines that require any new near-road monitors to be operational between January 1, 2014 and January 1, 2017. This rule replaces the 2010 rule which established deadlines that required new $NO_2$ monitors to be operational by January 1, 2013. Currently, AMS aims to have the Torresdale near-road monitoring site operational by January 1, 2014.

**Figure 25 - $NO_2$ Trends**



# Sulfur Dioxide ($SO_2$)

*Principle of Operation*
The concentration of $SO_2$ is based upon the measurement of fluorescence of $SO_2$ when it is exposed to Ultra Violet (UV) light (absorption of UV energy).

NAAQS:

Highest 99$^{th}$ percentile daily 1-hour Concentration = 75 ppb
Highest daily 3-hour Concentration (secondary standard) = 0.5 ppm

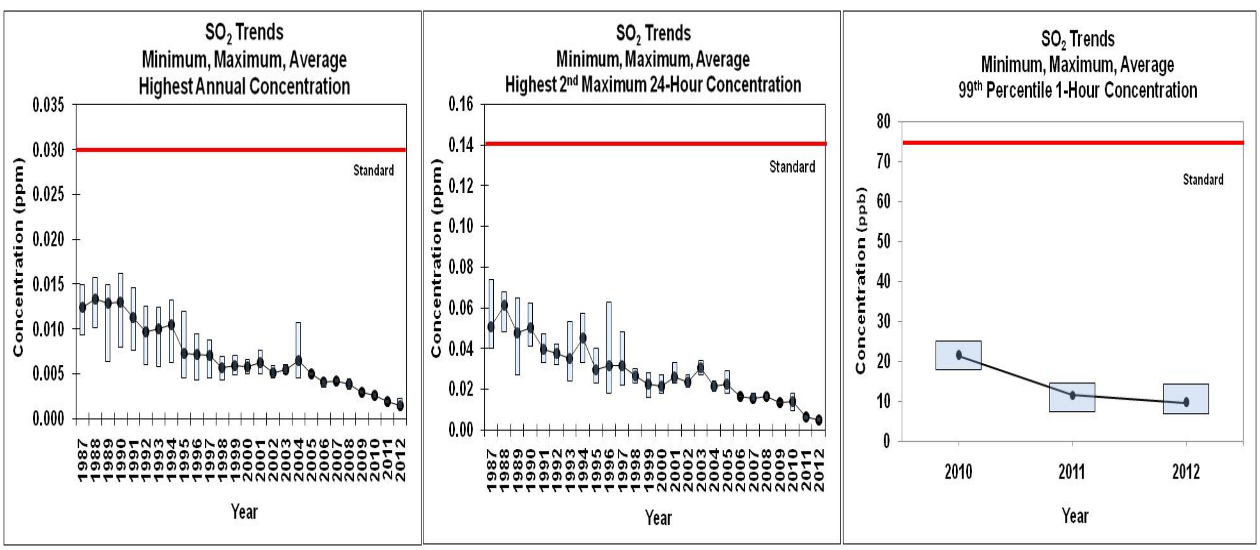
$SO_2$ is emitted from the burning of fuels that contain sulfur. Industrial grade fuel oils are the primary source in Philadelphia.

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. Monitors are placed to better understand the impact of the City's major emitters of $SO_2$.

$SO_2$ 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. In October 2006, ultra low sulfur diesel (ULSD) came on line for on-road vehicles; producers were required to begin producing ultra ULSD to comply with new requirements that 80% of diesel fuel used for on-road vehicles must be ULSD.

On June 2, 2010, EPA revoked the primary annual and 24-hour $SO_2$ standards of 30 ppb and 140 ppb, respectively, to a 1-hour standard of 75 ppb. After careful review of the best available science, on March 20, 2012, the EPA retained the secondary 3-hour $SO_2$ standard of 0.5 ppm to protect against environmental damage, typically effecting plants, soils, lakes, and streams.

**Figure 26 - $SO_2$ Trends**



# Lead (Pb)

NAAQS:
Highest 3-Month Rolling Average Concentration = 0.15 μg/m$^3$

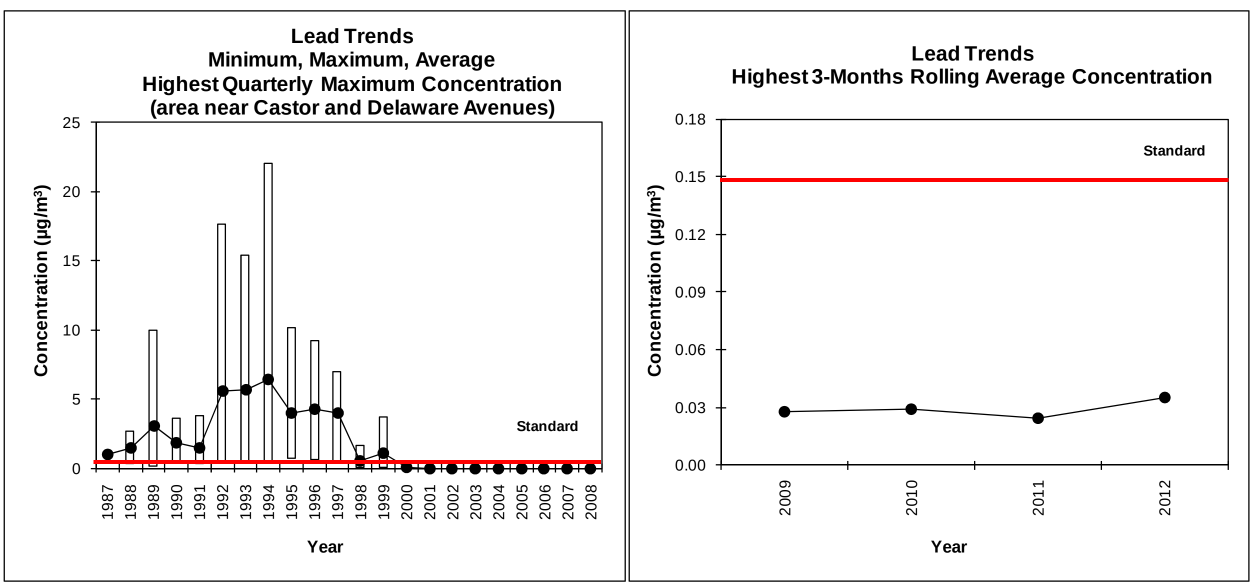
The processing of metals is the major source of lead emissions to the atmosphere. It does not travel over great distances in the air and so concentrations vary, with highest levels near particular industrial sites.

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 decreased significantly throughout the City due to the use of unleaded gasoline and greater control of emissions from companies that produce or process lead compounds. Lead levels in certain parts of the City were extremely high in the 1980's and 1990's due to the concentration of particular industries in the area. This is reflected in the previously high readings for monitors near Castor and Delaware Avenues. The levels of lead in these areas have drastically improved, and are now comparable to the rest of the City. Currently, AMS measures for ambient lead only at the BAX location.

On November 12, 2008, EPA strengthened the lead NAAQS standard from 1.5 μg/m$^3$ to 0.15 μg/m$^3$, measured as total suspended particles (TSP). AMS meets the new standard. EPA requires monitoring near lead sources with emissions of 0.5 to 1.0 tons per year. Philadelphia has no sources that emit 0.5 or more tons of Pb per year.

**Figure 27 - Lead (Pb) Trends**



# Particulate Matter

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 $PM_{2.5}$ are small particulate matter that measure less than 10 micrometers (0.00001 meters) and 2.5 micrometers (0.0000025 meters) respectively (1/30 thickness of human hair). These small particles penetrate deeply into the respiratory system and can have adverse health effects. In addition to health problems, particulate matter can cause reduced visibility, soiling, and damage to materials.

In 1997, the EPA revised the National Ambient Air Quality Standards to include fine particulate. Fine particles are made up of both primary (combustion) and secondary (formed in the air) sources. Particles remain airborne for long periods of time and disperse in uniform concentrations across wide areas, crossing geographic boundaries.

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. 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.

## Particulate Matter of less than 10 microns ($PM_{10}$)

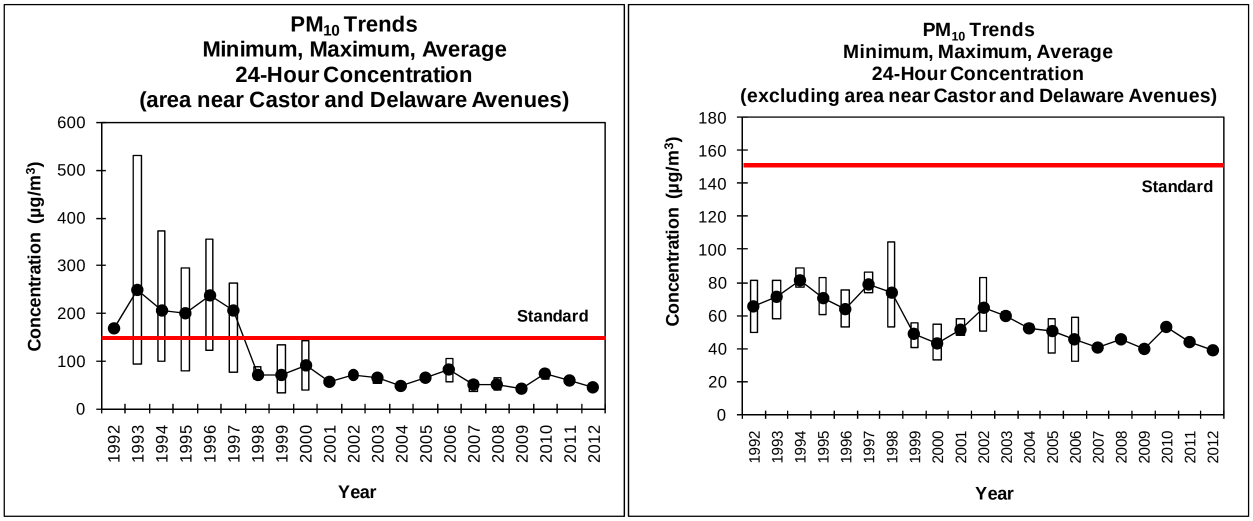
### $PM_{10}$

NAAQS:
Highest 2$^{nd}$ Maximum 24-Hour Concentration = 150 $\mu g/m^3$

Particulate matter levels have been decreasing due to regulations limiting the amount of emissions allowed and the change to cleaner fuels such as natural gas by industry, businesses and homes.

There are two sets of trend charts shown for this pollutant. 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 chart is presented to highlight that fact. Specific action 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. Continuous $PM_{10}$ data is used in the Air Quality Index. The graphs on the following page show $PM_{10}$ trends.

**Figure 28 - $PM_{10}$ Trends**




## Particulate Matter of less than 2.5 microns ($PM_{2.5}$)

### $PM_{2.5}$

NAAQS:
1997 Highest Annual Mean Concentration = 15 $\mu g/m^3$
2012 Highest Annual Mean Concentration = 12 $\mu g/m^3$
Highest 98$^{th}$ Percentile 24-Hour Concentration = 35 $\mu g/m^3$

$PM_{2.5}$ 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, increased respiratory symptoms and disease, and decreased lung functions. Sensitive groups that appear to be at the greatest risk for such effects include the elderly, children, and individuals with cardiopulmonary disease or respiratory ailments such as asthma.

In December 14, 2012, EPA strengthened the annual health standard for $PM_{2.5}$, from 15 $\mu g/m^3$ (the annual primary standard that was set in 1997) to 12 $\mu g/m^3$. EPA retains the existing the 24-hour health standard at 35 $\mu g/m^3$ that was issued in 2006. The final rule is effective as of March 18, 2013.

Measuring $PM_{2.5}$ requires highly sensitive equipment under tight temperature and humidity control. Philadelphia was in nonattainment for the 24-hour $PM_{2.5}$ standard, but is now in attainment for both annual and 24-hour $PM_{2.5}$ standards.

Monitors are placed to assess public exposure high levels. Continuous $PM_{2.5}$ data is used in the

Air Quality Index for some sites. Speciation shows the make-up of $PM_{2.5}$ in the City in general and the impact of large sources of emissions.

Figure 29 shows that Philadelphia has met the $PM_{2.5}$ 24-hour standard since 2008. The Design Value of the 24-hour standard which is used to demonstrate attainment, is based on a 3-year average of annual 98th percentile values. Figure 30 shows Philadelphia based on the site 421010047 (CHS) met the annual $PM_{2.5}$ standard for design value period of 2010 - 2012. CHS is one of five $PM_{2.5}$ monitoring sites that historically has experienced the highest $PM_{2.5}$ concentration. The Design Value is based on a 3-year average of annual averages.

**Figure 29 - $PM_{2.5}$ Trends**

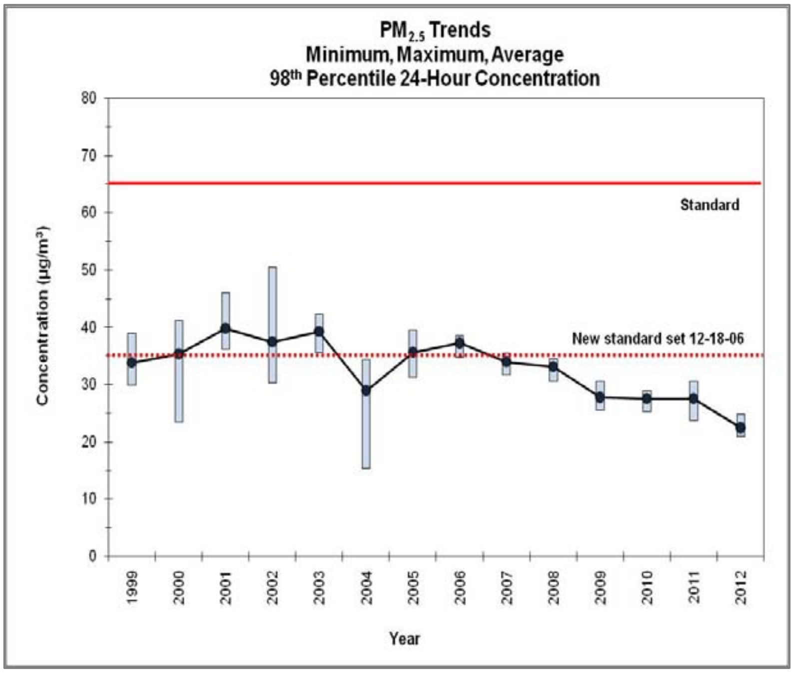
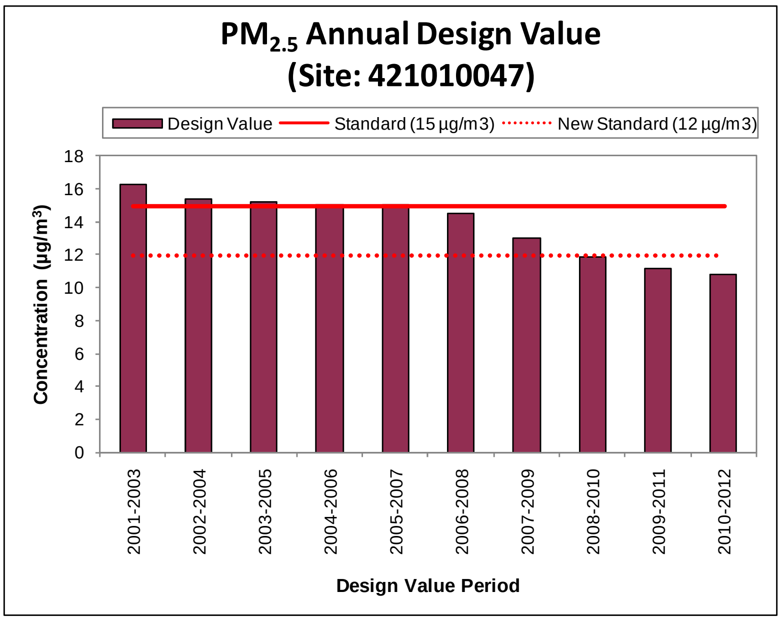



**Figure 30 - $PM_{2.5}$ Design Values**



# Toxics

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 lists 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), and 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).

The mix of monitor locations provides information on public exposure from major industry, road traffic, and background.

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. Risk is often expressed as the additional number of deaths that would occur over 70 years (a lifetime) than would have occurred without that ambient concentration of that pollutant. For example, one in a million implies that one person out of every million people would live longer without that amount of that pollutant in the air.

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 (NESHAP), a program 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 not quantified, contributing factor to 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. The group is currently compiling lists of diesel fleets interested in initiating retrofit or clean fuel projects. The list may help position the Philadelphia area for anticipated Federal funding. More information on this program can be found at http://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), Roxborough (ROX), Ritner (RIT) and PHL Airport (SWA) monitoring sites.

As part of EPA's National Air Toxics Assessment (NATA) activities, the latest, the 2005 NATA, was made available to the public in March 11, 2011. 180 of the 187 Clean Air Act air toxics plus diesel particulate matter 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 will be 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:

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

The 2005 NATA indicated high health risks in the City. Philadelphia ranked 87$^{th}$ in the country based on average 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 emission 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 the airport appear to be a significant source of diesel particulate.

AMS has determined 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.

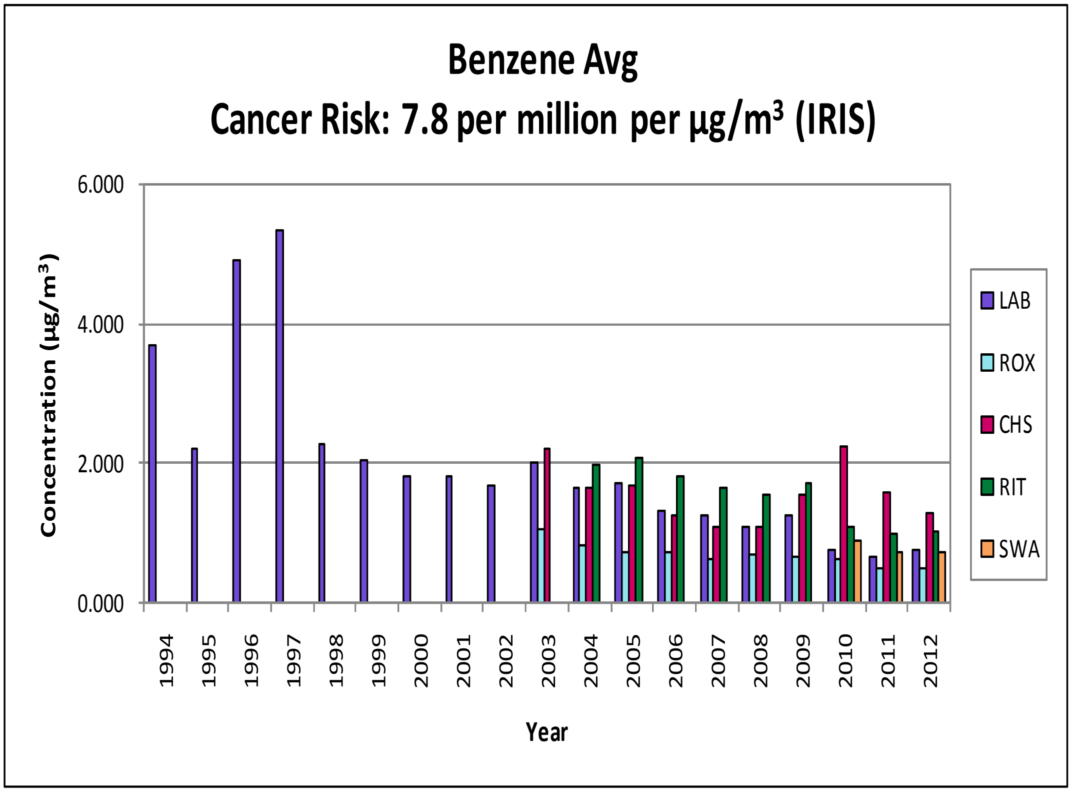
The risk calculation is based upon the standard methodology used by EPA. The excess lifetime cancer risk for each of the chemical compounds was calculated using unit risk factors (URFs). The URF is the measure of the probability of developing cancer from exposure over a lifetime to a specified concentration of a given chemical. Air toxics that are being measured in Philadelphia that show an excess lifetime cancer risk of 1 or more out of a million are:

**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.
**acetaldehyde** (Cas RN 75-07-0) - A colorless liquid or gas with a fruity odor. It is used to manufacture many other chemicals.
**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.
**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.
**tetrachloroethylene** (Cas RN 127-18-4) - A clear liquid with a sweet, chloroform-like odor. It is used in dry cleaning and metal degreasing. Its other common name is perchloroethylene.

Below is a graph of benzene trends over time.

**Figure 31 - Benzene Trends**



# Appendix A: Probe and Monitoring Path Siting Criteria

Below is a summary of the general requirements for probe and monitoring path siting criteria.

**Table A.1 - Table E-4 of Appendix E to 40 CFR Part 58 - Summary of Probe and Monitoring Path Siting Criteria**

| **Pollutant** | **Scale (maximum monitoring path length, meters** | **Height from ground to probe, inlet or 80% of monitoring path \1** | **Horizontal and vertical distance from supporting structures \2\ to probe, inlet or 90% of monitoring path \1\ (meters)** | **Distance from trees to probe, inlet or 90% of monitoring path \1\ meters** | **Distance from roadways to probe, inlet or monitoring path \1\ (meters)** |
|---|---|---|---|---|---|
| **$SO_2$** \3\,\4\,\5\,\6\ | Middle (300 m) Neighborhood, Urban and Regional (1 km) | 2-15 | > 1 | > 10 | N/A |
| **CO** \4\,\5\,\7\ | Micro (downtown or street canyon sites, near-road), middle (300 m) Neighborhood (1 km) | 2.5-3.5; 2-7; 2-15 | > 1 | > 10 | 2-10; downtown areas or street canyon microscale; 50 for near-road microscale; See Table E-2 of 40 CFR 58 Appendix E for middle and neighborhood scales |
| **$O_3$** \3\,\4\,\5\ | Middle (300 m) Neighborhood, Urban, and Regional (1 km) | 2-15 | > 1 | > 10 | See Table E-1 of 40 CFR 58 Appendix E for all scales |
| **$NO_2$ \3\,\4\,\5** | Micro (Near-road [50-300]) Middle (300 m) Neighborhood, Urban, and Regional (1 km) | 2-7 (micro); 2-15 (all other scales) | > 1 | > 10 | 50 meters for near-road microscale; See Table E-1 of 40 CFR 58 Appendix E for all other scales |
| **$O_3$ precursors (for PAMS)** \3\,\4\,\5\ | Neighborhood and Urban (1 km) | 2-15 | > 1 | > 10 | See Table E-4 of 40 CFR 58 Appendix E for all scales |
| **PM, Pb** \3\,\4\,\5\,\6\,\8\ | Micro: Middle, Neighborhood, Urban and Regional | 2-7 (micro); 2-7 (middle $PM_{10-2.5}$); 2-15 (all other scales) | > 2 (all scales, horizontal distance only) | > 10 (all scales) | 2-10 (micro); See Figure E-1 of 40 CFR 58 for all other scales |

N/A_Not applicable.
\1\ Monitoring path for open path analyzers is applicable only to middle or neighborhood scale CO monitoring, middle, neighborhood, urban, and regional scale $NO_2$ monitoring, and all applicable scales for monitoring $SO_2$,$O_3$, and $O_3$ precursors.
\2\ When probe is located on a rooftop, this separation distance is in reference to walls, parapets, or penthouses located on roof.
\3\ Should be >20 meters from the drip-line of tree(s) and must be 10 meters from the drip-line when the tree(s) act as an obstruction.
\4\ Distance from sampler, probe, or 90% of monitoring path to obstacle, such as a building, must be at least twice the height the obstacle protrudes above the sampler, probe, or monitoring path. Sites not meeting this criterion may be classified as middle scale (see text).
\5\ Must have unrestricted airflow 270 degrees around the probe or sampler; 180 degrees if the probe is on the side of a building or a wall.
\6\ The probe, sampler, or monitoring path should be away from minor sources, such as furnace or incineration flues. The separation distance is dependent on the height of the minor source's emission point (such as a flue), the type of fuel or waste burned, and the quality of the fuel (sulfur, ash, or lead content). This criterion is designed to avoid undue influences from minor sources.
\7\ For microscale CO monitoring sites, the probe must be >10 meters from a street intersection and preferably at a midblock location.
\8\ Collocated monitors must be within 4 meters of each other and at least 2 meters apart for flow rates greater than 200 liters/min or at least 1 meter apart for samplers having flow rates less than 200 liters/min to preclude airflow interference.

**Table A.2 - Table E-2 to Appendix E of Part 58. Minimum Separation Distance Between Roadways and Probes or Monitoring Paths for Monitoring Neighborhood Scale Carbon Monoxide**

| Roadway average daily traffic, vehicles per day | Minimum distance \9\ (meters) |
| --- | --- |
| ≤10,000 | 10 |
| 15,000 | 25 |
| 20,000 | 45 |
| 30,000 | 80 |
| 40,000 | 115 |
| 50,000 | 135 |
| ≥60,000 | 150 |

\9\ Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.

**Table A.3 - Table E-1 to Appendix E of Part 58. Minimum Separation Distance Between Roadways and Probes or Monitoring Paths for Monitoring Neighborhood and Urban Scale Ozone (O3) and Oxides of Nitrogen (NO, NO2, NOx, NOy)**

| Roadway average daily traffic, vehicles per day | Minimum distance \10\ (meters) | Minimum distance \10\,\11 (meters) |
|---|---|---|
| ≤1,000 | 10 | 10 |
| 10,000 | 10 | 20 |
| 15,000 | 20 | 30 |
| 20,000 | 30 | 40 |
| 40,000 | 50 | 60 |
| 70,000 | 100 | 100 |
| ≥110,000 | 250 | 250 |

\10\ Distance from the edge of the nearest traffic lane. The distance for intermediate traffic counts should be interpolated from the table values based on the actual traffic count.
\11\ Applicable for ozone monitors whose placement has not already been approved as of December 18, 2006.

Values based on the actual traffic count.

**Figure A.1 – Figure E-1, 40 Part 58 Appendix E – Distance of PM Samplers to Nearest Traffic Lane (meters)**

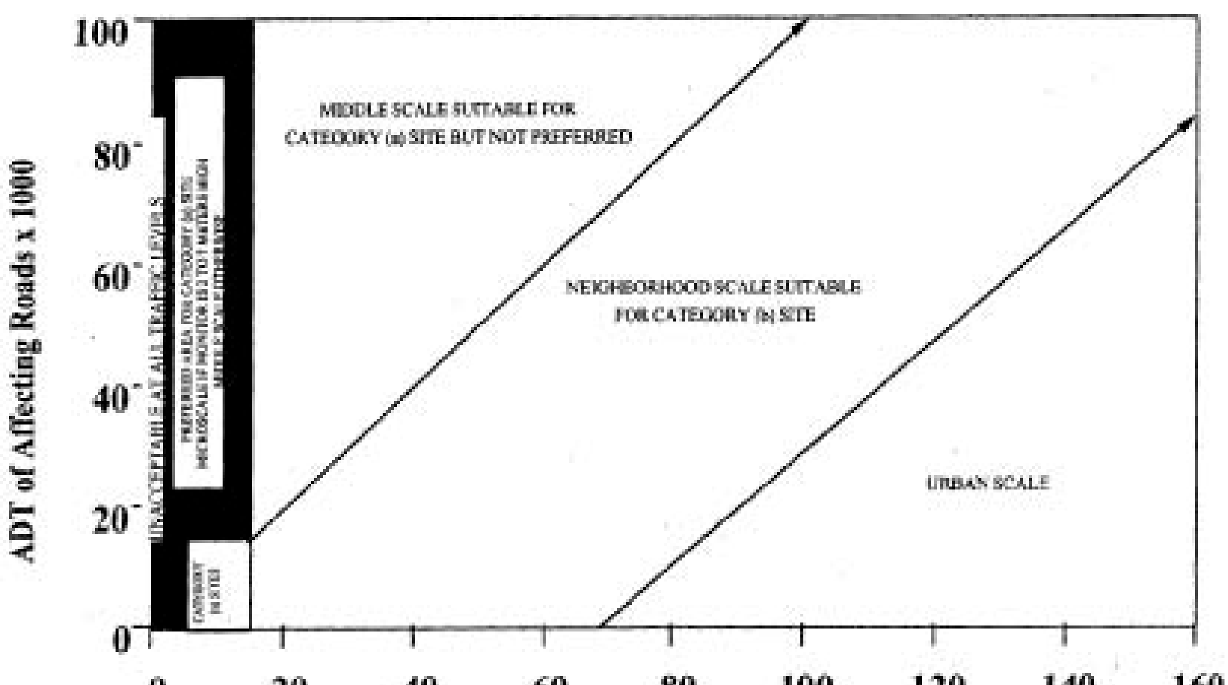



Figure E-1. Distance of PM samplers to nearest traffic lane (meters)

## Appendix B: Request to Exclude $PM_{2.5}$ Continuous FEM Data from Being Compared to the National Ambient Air Quality Standard (NAAQS)

**Introduction:**

Our monitoring program has historically operated $PM_{2.5}$ continuous monitors primarily to support forecasting and reporting of the Air Quality Index (AQI). These monitors supply data every hour to update the AQI on our web site, www.phila.gov/aqi as well as on national web sites such as AIRNow (www.airnow.gov). We have been using this kind of monitor over the past five years since we implemented the $PM_{2.5}$ monitoring program more than a decade ago. Over the last few years, a number of $PM_{2.5}$ continuous monitors have been approved as Federal Equivalent Methods (FEMs). By utilizing an approved FEM, any subsequent data produced from the method may be eligible for comparison to EPA's health based standard known as the National Ambient Air Quality Standards (NAAQS). The primary advantage of operating a $PM_{2.5}$ continuous FEM is that it can simultaneously support the AQI and supply data that is eligible for comparison to the NAAQS. Thus, a network utilizing $PM_{2.5}$ continuous FEMs can minimize the number of filter-based FRMs operated in the network, which are primarily used for comparison to the NAAQS. These filter-based FRMs are resource intensive in that they require field operations as well as pre- and post-sampling laboratory analysis which results in data not being available for approximately 2-4 weeks after sample collection.

Our monitoring program has been working with $PM_{2.5}$ continuous FEMs including deployment at a few sites to evaluate their performance. Although the $PM_{2.5}$ continuous FEMs are automated methods, these methods still require careful attention in their set-up, operation, and validation of data. Once enough data was collected, the performance of the FEM method was evaluated in comparison to the collocated FRM methods. This evaluation is further explained below along with our recommendations regarding the use of the data from these methods.

**Request for Exclusion of $PM_{2.5}$ Continuous FEM data from Comparison to the NAAQS:**

In accordance with the PM NAAQS rule published on January 15th, 2013 (78 FR 3086), and specific to the provisions detailed in §58.10 (b)(13) and §58.11 (e), we are requesting that data from the following monitor be set aside for comparison to the NAAQS. While our agency is working to optimize the monitoring instrumentation we use to meet all of our monitoring objectives, we are not yet at a point where the comparability of the $PM_{2.5}$ continuous FEM operated in our network compared to collocated FRM is acceptable such that we are comfortable using the continuous FEM data for comparison to the NAAQS. After assessing the comparability of the $PM_{2.5}$ FEM to the collocated FRM for our network, we have determined that the site listed below does not meet the comparability requirements. Detailed one-page assessments from which the information described below was obtained are included at the end of this section.

## Table B.1 – Request for Exclusion of $PM_{2.5}$ Continuous FEM Data

| Site Name | City | Site ID | Cont POC | Method Description | $PM_{2.5}$ Cont. Begin Date | $PM_{2.5}$ Cont End Date | Continuous/ FRM Sampler pairs per season | Slope (m) | Intercept (y) | Meets bias requirement | Correlation (r) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| *Sites with $PM_{2.5}$ continuous FEMs that are collocated with FRMs:* | | | | | | | | | | | |
| **LAB** | **Philadelphia** | **42-101-0004** | **2** | **MetOne BAM Continuous Monitor** | **January 1, 2011** | **March 31, 2013** | Winter = 34 | **0.97** | **4.85** | **No** | **0.77** |
| | | | | | | | Spring = 27 | **1.46** | **-0.46** | **No** | **0.83** |
| | | | | | | | Summer = 24 | **1.08** | **2.82** | **No=Intercept**<br>**Yes=slope** | **0.91** |
| | | | | | | | Fall = 20 | **1.18** | **4.97** | **No** | **0.96** |
| | | | | | | | Total = 105 | **1.10** | **3.39** | **No=Intercept**<br>**Yes=slope** | **0.86** |
| *Sites with $PM_{2.5}$ continuous FEMs that are <u>not</u> collocated with FRMs:* | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Period of Exclusion of Data from the $PM_{2.5}$ Continuous FEMs:**

As written on the above table's detail, our agency would like to request $PM_{2.5}$ continuous FEM data from years of 2011 to Spring 2013 to be excluded. Per EPA Regional 3 Office approval, we will load or move as necessary this data to EPA's AQS database in a manner where the data is only used for the appropriate monitoring objective(s) (i.e., use data for both the NAAQS and AQI, just the AQI, or neither the NAAQS or AQI). Additionally, we will continue to load any new data generated for the next 18 months (intended to represent the period until December 31 of 2014) in the same manner or until such time as we request and receive approval from the EPA Regional 3 Office to change the monitoring objectives that the data from the $PM_{2.5}$ continuous FEMs can support.

**$PM_{2.5}$ Continuous FEM data for Reporting the AQI:**

In our assessment of the comparability of the $PM_{2.5}$ continuous FEM to collocated FRM, we believe that the data would not be appropriate for reporting the AQI. However, we will continue to utilize our pre-FEM $PM_{2.5}$ continuous monitor to support our real-time reporting needs. We will store the data from the $PM_{2.5}$ continuous FEM in parameter code 88501 so that it is available for data users with the caveat that it will not be used in NAAQS or AQI calculations.

**Continued Operation of $PM_{2.5}$ Monitors to Support NAAQS and AQI Reporting**

While we are requesting that data from the monitor listed above be set aside for comparison to the NAAQS, we will continue to operate $PM_{2.5}$ FRM to support the objective of comparison to the NAAQS. We will also operate our $PM_{2.5}$ continuous monitor for use in AQI reporting. Each of these FRM and $PM_{2.5}$ continuous monitors will be operated at the location previously described in this plan and at the locations that meet the objectives of the Network Design Criteria for Ambient Air Quality Monitoring described in Appendix D to Part 58.

**Assessments:**

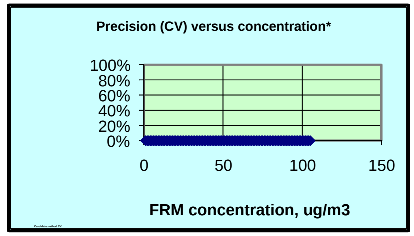
The following one-page assessment is a location where our agency has a collocated $PM_{2.5}$ FRM and continuous FEM monitors. This assessment is represented in the "**Table B.1 – Request for Exclusion of $PM_{2.5}$ Continuous FEM Data"** above.

# Summary – Candidate ARM Comparability

| | |
|---|---|
| Applicant: | |
| Candidate method: | Met One BAM |
| Test site: | Philadelphia LAB |

| Data sets | Number | | | |
|---|---|---|---|---|
| Valid data sets available: | 105 | (Including | 1 | data sets excluded because FRM conc. < 3.) |
| Number of valid data sets required for ARM Comparison: | 90 | | | |
| **Number of valid data sets for this test is:** | **OK** | | | |
| Additional data sets needed: | -- | | | |

| **Precision (if data are available)** | Data set mean ?g/m$^3$ | | Data set precision ?g/m$^3$ | | **Relative precision (CV)** | |
|---|---|---|---|---|---|---|
| | FRM | Candidate | FRM | Candidate | **FRM** | **Candidate** |
| **Mean:** | **9.3** | **13.6** | | | | |
| Maximum: | 25.4 | 29.8 | | | | |
| Minimum: | 2.9 | 3.9 | | | | |
| Candidate / FRM Ratio: | 146.9% | | | | | |
| | **RMS Relative Precision for this site:** | | | | | |
| | **Test requirements - Class III:** | | | | **10.0%** | **15.0%** |
| | **Precision Test Results for site:** | | | | | |




| **Regression statistics** | | **Slope**[1] | **Intercept**[2] | **Correlation (r)** |
|---|---|---|---|---|
| **Statistics for this test site:** | | **1.10** | **3.39** | **0.86** |
| **Limits for** | **Upper:** | **1.10** | **0.49** | |
| **Class III** | **Lower:** | **0.90** | **-2.00** | **0.95** |
| **Test Results (Pass/Fail):** | | **PASS** | **FAIL** | **FAIL** |

[1]Multiplicative bias [2]Additive bias

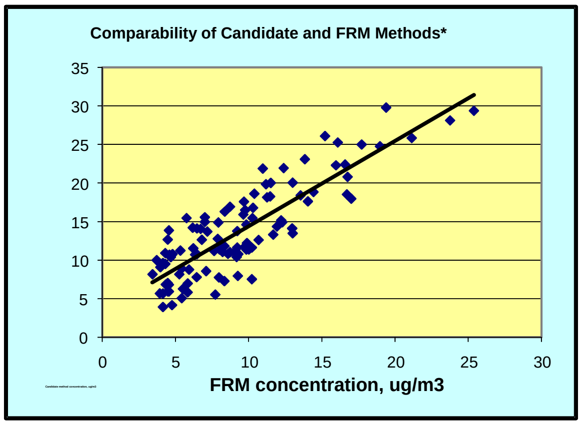



**Figure B.1 – Comparability Chart of Candidate and FRM Methods**

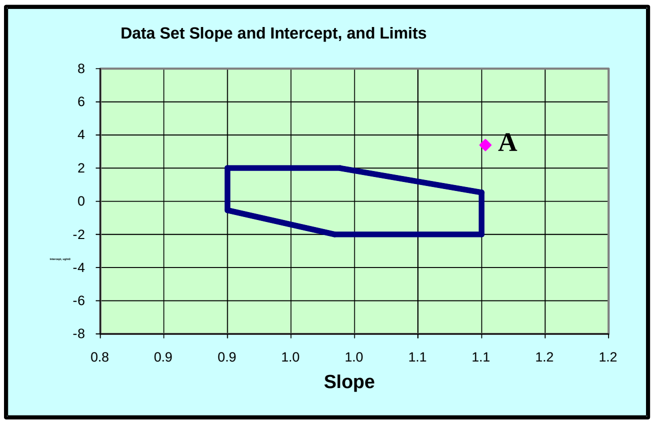



**Figure B.2 – Data Set Slope and Intercepts, and Limits Chart**

From the Data Set Slope and Intercept, and Limits chart on **Figure B.2**, “A” as it represents all data appears to be outside the box which indicates that this bias does not meet the acceptance criteria. Our agency has utilized one of the spreadsheet templates that are available on AMTIC (http://www.epa.gov/ttn/amtic/contmont.html) to ensure the combination of the multiplicative (slope) and additive (intercept) bias is outside the required test specifications on Table C-4 of Part 53. The test specifications require the slope and the intercept to be within a certain range. The slope has to be within 1 ± 0.10. The slope generated from the assessment is 1.10. With this number, the slope meets the multiplicative bias criterion; it is within the bounds of 0.90 and 1.10. The second criterion that needs to be checked is the additive bias (intercept).The intercept’s lower limit is equal to 15.05 – (17.32 x slope), but cannot be less than -2.0. The intercept’s upper limit is equal to 15.05 – (13.20 x slope), but cannot be more than +2.0. In the LAB’s case, the intercept lower and upper limits are -2.0 and +0.49, respectively. The LAB’s intercept generated is 3.39 and it is outside the bounds of -2.00 to +0.49. The aforementioned points therefore confirm that the overall bias for the LAB site has not been met.

# Appendix C: Detailed Information on Torresdale (TOR) Site

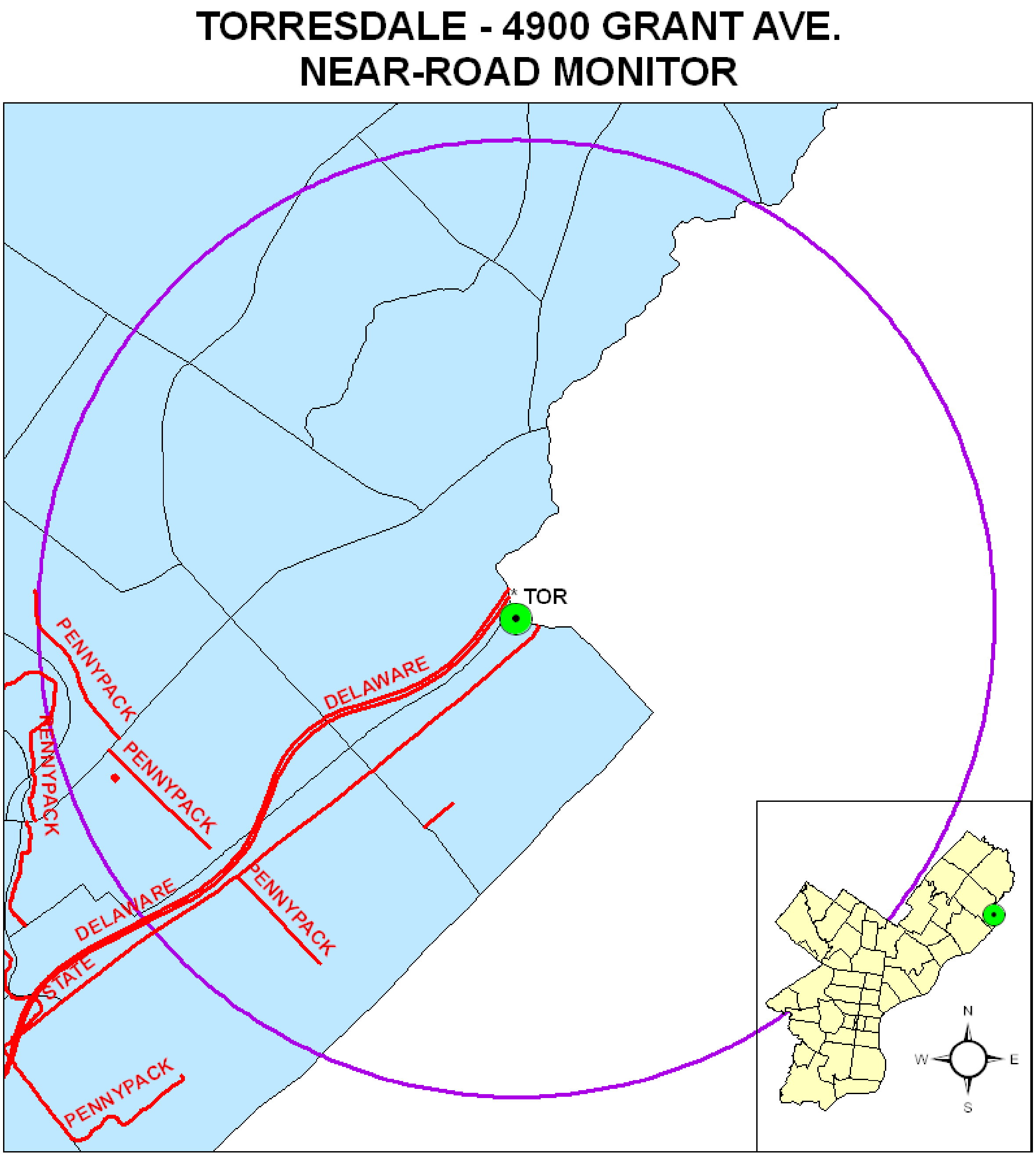
## TOR

**Table C.1 - Detailed TOR Information with Monitoring Station Picture**

**AMS SITE ID: TOR**
**AQS Site ID:**
**Street Address: 4901 Grant Ave. & James St., 19114**
**Geographical Coordinates**
**Latitude: 40.054478**
**Longitude: -74.984474**

| Parameter | Sampling Type | Operating Schedule | Collection Method | Analysis Method | Comments | AQS Method | Spatial Scale | Monitoring Objective | Probe Height (m) | Begin Date |
|---|---|---|---|---|---|---|---|---|---|---|
| CO | NAMS | Continuous | Instrumental | Nondispersive infrared | | 93 | Microscale/ Middle Scale | Highest concentration | | |
| $NO_2$ | NAMS | Continuous | Instrumental | Chemiluminescence | | 99 | Microscale/ Middle Scale | Highest concentration | | |

**Figure C.1 - TOR Monitoring Site Map with Major Streets and Major Emission Sources**




* To be operational by 1/1/2014

**Figure C.2 - TOR Aerial View**

**Henry Kim**

**From:** chow, alice [chow.alice@epa.gov]
**Sent:** Wednesday, June 26, 2013 6:54 AM
**To:** Henry Kim; Hallie Weiss; Dennis Sosna
**Cc:** schmidt, howard
**Subject:** FW: R3 approval of PHL AMS near-road NO2 monitor

**Categories:** FYI

Good morning!

I wanted to let you know that I concur with Howard's approval for the location of the AMS near-road NO2 monitor at the Torresdale Train Station.

Alice

_____________________________________________

Alice H. Chow
Acting Associate Director
Office of Air Monitoring and Analysis (3AP40)
Air Protection Division
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103-2029

Office: 215-814-2144
Fax: 215-814-2124
Email: chow.alice@epa.gov
_____________________________________________

**From:** schmidt, howard
**Sent:** Tuesday, June 25, 2013 1:25 PM
**To:** chow, alice
**Subject:** R3 approval of PHL AMS near-road NO2 monitor

Hi Alice,

I approve of the location proposed by PHL AMS for their near-road NO2 monitor at the Torresdale Train Station based on the following:

1. Extensive documentation on traffic counts and other parameters as suggested by the EPA Technical Assistance Document
2. Multiple field trips where I personally visited the site and met with PHL AMS staff
3. Continued contact via phone and email whenever updates were appropriate

I ask for your concurrence with this matter.

Please forward this email with a short note to:

Henry Kim: henry.kim@phila.gov

Hallie Weiss: Hallie.weiss@phila.gov

Dennis Sosna: dennis.sosna@phila.gov

Thank you!

Howard Schmidt, MS, MBA
EPA Region 3
Office of Air Monitoring & Analysis
1650 Arch St. 3AP40
Philadelphia, PA 19103
215-814-2133

# Final Site Selection for the Near-Road $NO_2$ Monitor

In Appendix D of the 2012-2013 Plan, AMS listed 3 potential sites for the near-road $NO_2$ monitor. The table below lists the pros/cons of each site.

| Site | Pros | Cons |
|---|---|---|
| Site A – PennDot Road Salt Storage Facility (near Aramingo Ave & I95) | - Perfect location<br>- Electricity available<br>- Highest FE-AADT<br>- Flat surface to mount air monitoring trailer | - Off-ramp access to and from site (safety)<br>- Too much salt handing activities<br>- Resistance from PennDOT |
| Site D – Torresdale Train Station (Grant Ave & James St) | - Safe location in parking area<br>- Electricity available<br>- Flat surface to mount air monitoring trailer<br>- Easy access to site<br>- 4$^{th}$ highest FE-ADDT | - Loss of three parking spaces |
| Site E - International Longshoremen Association Memorial Hall (Near I-95 and Packer Ave) | - Electricity Available<br>- South Philadelphia area (monitoring point of interest)<br>- 5$^{th}$ highest FE-AADT | - Not easy access-exit (going to another exit and came back)<br>- Grassy area - need to work on surface<br>- Safety issue |

On February 24, 2012, AMS staff and Howard Schmidt from EPA Region III, visited the 3 sites. On May 7, 2012, AMS notified Howard Schmidt via email regarding the selection of the near-road site. The Torresdale Train Station was selected as the “best” site because it provided the safest location for AMS personnel and the air monitoring equipment.

# Near-Road NO2 Monitoring Analysis for Philadelphia County

City of Philadelphia
Department of Public Health
Air Management Services

# Table of Contents

## Tables

**Figures**

## Background

On February 9, 2010, EPA promulgated (75 FR 6474) new minimum monitoring requirements for the nitrogen dioxide ($NO_2$) monitoring network in support of a newly revised 1-hour $NO_2$ National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road $NO_2$ monitoring stations in larger urban areas where hourly $NO_2$ concentrations in the near-road environment are believed to be the highest in that urban area. State and local air agencies are required to consider traffic volumes, fleet mix, roadway design, traffic congestion patterns, local terrain or topography, and meteorology in the implementation process of any required near-road $NO_2$ monitor.

EPA recognized that the combination of increased vehicle-miles-traveled (VMT), which correspond to on-road mobile source emissions, with higher urban population densities can result in an increased potential for exposure and associated risks to human health and welfare. As a result, the EPA promulgated requirements for near-road $NO_2$ monitors in urban areas where peak, ambient 1-hour $NO_2$ concentrations can be expected to occur that are particularly attributable to on-road mobile sources. Monitoring requirements are based upon population levels and a specific traffic metric within Core Based Statistical Areas (CBSAs). State and local ambient air monitoring agencies are required (per 40 CFR Part 58 Appendix D, Section 4.3.2.a) to use the latest available census figures (e.g., census counts and/or estimates) and available traffic data in assessing what may be required of them under this new rule.

## Section 1 - Identifying the Extent of Required Near-Road Monitoring for the Philadelphia CBSA

The first step in implementing the required monitoring for Philadelphia CBSA, is to identify the extent to which monitoring requirements apply. The review is presented below. The result is that the Philadelphia CBSA needs two near-road $NO_2$ monitors.

**Review.** In 40 CFR Part 58 Appendix D, the EPA requires state and local air agencies to operate one near-road $NO_2$ monitor in each CBSA with a population of 500,000 or more persons. *CBSAs with 2,500,000 or more persons, or those CBSAs with one or more roadway segments carrying traffic volumes of 250,000 or more vehicles (as measured by annual average daily traffic [AADT] counts), shall have two near-road NO2 monitors within that CBSA.* State and local ambient air monitoring agencies are required to use the most up-to-date census information and traffic data in assessing what may be required of them under this rule, per 40 CFR Part 58 Appendix D, Section 4.3.2.a.

**Identifying Census Data for the Philadelphia CBSA.** Philadelphia Air Management Services (AMS) used the U.S. Census Bureau as the source of its population estimate (http://www.census.gov/popest/metro/metro.html). The "Philadelphia" CBSA which is comprised of five counties in PA: Philadelphia, Bucks, Chester, Delaware, and Montgomery, four counties in NJ: Burlington, Camden, Gluocester,and Salem, one county in DE: New Castle, and one county in MD: Cecil. The Philadelphia CBSA has a population of 5,968,252 per http://www.census.gov/popest/gallery/maps/CBSA-Fig1a_2009.html.

**Identifying Roadway Traffic Volumes in Excess of 250,000 AADT.** AMS obtained Pennsylvania Department of Transportation's (PennDOT) traffic volume data, including AADT data, from the following sources:

- Internet Traffic Monitoring System (ITMS) http://www.dot7.state.pa.us/itms/main.htm
- Traffic Volume Map http://www.dot.state.pa.us/Internet/Bureaus/pdPlanRes.nsf/infoBPRTrafficInfoTrafficVolumeMap , and specifically ftp://ftp.dot.state.pa.us/public/pdf/BPR_pdf_files/MAPS/Traffic/Traffic_Volume/2009/philadelphia_2009_tv.pdf
- Traffic Counts found at the Pennsylvania Spatial Data Access (PASDA), the official public access geospatial clearinghouse for the Commonwealth of Pennsylvania http://www.pasda.psu.edu/uci/MetadataDisplay.aspx?entry=PASDA&file=PaTraffic2011_01.xml&dataset=56 and http://www.pasda.psu.edu/data/padot/state/PaStateRoads2011_01.zip

Given that the Philadelphia CBSA has a population of more than 2,500,000 persons, it will need two near-road $NO_2$ monitors

**Meeting Requirements in CBSAs Covering Multiple Geo- Political Boundaries (Multi-Agency/Multi-State).** The Philadelphia CBSA covers an area that includes Philadelphia, Bucks, Chester, Delaware, Montgomery, Burlington, Camden, Gluocester, Salem, New Castle, and Cecil counties. The Pennsylvania Department of Environmental Protection serves as the air agency for all counties in PA, except Philadelphia, the most populous, which is served by AMS, and Allegheny which is served by Allegheny County Health Department (ACHD). AMS analyzed AADT for roadway segments located in Philadelphia County. The result is that the first near-road $NO_2$ monitor for the Philadelphia CBSA will be located in Philadelphia County and be installed and operated by AMS. AMS discussed with the EPA Region III, the determination of where the near-road monitoring should be conducted. These discussions were conducted before and during the traffic data analysis process and while determining an initial list of candidate road segments.

## Section 2 - Traffic Data for Use in Identifying Candidate Road Segments for Near-Road $NO_2$ Monitoring

The second step in identifying the candidate $NO_2$ near-road monitoring site in Philadelphia County is to collect and analyze traffic data. Traffic data indicate the anticipated level and type of activity on road segments that can be used to compare anticipated pollutant emissions among multiple road segments in the Philadelphia CBSA. This section summarizes the data and sources that were used in generating a list of candidate road segments for evaluation as potential near-road $NO_2$ monitoring sites. The purpose of using these recommended data and sources was ultimately to identify a location where the highest motor vehicle emissions leading to peak near-road $NO_2$ concentrations was likely to occur.

**Annual Average Daily Traffic.** AADT is a measure of the total volume of traffic on a roadway segment for one year divided by the number of days in the year. This parameter can be used to identify the relative traffic activity and corresponding potential for pollutant emissions experienced along roads. Generally, AADT is representative of the traffic volume along a length of road, or "road segment", where individual road segments are typically defined as a length of road between two points, such as intersections, highway exits, highway mile markers, geo-political boundaries, or other features where the traffic volume or pattern is likely to change. *The sources of AADT data analyzed by AMS to determine the appropriate location of the near-road $NO_2$ monitor for the Philadelphia County are defined in Step 1, above.*

**Fleet Mix Data.** While AADT describes the total volume of traffic on a road, fleet mix data provides specific counts, or percentages of total traffic volume, of different types of vehicles that comprise the total traffic volume. Most commonly, fleet mix data differentiate between light-duty (LD) passenger vehicles and heavy-duty (HD) trucks. LD vehicles typically burn gasoline, while HD trucks operate on diesel fuel. Understanding the number or percentage of HD vehicles within the total traffic volume is important because the difference in the amount of nitrogen oxides ($NO_X$) emitted on a per vehicle basis between the two vehicle types varies greatly. HD vehicles typically emit much higher amounts of $NO_X$ than LD vehicles. Since these $NO_X$ emissions include $NO_2$ (as well as nitrogen oxide [NO], which readily converts to $NO_2$ in the near-road environment in the presence of ozone, and which also can be oxidized to $NO_2$ through other photochemical processes), these emission differences are important in identifying locations where peak $NO_2$ concentrations may occur. For all vehicles, $NO_X$ emissions vary by vehicle type, load, speed, and highway grade. *AMS used the truck count data found on the Penn DOT Internet Travel Monitoring System,* **http://www.dot7.state.pa.us/itms/main.htm**, *linked to the specific roadway map segment.*

**Congestion Patterns.** Congestion patterns is an important factor in the near-road $NO_2$ site selection process because traffic congestion can lead to vehicle operating conditions, particularly stop-and-go traffic, that may increase emissions per vehicle (as compared to vehicles operating at steady-state highway speeds). Congestion pattern data can be presented as:

- **Level of service (LOS),** which describes the effectiveness of a transportation facility, such as a road segment, and is determined for individual road segments by the evaluation of multiple pieces of traffic information, including time-resolved traffic counts, traffic speeds, and the relative frequency of occurrence of congested conditions. The LOS is presented as a qualitative measure, using a letter grading system with grading ranges from A to F. Those road segments with higher relative congestion (e.g., a worse letter grade) may be more likely to have relatively higher $NO_2$ emissions potential per vehicle than otherwise similar road segments with less congestion. *A complete LOS data was not available for Philadelphia County.*

- **Volume-to-capacity (v/c) ratio** which compares peak traffic volumes on a road segment with the capacity of the road based on the number of lanes. This calculation typically accounts for the larger size of HD vehicles and focuses on traffic conditions during peak hours of operation. *This data was also not available for Philadelphia County.*

- **"AADT by lane"** for individual road segments. This indicator is determined by dividing the total AADT by the number of lanes on a road segment. AADT by lane is used to aid in understanding the potential congestion of a road segment in the absence of LOS or Volume-to-capacity ratio information (*as is the case for Philadelphia County*) by accounting for how much traffic volume is using a given number of available driving lanes. As such, a larger number of vehicles per lane indicate a greater potential for traffic congestion. Since AADT by lane is not based on the multiple metrics that LOS and v/c ratio are based upon, *it should be viewed only as a rough surrogate* to what these data might represent for a given road segment, and is used only because LOS or v/c ratio data are not available. The equation is:

$$\text{AADT by Lane} = \frac{\text{AADT}}{\text{Number of Lane}}$$

where, AADT is the actual total traffic volume on the road segment, and the number of lanes is the *total number of lanes*, *in both directions*, on that road segment.

## Section 3 - Creating an Initial List of Candidate Road Segments Using Traffic Data

The site selection process for required near-road $NO_2$ monitors, per 40 CFR Part 58 Appendix D, includes the ranking of road segments in a CBSA by AADT, followed by the consideration of five other factors: fleet mix, congestion patterns, roadway design, terrain, and meteorology.

### *3.1 Using AADT to Initially Rank Road Segments*

The first step in the traffic data evaluation process is to satisfy the requirement in 40 CFR Part 58 Appendix D, section 4.3, to rank road segments in a CBSA based on the total traffic volume, represented by AADT. The intent of this first step is to begin to focus the evaluation process to road segments that are more likely to have higher potential for $NO_X$ emissions due to their higher volumes of traffic.

The following is a list of road segments in the Philadelphia County ranked by AADT using 2010 data from Penn DOT. The data is arranged in descending order, where the segment with the highest AADT is ranked first. This list includes the road segment ID, road information, and AADT value. Philadelphia County has two main interstates, I-76 that stretches from east to west and I-95 that stretches from north to south. All the segments from both interstates that pass through the Philadelphia County only, are listed below in Table 1.

**Table 1 - Rank by AADT**

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | STREET NAME | TRAF RT. N1 | AADT RANK |
|---|---|---|---|---|---|---|---|---|
| 0095 | 0211 | 3043 | 36 | 3 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0215 | 2274 | 36 | 3 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0221 | 1728 | 36 | 3 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0225 | 3378 | 48 | 4 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0231 | 3680 | 59 | 4 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0235 | 2619 | 57 | 4 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0241 | 1835 | 50 | 4 | 82700 | DELAWARE EX SB | 095 | 1 |
| 0095 | 0214 | 2259 | 36 | 3 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0220 | 1682 | 48 | 4 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0224 | 3284 | 66 | 4 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0230 | 3680 | 59 | 3 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0234 | 2619 | 57 | 4 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0240 | 1829 | 50 | 4 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0095 | 0244 | 1808 | 60 | 5 | 77099 | DELAWARE EX NB | 095 | 2 |
| 0076 | 3441 | 2112 | 25 | 2 | 73375 | SCHUYLKILL EX WB | 076 | 3 |
| 0076 | 3445 | 3156 | 27 | 2 | 73375 | SCHUYLKILL EX WB | 076 | 3 |
| 0076 | 3435 | 2687 | 38 | 3 | 73375 | SCHUYLKILL EX WB | 076 | 3 |
| 0095 | 0250 | 3226 | 65 | 4 | 72642 | DELAWARE EX NB | 095 | 4 |
| 0095 | 0254 | 2453 | 52 | 5 | 72642 | DELAWARE EX NB | 095 | 4 |
| 0095 | 0260 | 1535 | 55 | 4 | 72642 | DELAWARE EX NB | 095 | 4 |
| 0076 | 3434 | 2640 | 38 | 3 | 72405 | SCHUYLKILL EX EB | 076 | 5 |
| 0076 | 3440 | 2651 | 25 | 2 | 72405 | SCHUYLKILL EX EB | 076 | 5 |
| 0076 | 3444 | 3156 | 27 | 2 | 72405 | SCHUYLKILL EX EB | 076 | 5 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | STREET NAME | TRAF RT. N1 | AADT RANK |
|---|---|---|---|---|---|---|---|---|
| 0076 | 3450 | 2612 | 30 | 2 | 70614 | SCHUYLKILL EX EB | 076 | 6 |
| 0076 | 3454 | 3946 | 27 | 2 | 70614 | SCHUYLKILL EX EB | 076 | 6 |
| 0076 | 3460 | 1434 | 36 | 3 | 70614 | SCHUYLKILL EX EB | 076 | 6 |
| 0076 | 3464 | 2544 | 37 | 3 | 70614 | SCHUYLKILL EX EB | 076 | 6 |
| 0076 | 3470 | 1483 | 57 | 3 | 70614 | SCHUYLKILL EX EB | 076 | 6 |
| 0076 | 3451 | 2602 | 33 | 2 | 70614 | SCHUYLKILL EX WB | 076 | 6 |
| 0076 | 3455 | 3927 | 27 | 2 | 70614 | SCHUYLKILL EX WB | 076 | 6 |
| 0076 | 3461 | 1411 | 37 | 3 | 70614 | SCHUYLKILL EX WB | 076 | 6 |
| 0076 | 3465 | 2509 | 37 | 3 | 70614 | SCHUYLKILL EX WB | 076 | 6 |
| 0076 | 3471 | 1709 | 37 | 3 | 70614 | SCHUYLKILL EX WB | 076 | 6 |
| 0095 | 0115 | 2300 | 61 | 4 | 66008 | DELAWARE EX SB | 095 | 7 |
| 0095 | 0245 | 1814 | 48 | 4 | 65071 | DELAWARE EX SB | 095 | 8 |
| 0095 | 0251 | 3242 | 65 | 4 | 65071 | DELAWARE EX SB | 095 | 8 |
| 0095 | 0255 | 2414 | 60 | 5 | 65071 | DELAWARE EX SB | 095 | 8 |
| 0095 | 0261 | 1537 | 48 | 4 | 65071 | DELAWARE EX SB | 095 | 8 |
| 0095 | 0320 | 2744 | 36 | 3 | 64393 | DELAWARE EX NB | 095 | 9 |
| 0095 | 0324 | 2793 | 36 | 3 | 64393 | DELAWARE EX NB | 095 | 9 |
| 0095 | 0330 | 2640 | 36 | 3 | 64393 | DELAWARE EX NB | 095 | 9 |
| 0095 | 0334 | 2640 | 36 | 3 | 64393 | DELAWARE EX NB | 095 | 9 |
| 0095 | 0340 | 2651 | 36 | 3 | 64393 | DELAWARE EX NB | 095 | 9 |
| 0095 | 0265 | 4254 | 67 | 3 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0271 | 2750 | 36 | 3 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0275 | 2226 | 48 | 4 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0281 | 2731 | 48 | 4 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0285 | 2695 | 48 | 4 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0291 | 1944 | 48 | 4 | 63944 | DELAWARE EX SB | 095 | 10 |
| 0095 | 0264 | 4229 | 67 | 3 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0095 | 0270 | 2710 | 43 | 3 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0095 | 0274 | 2270 | 36 | 3 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0095 | 0280 | 2728 | 36 | 3 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0095 | 0284 | 2681 | 36 | 4 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0095 | 0290 | 1990 | 48 | 4 | 63816 | DELAWARE EX NB | 095 | 11 |
| 0076 | 3415 | 2575 | 38 | 3 | 63210 | SCHUYLKILL EX WB | 076 | 12 |
| 0076 | 3421 | 2579 | 66 | 3 | 63210 | SCHUYLKILL EX WB | 076 | 12 |
| 0076 | 3425 | 2731 | 38 | 3 | 63210 | SCHUYLKILL EX WB | 076 | 12 |
| 0076 | 3431 | 2584 | 38 | 3 | 63210 | SCHUYLKILL EX WB | 076 | 12 |
| 0095 | 0321 | 2781 | 36 | 3 | 62171 | DELAWARE EX SB | 095 | 13 |
| 0095 | 0325 | 2782 | 36 | 3 | 62171 | DELAWARE EX SB | 095 | 13 |
| 0095 | 0331 | 2546 | 36 | 3 | 62171 | DELAWARE EX SB | 095 | 13 |
| 0095 | 0335 | 2633 | 36 | 3 | 62171 | DELAWARE EX SB | 095 | 13 |
| 0095 | 0341 | 2628 | 36 | 3 | 62171 | DELAWARE EX SB | 095 | 13 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | STREET NAME | TRAF RT. N1 | AADT RANK |
|---|---|---|---|---|---|---|---|---|
| 0076 | 3414 | 2640 | 38 | 3 | 61839 | SCHUYLKILL EX EB | 076 | 14 |
| 0076 | 3420 | 2640 | 66 | 3 | 61839 | SCHUYLKILL EX EB | 076 | 14 |
| 0076 | 3424 | 2640 | 38 | 3 | 61839 | SCHUYLKILL EX EB | 076 | 14 |
| 0076 | 3430 | 2640 | 38 | 3 | 61839 | SCHUYLKILL EX EB | 076 | 14 |
| 0095 | 0294 | 2975 | 55 | 4 | 59984 | DELAWARE EX NB | 095 | 15 |
| 0095 | 0300 | 2814 | 57 | 4 | 59984 | DELAWARE EX NB | 095 | 15 |
| 0095 | 0304 | 2759 | 47 | 4 | 59984 | DELAWARE EX NB | 095 | 15 |
| 0095 | 0310 | 2640 | 47 | 4 | 59984 | DELAWARE EX NB | 095 | 15 |
| 0095 | 0314 | 2615 | 36 | 3 | 59984 | DELAWARE EX NB | 095 | 15 |
| 0076 | 3395 | 2303 | 76 | 4 | 59368 | SCHUYLKILL EX WB | 076 | 16 |
| 0076 | 3401 | 2937 | 50 | 4 | 59368 | SCHUYLKILL EX WB | 076 | 16 |
| 0076 | 3405 | 2705 | 50 | 4 | 59368 | SCHUYLKILL EX WB | 076 | 16 |
| 0076 | 3411 | 2667 | 50 | 4 | 59368 | SCHUYLKILL EX WB | 076 | 16 |
| 0076 | 3394 | 2416 | 41 | 3 | 59331 | SCHUYLKILL EX EB | 076 | 17 |
| 0076 | 3400 | 2691 | 50 | 4 | 59331 | SCHUYLKILL EX EB | 076 | 17 |
| 0076 | 3404 | 2655 | 50 | 4 | 59331 | SCHUYLKILL EX EB | 076 | 17 |
| 0076 | 3410 | 2640 | 50 | 4 | 59331 | SCHUYLKILL EX EB | 076 | 17 |
| 0095 | 0114 | 1917 | 48 | 4 | 58330 | DELAWARE EX NB | 095 | 18 |
| 0095 | 0295 | 3017 | 36 | 3 | 57892 | DELAWARE EX SB | 095 | 19 |
| 0095 | 0301 | 2745 | 57 | 4 | 57892 | DELAWARE EX SB | 095 | 19 |
| 0095 | 0305 | 2788 | 48 | 4 | 57892 | DELAWARE EX SB | 095 | 19 |
| 0095 | 0311 | 2640 | 48 | 4 | 57892 | DELAWARE EX SB | 095 | 19 |
| 0095 | 0315 | 2638 | 36 | 3 | 57892 | DELAWARE EX SB | 095 | 19 |
| 0095 | 0164 | 3923 | 52 | 4 | 52414 | DELAWARE EX NB | 095 | 20 |
| 0095 | 0170 | 5233 | 52 | 3 | 52414 | DELAWARE EX NB | 095 | 20 |
| 0095 | 0165 | 3927 | 52 | 4 | 49385 | DELAWARE EX SB | 095 | 21 |
| 0095 | 0171 | 5163 | 52 | 3 | 49385 | DELAWARE EX SB | 095 | 21 |
| 0095 | 0181 | 2435 | 60 | 4 | 49385 | DELAWARE EX SB | 095 | 21 |
| 0095 | 0134 | 3021 | 73 | 4 | 49048 | DELAWARE EX NB | 095 | 22 |
| 0095 | 0140 | 2677 | 74 | 3 | 49048 | DELAWARE EX NB | 095 | 22 |
| 0095 | 0135 | 3244 | 74 | 4 | 46889 | DELAWARE EX SB | 095 | 23 |
| 0095 | 0141 | 2679 | 74 | 3 | 46889 | DELAWARE EX SB | 095 | 23 |
| 0076 | 3380 | 2640 | 35 | 2 | 45400 | SCHUYLKILL EX EB | 076 | 24 |
| 0076 | 3384 | 2657 | 24 | 2 | 45400 | SCHUYLKILL EX EB | 076 | 24 |
| 0076 | 3381 | 2665 | 35 | 2 | 42904 | SCHUYLKILL EX WB | 076 | 24 |
| 0076 | 3385 | 2667 | 24 | 2 | 42904 | SCHUYLKILL EX WB | 076 | 24 |
| 0095 | 0180 | 2471 | 55 | 3 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0095 | 0184 | 2599 | 55 | 3 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0095 | 0190 | 2978 | 67 | 3 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0095 | 0194 | 4418 | 67 | 4 | 42766 | DELAWARE EX NB | 095 | 25 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | STREET NAME | TRAF RT. N1 | AADT RANK |
|---|---|---|---|---|---|---|---|---|
| 0095 | 0200 | 1786 | 36 | 3 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0095 | 0204 | 1826 | 61 | 4 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0095 | 0210 | 3049 | 36 | 3 | 42766 | DELAWARE EX NB | 095 | 25 |
| 0076 | 3391 | 2902 | 24 | 2 | 39179 | SCHUYLKILL EX WB | 076 | 26 |
| 0095 | 0145 | 3114 | 55 | 4 | 38912 | DELAWARE EX SB | 095 | 27 |
| 0095 | 0151 | 5167 | 48 | 3 | 38912 | DELAWARE EX SB | 095 | 27 |
| 0095 | 0161 | 1949 | 55 | 3 | 38912 | DELAWARE EX SB | 095 | 27 |
| 0095 | 0144 | 3378 | 55 | 4 | 38406 | DELAWARE EX NB | 095 | 28 |
| 0095 | 0150 | 5167 | 48 | 3 | 38406 | DELAWARE EX NB | 095 | 28 |
| 0095 | 0160 | 1946 | 55 | 3 | 38406 | DELAWARE EX NB | 095 | 28 |
| 0095 | 0185 | 2574 | 60 | 3 | 38185 | DELAWARE EX SB | 095 | 29 |
| 0095 | 0191 | 2978 | 67 | 3 | 38185 | DELAWARE EX SB | 095 | 29 |
| 0095 | 0195 | 4418 | 67 | 4 | 38185 | DELAWARE EX SB | 095 | 29 |
| 0095 | 0201 | 1781 | 48 | 4 | 38185 | DELAWARE EX SB | 095 | 29 |
| 0095 | 0205 | 1819 | 66 | 3 | 38185 | DELAWARE EX SB | 095 | 29 |
| 0095 | 0121 | 2416 | 60 | 5 | 36491 | DELAWARE EX SB | 095 | 30 |
| 0095 | 0125 | 2809 | 60 | 5 | 36491 | DELAWARE EX SB | 095 | 30 |
| 0095 | 0131 | 2640 | 36 | 3 | 36491 | DELAWARE EX SB | 095 | 30 |
| 0076 | 3390 | 2852 | 24 | 2 | 36031 | SCHUYLKILL EX EB | 076 | 31 |
| 0095 | 0120 | 2528 | 60 | 5 | 34459 | DELAWARE EX NB | 095 | 32 |
| 0095 | 0124 | 2775 | 36 | 3 | 34459 | DELAWARE EX NB | 095 | 32 |
| 0095 | 0130 | 2640 | 36 | 3 | 34459 | DELAWARE EX NB | 095 | 32 |

Looking at the data in Table 1, it is important to realize that the road segments are for one direction and that both directions of the road are adjacent to each other. For purposes of ranking the roadway segments with respect to the highest AADT, it is necessary to group the segments that make up a "cross-section" of the roadway, and then rank the traffic counts. Table 2, below, performs that grouping and related re-ranking.

**Table 2 - Rank by AADT for the Grouped Segments Representing Lanes for Both Directions**

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | STREET NAME | LOCATION | TRAF RT. N1 | TOTAL AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0214 | 2259 | 36 | 3 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0220 | 1682 | 48 | 4 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0224 | 3284 | 66 | 4 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0230 | 3680 | 59 | 3 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0234 | 2619 | 57 | 4 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0240 | 1829 | 50 | 4 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0244 | 1808 | 60 | 5 | 77099 | 159799 | DELAWARE EX NB | Exit 22 to Exit 25 | 095 | 1 |
| 0095 | 0211 | 3043 | 36 | 3 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| 0095 | 0215 | 2274 | 36 | 3 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | STREET NAME | LOCATION | TRAF RT. N1 | TOTAL AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0221 | 1728 | 36 | 3 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| 0095 | 0225 | 3378 | 48 | 4 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| 0095 | 0231 | 3680 | 59 | 4 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| 0095 | 0235 | 2619 | 57 | 4 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| 0095 | 0241 | 1835 | 50 | 4 | 82700 | 159799 | DELAWARE EX SB | Exit 25 to Exit 22 | 095 | 1 |
| | | | | | | | | | | |
| 0076 | 3434 | 2640 | 38 | 3 | 72405 | 145780 | SCHUYLKILL EX EB | Exit 343 to Exit 346A | 076 | 2 |
| 0076 | 3440 | 2651 | 25 | 2 | 72405 | 145780 | SCHUYLKILL EX EB | Exit 343 to Exit 346A | 076 | 2 |
| 0076 | 3444 | 3156 | 27 | 2 | 72405 | 145780 | SCHUYLKILL EX EB | Exit 343 to Exit 346A | 076 | 2 |
| 0076 | 3441 | 2112 | 25 | 2 | 73375 | 145780 | SCHUYLKILL EX WB | Exit 346A to Exit 343 | 076 | 2 |
| 0076 | 3445 | 3156 | 27 | 2 | 73375 | 145780 | SCHUYLKILL EX WB | Exit 346A to Exit 343 | 076 | 2 |
| 0076 | 3435 | 2687 | 38 | 3 | 73375 | 145780 | SCHUYLKILL EX WB | Exit 346A to Exit 343 | 076 | 2 |
| | | | | | | | | | | |
| 0076 | 3450 | 2612 | 30 | 2 | 70614 | 141228 | SCHUYLKILL EX EB | Exit 346A to Exit 347B (End of I-76) | 076 | 3 |
| 0076 | 3454 | 3946 | 27 | 2 | 70614 | 141228 | SCHUYLKILL EX EB | Exit 346A to Exit 347B (End of I-76) | 076 | 3 |
| 0076 | 3460 | 1434 | 36 | 3 | 70614 | 141228 | SCHUYLKILL EX EB | Exit 346A to Exit 347B (End of I-76) | 076 | 3 |
| 0076 | 3464 | 2544 | 37 | 3 | 70614 | 141228 | SCHUYLKILL EX EB | Exit 346A to Exit 347B (End of I-76) | 076 | 3 |
| 0076 | 3470 | 1483 | 57 | 3 | 70614 | 141228 | SCHUYLKILL EX EB | Exit 346A to Exit 347B (End of I-76) | 076 | 3 |
| 0076 | 3451 | 2602 | 33 | 2 | 70614 | 141228 | SCHUYLKILL EX WB | Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 |
| 0076 | 3455 | 3927 | 27 | 2 | 70614 | 141228 | SCHUYLKILL EX WB | Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 |
| 0076 | 3461 | 1411 | 37 | 3 | 70614 | 141228 | SCHUYLKILL EX WB | Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 |
| 0076 | 3465 | 2509 | 37 | 3 | 70614 | 141228 | SCHUYLKILL EX WB | Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 |
| 0076 | 3471 | 1709 | 37 | 3 | 70614 | 141228 | SCHUYLKILL EX WB | Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 |
| | | | | | | | | | | |
| 0095 | 0250 | 3226 | 65 | 4 | 72642 | 137713 | DELAWARE EX NB | Exit 25 to I-95 N - Trenton | 095 | 4 |
| 0095 | 0254 | 2453 | 52 | 5 | 72642 | 137713 | DELAWARE EX NB | Exit 25 to I-95 N - Trenton | 095 | 4 |
| 0095 | 0260 | 1535 | 55 | 4 | 72642 | 137713 | DELAWARE EX NB | Exit 25 to I-95 N - Trenton | 095 | 4 |
| 0095 | 0245 | 1814 | 48 | 4 | 65071 | 137713 | DELAWARE EX SB | I-95 N - Trenton to Exit 25 | 095 | 4 |
| 0095 | 0251 | 3242 | 65 | 4 | 65071 | 137713 | DELAWARE EX SB | I-95 N - Trenton to Exit 25 | 095 | 4 |
| 0095 | 0255 | 2414 | 60 | 5 | 65071 | 137713 | DELAWARE EX SB | I-95 N - Trenton to Exit 25 | 095 | 4 |
| 0095 | 0261 | 1537 | 48 | 4 | 65071 | 137713 | DELAWARE EX SB | I-95 N - Trenton to Exit 25 | 095 | 4 |
| | | | | | | | | | | |
| 0095 | 0264 | 4229 | 67 | 3 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |
| 0095 | 0270 | 2710 | 43 | 3 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | STREET NAME | LOCATION | TRAF RT. N1 | TOTAL AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0274 | 2270 | 36 | 3 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |
| 0095 | 0280 | 2728 | 36 | 3 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |
| 0095 | 0284 | 2681 | 36 | 4 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |
| 0095 | 0290 | 1990 | 48 | 4 | 63816 | 127760 | DELAWARE EX NB | I-95 N - Trenton to Exit 30 | 095 | 5 |
| 0095 | 0265 | 4254 | 67 | 3 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| 0095 | 0271 | 2750 | 36 | 3 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| 0095 | 0275 | 2226 | 48 | 4 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| 0095 | 0281 | 2731 | 48 | 4 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| 0095 | 0285 | 2695 | 48 | 4 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| 0095 | 0291 | 1944 | 48 | 4 | 63944 | 127760 | DELAWARE EX SB | Exit 30 to I-95 N - Trenton | 095 | 5 |
| | | | | | | | | | | |
| 0095 | 0320 | 2744 | 36 | 3 | 64393 | 126564 | DELAWARE EX NB | Exit 32 to Exit 33 | 095 | 6 |
| 0095 | 0324 | 2793 | 36 | 3 | 64393 | 126564 | DELAWARE EX NB | Exit 32 to Exit 33 | 095 | 6 |
| 0095 | 0330 | 2640 | 36 | 3 | 64393 | 126564 | DELAWARE EX NB | Exit 32 to Exit 33 | 095 | 6 |
| 0095 | 0334 | 2640 | 36 | 3 | 64393 | 126564 | DELAWARE EX NB | Exit 32 to Exit 33 | 095 | 6 |
| 0095 | 0340 | 2651 | 36 | 3 | 64393 | 126564 | DELAWARE EX NB | Exit 32 to Exit 33 | 095 | 6 |
| 0095 | 0321 | 2781 | 36 | 3 | 62171 | 126564 | DELAWARE EX SB | Exit 33 to Exit 32 | 095 | 6 |
| 0095 | 0325 | 2782 | 36 | 3 | 62171 | 126564 | DELAWARE EX SB | Exit 33 to Exit 32 | 095 | 6 |
| 0095 | 0331 | 2546 | 36 | 3 | 62171 | 126564 | DELAWARE EX SB | Exit 33 to Exit 32 | 095 | 6 |
| 0095 | 0335 | 2633 | 36 | 3 | 62171 | 126564 | DELAWARE EX SB | Exit 33 to Exit 32 | 095 | 6 |
| 0095 | 0341 | 2628 | 36 | 3 | 62171 | 126564 | DELAWARE EX SB | Exit 33 to Exit 32 | 095 | 6 |
| | | | | | | | | | | |
| 0076 | 3414 | 2640 | 38 | 3 | 61839 | 125049 | SCHUYLKILL EX EB | Exit 341 to Exit 343 | 076 | 7 |
| 0076 | 3420 | 2640 | 66 | 3 | 61839 | 125049 | SCHUYLKILL EX EB | Exit 341 to Exit 343 | 076 | 7 |
| 0076 | 3424 | 2640 | 38 | 3 | 61839 | 125049 | SCHUYLKILL EX EB | Exit 341 to Exit 343 | 076 | 7 |
| 0076 | 3430 | 2640 | 38 | 3 | 61839 | 125049 | SCHUYLKILL EX EB | Exit 341 to Exit 343 | 076 | 7 |
| 0076 | 3415 | 2575 | 38 | 3 | 63210 | 125049 | SCHUYLKILL EX WB | Exit 343 to Exit 341 | 076 | 7 |
| 0076 | 3421 | 2579 | 66 | 3 | 63210 | 125049 | SCHUYLKILL EX WB | Exit 343 to Exit 341 | 076 | 7 |
| 0076 | 3425 | 2731 | 38 | 3 | 63210 | 125049 | SCHUYLKILL EX WB | Exit 343 to Exit 341 | 076 | 7 |
| 0076 | 3431 | 2584 | 38 | 3 | 63210 | 125049 | SCHUYLKILL EX WB | Exit 343 to Exit 341 | 076 | 7 |
| | | | | | | | | | | |
| 0095 | 0114 | 1917 | 48 | 4 | 58330 | 124338 | DELAWARE EX NB | Boundary with Delaware Co. to Exit 12 | 095 | 8 |
| 0095 | 0115 | 2300 | 61 | 4 | 66008 | 124338 | DELAWARE EX SB | Exit 12 to boundary with Delaware Co. | 095 | 8 |
| | | | | | | | | | | |
| 0076 | 3394 | 2416 | 41 | 3 | 59331 | 118699 | SCHUYLKILL EX EB | Exit 340A to Exit 341 | 076 | 9 |
| 0076 | 3400 | 2691 | 50 | 4 | 59331 | 118699 | SCHUYLKILL EX EB | Exit 340A to Exit 341 | 076 | 9 |
| 0076 | 3404 | 2655 | 50 | 4 | 59331 | 118699 | SCHUYLKILL EX EB | Exit 340A to Exit 341 | 076 | 9 |
| 0076 | 3410 | 2640 | 50 | 4 | 59331 | 118699 | SCHUYLKILL EX EB | Exit 340A to Exit 341 | 076 | 9 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | STREET NAME | LOCATION | TRAF RT. N1 | TOTAL AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|
| 0076 | 3395 | 2303 | 76 | 4 | 59368 | 118699 | SCHUYLKILL EX WB | Exit 341 to Exit 340A | 076 | 9 |
| 0076 | 3401 | 2937 | 50 | 4 | 59368 | 118699 | SCHUYLKILL EX WB | Exit 341 to Exit 340A | 076 | 9 |
| 0076 | 3405 | 2705 | 50 | 4 | 59368 | 118699 | SCHUYLKILL EX WB | Exit 341 to Exit 340A | 076 | 9 |
| 0076 | 3411 | 2667 | 50 | 4 | 59368 | 118699 | SCHUYLKILL EX WB | Exit 341 to Exit 340A | 076 | 9 |
| | | | | | | | | | | |
| 0095 | 0294 | 2975 | 55 | 4 | 59984 | 117876 | DELAWARE EX NB | Exit 30 to Exit 32 | 095 | 10 |
| 0095 | 0300 | 2814 | 57 | 4 | 59984 | 117876 | DELAWARE EX NB | Exit 30 to Exit 32 | 095 | 10 |
| 0095 | 0304 | 2759 | 47 | 4 | 59984 | 117876 | DELAWARE EX NB | Exit 30 to Exit 32 | 095 | 10 |
| 0095 | 0310 | 2640 | 47 | 4 | 59984 | 117876 | DELAWARE EX NB | Exit 30 to Exit 32 | 095 | 10 |
| 0095 | 0314 | 2615 | 36 | 3 | 59984 | 117876 | DELAWARE EX NB | Exit 30 to Exit 32 | 095 | 10 |
| 0095 | 0295 | 3017 | 36 | 3 | 57892 | 117876 | DELAWARE EX SB | Exit 32 to Exit 30 | 095 | 10 |
| 0095 | 0301 | 2745 | 57 | 4 | 57892 | 117876 | DELAWARE EX SB | Exit 32 to Exit 30 | 095 | 10 |
| 0095 | 0305 | 2788 | 48 | 4 | 57892 | 117876 | DELAWARE EX SB | Exit 32 to Exit 30 | 095 | 10 |
| 0095 | 0311 | 2640 | 48 | 4 | 57892 | 117876 | DELAWARE EX SB | Exit 32 to Exit 30 | 095 | 10 |
| 0095 | 0315 | 2638 | 36 | 3 | 57892 | 117876 | DELAWARE EX SB | Exit 32 to Exit 30 | 095 | 10 |
| | | | | | | | | | | |
| 0095 | 0164 | 3923 | 52 | 4 | 52414 | 101799 | DELAWARE EX NB | Exit 17 to Exit 19 | 095 | 11 |
| 0095 | 0170 | 5233 | 52 | 3 | 52414 | 101799 | DELAWARE EX NB | Exit 17 to Exit 19 | 095 | 11 |
| 0095 | 0165 | 3927 | 52 | 4 | 49385 | 101799 | DELAWARE EX SB | Walt Whitman Br to Exit 17 | 095 | 11 |
| 0095 | 0171 | 5163 | 52 | 3 | 49385 | 101799 | DELAWARE EX SB | Walt Whitman Br to Exit 17 | 095 | 11 |
| 0095 | 0181 | 2435 | 60 | 4 | 49385 | 101799 | DELAWARE EX SB | Walt Whitman Br to Exit 17 | 095 | 11 |
| | | | | | | | | | | |
| 0095 | 0134 | 3021 | 73 | 4 | 49048 | 95937 | DELAWARE EX NB | Exit 13 to W. Fort Mifflin Rd | 095 | 12 |
| 0095 | 0140 | 2677 | 74 | 3 | 49048 | 95937 | DELAWARE EX NB | Exit 13 to W. Fort Mifflin Rd | 095 | 12 |
| 0095 | 0135 | 3244 | 74 | 4 | 46889 | 95937 | DELAWARE EX SB | Exit 15 to Bartram Ave | 095 | 12 |
| 0095 | 0141 | 2679 | 74 | 3 | 46889 | 95937 | DELAWARE EX SB | Exit 15 to Bartram Ave | 095 | 12 |
| | | | | | | | | | | |
| 0076 | 3380 | 2640 | 35 | 2 | 45400 | 88304 | SCHUYLKILL EX EB | Exit 338 to Exit 340A | 076 | 13 |
| 0076 | 3384 | 2657 | 24 | 2 | 45400 | 88304 | SCHUYLKILL EX EB | Exit 338 to Exit 340A | 076 | 13 |
| 0076 | 3381 | 2665 | 35 | 2 | 42904 | 88304 | SCHUYLKILL EX WB | Exit 339 (US 1 S - City Ave) to Exit 338 | 076 | 13 |
| 0076 | 3385 | 2667 | 24 | 2 | 42904 | 88304 | SCHUYLKILL EX WB | Exit 339 (US 1 S - City Ave) to Exit 338 | 076 | 13 |
| | | | | | | | | | | |
| 0095 | 0180 | 2471 | 55 | 3 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0184 | 2599 | 55 | 3 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0190 | 2978 | 67 | 3 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | STREET NAME | LOCATION | TRAF RT. N1 | TOTAL AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0194 | 4418 | 67 | 4 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0200 | 1786 | 36 | 3 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0204 | 1826 | 61 | 4 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0210 | 3049 | 36 | 3 | 42766 | 80951 | DELAWARE EX NB | Exit 19 to Exit 22 | 095 | 14 |
| 0095 | 0185 | 2574 | 60 | 3 | 38185 | 80951 | DELAWARE EX SB | Exit 22 to Walt Whitman Br | 095 | 14 |
| 0095 | 0191 | 2978 | 67 | 3 | 38185 | 80951 | DELAWARE EX SB | Exit 22 to Walt Whitman Br | 095 | 14 |
| 0095 | 0195 | 4418 | 67 | 4 | 38185 | 80951 | DELAWARE EX SB | Exit 22 to Walt Whitman Br | 095 | 14 |
| 0095 | 0201 | 1781 | 48 | 4 | 38185 | 80951 | DELAWARE EX SB | Exit 22 to Walt Whitman Br | 095 | 14 |
| 0095 | 0205 | 1819 | 66 | 3 | 38185 | 80951 | DELAWARE EX SB | Exit 22 to Walt Whitman Br | 095 | 14 |
| | | | | | | | | | | |
| 0095 | 0144 | 3378 | 55 | 4 | 38406 | 77318 | DELAWARE EX NB | W. Fort Mifflin Rd to Exit 17 | 095 | 15 |
| 0095 | 0150 | 5167 | 48 | 3 | 38406 | 77318 | DELAWARE EX NB | W. Fort Mifflin Rd to Exit 17 | 095 | 15 |
| 0095 | 0160 | 1946 | 55 | 3 | 38406 | 77318 | DELAWARE EX NB | W. Fort Mifflin Rd to Exit 17 | 095 | 15 |
| 0095 | 0145 | 3114 | 55 | 4 | 38912 | 77318 | DELAWARE EX SB | Exit 17 to Exit 15 | 095 | 15 |
| 0095 | 0151 | 5167 | 48 | 3 | 38912 | 77318 | DELAWARE EX SB | Exit 17 to Exit 15 | 095 | 15 |
| 0095 | 0161 | 1949 | 55 | 3 | 38912 | 77318 | DELAWARE EX SB | Exit 17 to Exit 15 | 095 | 15 |
| | | | | | | | | | | |
| 0076 | 3390 | 2852 | 24 | 2 | 36031 | 75210 | SCHUYLKILL EX EB | US 1 N to Exit 340 A (Phila Co.) | 076 | 16 |
| 0076 | 3391 | 2902 | 24 | 2 | 39179 | 75210 | SCHUYLKILL EX WB | Exit 340 A (Phila Co.) to US 1 S | 076 | 16 |
| | | | | | | | | | | |
| 0095 | 0120 | 2528 | 60 | 5 | 34459 | 70950 | DELAWARE EX NB | Exit 12 to Exit 13 | 095 | 17 |
| 0095 | 0124 | 2775 | 36 | 3 | 34459 | 70950 | DELAWARE EX NB | Exit 12 to Exit 13 | 095 | 17 |
| 0095 | 0130 | 2640 | 36 | 3 | 34459 | 70950 | DELAWARE EX NB | Exit 12 to Exit 13 | 095 | 17 |
| 0095 | 0121 | 2416 | 60 | 5 | 36491 | 70950 | DELAWARE EX SB | Exit 13 to Exit 12 | 095 | 17 |
| 0095 | 0125 | 2809 | 60 | 5 | 36491 | 70950 | DELAWARE EX SB | Exit 13 to Exit 12 | 095 | 17 |
| 0095 | 0131 | 2640 | 36 | 3 | 36491 | 70950 | DELAWARE EX SB | Exit 13 to Exit 12 | 095 | 17 |

Note: Northbound (NB); Southbound (SB); Eastbound (EB); Westbound (WB)

## *3.2 Combining Fleet Mix Data and AADT Data to Rank Road Segments*

The fleet mix metric accounts for the amount of HD (heavy duty) vehicles on a roadway, or the ratio of HD vehicles to LD (light duty) vehicles on a road. Fleet mix is an important factor because of the higher amount of $NO_X$ emitted per vehicle for HDVs. Therefore, accounting for fleet mix in the near-road $NO_2$ monitoring site selection process more accurately focuses the search on road segments where potential on-road emissions may more consistently lead to peak $NO_2$ concentrations in the near-road environment. Table 3**,** below, is updated from Table 2 with a new column for HD vehicles AADT for each road segment and grouped segments. The grouped rows were re-ranked based on Total HD vehicles for the groupings.

**Table 3 - Rank by HD Vehicle Counts (All Segments are Part of ST.RT.NO. 0076 and 0095)**

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0250 | 3226 | 65 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 |
| 0095 | 0254 | 2453 | 52 | 5 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 |
| 0095 | 0260 | 1535 | 55 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 |
| 0095 | 0245 | 1814 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 |
| 0095 | 0251 | 3242 | 65 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 |
| 0095 | 0255 | 2414 | 60 | 5 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 |
| 0095 | 0261 | 1537 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 |
| | | | | | | | | | | | | |
| 0095 | 0164 | 3923 | 52 | 4 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 |
| 0095 | 0170 | 5233 | 52 | 3 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 |
| 0095 | 0165 | 3927 | 52 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 |
| 0095 | 0171 | 5163 | 52 | 3 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 |
| 0095 | 0181 | 2435 | 60 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 |
| | | | | | | | | | | | | |
| 0095 | 0214 | 2259 | 36 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0220 | 1682 | 48 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0224 | 3284 | 66 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0230 | 3680 | 59 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0234 | 2619 | 57 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0240 | 1829 | 50 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0244 | 1808 | 60 | 5 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 |
| 0095 | 0211 | 3043 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0215 | 2274 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| 0095 | 0221 | 1728 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| 0095 | 0225 | 3378 | 48 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| 0095 | 0231 | 3680 | 59 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| 0095 | 0235 | 2619 | 57 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| 0095 | 0241 | 1835 | 50 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 |
| | | | | | | | | | | | | |
| 0095 | 0180 | 2471 | 55 | 3 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0184 | 2599 | 55 | 3 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0190 | 2978 | 67 | 3 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0194 | 4418 | 67 | 4 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0200 | 1786 | 36 | 3 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0204 | 1826 | 61 | 4 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0210 | 3049 | 36 | 3 | 42766 | 80951 | DEL EX NB Exit 19 to Exit 22 | 095 | 14 | 7698 | 14953 | 4 |
| 0095 | 0185 | 2574 | 60 | 3 | 38185 | 80951 | DEL EX SB Exit 22 to Walt Whitman Br | 095 | 14 | 7255 | 14953 | 4 |
| 0095 | 0191 | 2978 | 67 | 3 | 38185 | 80951 | DEL EX SB Exit 22 to Walt Whitman Br | 095 | 14 | 7255 | 14953 | 4 |
| 0095 | 0195 | 4418 | 67 | 4 | 38185 | 80951 | DEL EX SB Exit 22 to Walt Whitman Br | 095 | 14 | 7255 | 14953 | 4 |
| 0095 | 0201 | 1781 | 48 | 4 | 38185 | 80951 | DEL EX SB Exit 22 to Walt Whitman Br | 095 | 14 | 7255 | 14953 | 4 |
| 0095 | 0205 | 1819 | 66 | 3 | 38185 | 80951 | DEL EX SB Exit 22 to Walt Whitman Br | 095 | 14 | 7255 | 14953 | 4 |
| | | | | | | | | | | | | |
| 0095 | 0114 | 1917 | 48 | 4 | 58330 | 124338 | DEL EX NB Boundary with Delaware Co. to Exit 12 | 095 | 8 | 7583 | 14844 | 5 |
| 0095 | 0115 | 2300 | 61 | 4 | 66008 | 124338 | DEL EX SB Exit 12 to boundary with Delaware Co. | 095 | 8 | 7261 | 14844 | 5 |
| | | | | | | | | | | | | |
| 0095 | 0320 | 2744 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 |
| 0095 | 0324 | 2793 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0330 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 |
| 0095 | 0334 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 |
| 0095 | 0340 | 2651 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 |
| 0095 | 0321 | 2781 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 |
| 0095 | 0325 | 2782 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 |
| 0095 | 0331 | 2546 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 |
| 0095 | 0335 | 2633 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 |
| 0095 | 0341 | 2628 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 |
| | | | | | | | | | | | | |
| 0095 | 0134 | 3021 | 73 | 4 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 |
| 0095 | 0140 | 2677 | 74 | 3 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 |
| 0095 | 0135 | 3244 | 74 | 4 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 |
| 0095 | 0141 | 2679 | 74 | 3 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 |
| | | | | | | | | | | | | |
| 0095 | 0120 | 2528 | 60 | 5 | 34459 | 70950 | DEL EX NB Exit 12 to Exit 13 | 095 | 17 | 6892 | 13825 | 8 |
| 0095 | 0124 | 2775 | 36 | 3 | 34459 | 70950 | DEL EX NB Exit 12 to Exit 13 | 095 | 17 | 6892 | 13825 | 8 |
| 0095 | 0130 | 2640 | 36 | 3 | 34459 | 70950 | DEL EX NB Exit 12 to Exit 13 | 095 | 17 | 6892 | 13825 | 8 |
| 0095 | 0121 | 2416 | 60 | 5 | 36491 | 70950 | DEL EX SB Exit 13 to Exit 12 | 095 | 17 | 6933 | 13825 | 8 |
| 0095 | 0125 | 2809 | 60 | 5 | 36491 | 70950 | DEL EX SB Exit 13 to Exit 12 | 095 | 17 | 6933 | 13825 | 8 |
| 0095 | 0131 | 2640 | 36 | 3 | 36491 | 70950 | DEL EX SB Exit 13 to Exit 12 | 095 | 17 | 6933 | 13825 | 8 |
| | | | | | | | | | | | | |
| 0076 | 3394 | 2416 | 41 | 3 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 |
| 0076 | 3400 | 2691 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 |
| 0076 | 3404 | 2655 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 |
| 0076 | 3410 | 2640 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 |
| 0076 | 3395 | 2303 | 76 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0076 | 3401 | 2937 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 |
| 0076 | 3405 | 2705 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 |
| 0076 | 3411 | 2667 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 |
| | | | | | | | | | | | | |
| 0095 | 0294 | 2975 | 55 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 |
| 0095 | 0300 | 2814 | 57 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 |
| 0095 | 0304 | 2759 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 |
| 0095 | 0310 | 2640 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 |
| 0095 | 0314 | 2615 | 36 | 3 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 |
| 0095 | 0295 | 3017 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 |
| 0095 | 0301 | 2745 | 57 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 |
| 0095 | 0305 | 2788 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 |
| 0095 | 0311 | 2640 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 |
| 0095 | 0315 | 2638 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 |
| | | | | | | | | | | | | |
| 0095 | 0144 | 3378 | 55 | 4 | 38406 | 77318 | DEL EX NB W. Fort Mifflin Rd to Exit 17 | 095 | 15 | 5761 | 11598 | 11 |
| 0095 | 0150 | 5167 | 48 | 3 | 38406 | 77318 | DEL EX NB W. Fort Mifflin Rd to Exit 17 | 095 | 15 | 5761 | 11598 | 11 |
| 0095 | 0160 | 1946 | 55 | 3 | 38406 | 77318 | DEL EX NB W. Fort Mifflin Rd to Exit 17 | 095 | 15 | 5761 | 11598 | 11 |
| 0095 | 0145 | 3114 | 55 | 4 | 38912 | 77318 | DEL EX SB Exit 17 to Exit 15 | 095 | 15 | 5837 | 11598 | 11 |
| 0095 | 0151 | 5167 | 48 | 3 | 38912 | 77318 | DEL EX SB Exit 17 to Exit 15 | 095 | 15 | 5837 | 11598 | 11 |
| 0095 | 0161 | 1949 | 55 | 3 | 38912 | 77318 | DEL EX SB Exit 17 to Exit 15 | 095 | 15 | 5837 | 11598 | 11 |
| | | | | | | | | | | | | |
| 0095 | 0264 | 4229 | 67 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |
| 0095 | 0270 | 2710 | 43 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |
| 0095 | 0274 | 2270 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |
| 0095 | 0280 | 2728 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0095 | 0284 | 2681 | 36 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |
| 0095 | 0290 | 1990 | 48 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 |
| 0095 | 0265 | 4254 | 67 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| 0095 | 0271 | 2750 | 36 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| 0095 | 0275 | 2226 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| 0095 | 0281 | 2731 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| 0095 | 0285 | 2695 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| 0095 | 0291 | 1944 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 |
| | | | | | | | | | | | | |
| 0076 | 3434 | 2640 | 38 | 3 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 |
| 0076 | 3440 | 2651 | 25 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 |
| 0076 | 3444 | 3156 | 27 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 |
| 0076 | 3441 | 2112 | 25 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 |
| 0076 | 3445 | 3156 | 27 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 |
| 0076 | 3435 | 2687 | 38 | 3 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 |
| | | | | | | | | | | | | |
| 0076 | 3450 | 2612 | 30 | 2 | 70614 | 141228 | SCH EX EB Exit 346A to Exit 347B (End of I-76) | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3454 | 3946 | 27 | 2 | 70614 | 141228 | SCH EX EB Exit 346A to Exit 347B (End of I-76) | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3460 | 1434 | 36 | 3 | 70614 | 141228 | SCH EX EB Exit 346A to Exit 347B (End of I-76) | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3464 | 2544 | 37 | 3 | 70614 | 141228 | SCH EX EB Exit 346A to Exit 347B (End of I-76) | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3470 | 1483 | 57 | 3 | 70614 | 141228 | SCH EX EB Exit 346A to Exit 347B (End of I-76) | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3451 | 2602 | 33 | 2 | 70614 | 141228 | SCH EX WB Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3455 | 3927 | 27 | 2 | 70614 | 141228 | SCH EX WB Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3461 | 1411 | 37 | 3 | 70614 | 141228 | SCH EX WB Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 | 4236 | 8472 | 14 |
| 0076 | 3465 | 2509 | 37 | 3 | 70614 | 141228 | SCH EX WB Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 | 4236 | 8472 | 14 |

| ST. RT. NO | SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0076 | 3471 | 1709 | 37 | 3 | 70614 | 141228 | SCH EX WB Beginning of I-76 (S.26th St) to Exit 346A | 076 | 3 | 4236 | 8472 | 14 |
| | | | | | | | | | | | | |
| 0076 | 3380 | 2640 | 35 | 2 | 45400 | 88304 | SCH EX EB Exit 338 to Exit 340A | 076 | 13 | 4086 | 7518 | 15 |
| 0076 | 3384 | 2657 | 24 | 2 | 45400 | 88304 | SCH EX EB Exit 338 to Exit 340A | 076 | 13 | 4086 | 7518 | 15 |
| 0076 | 3381 | 2665 | 35 | 2 | 42904 | 88304 | SCH EX WB Exit 339 (US 1 S - City Ave) to Exit 338 | 076 | 13 | 3432 | 7518 | 15 |
| 0076 | 3385 | 2667 | 24 | 2 | 42904 | 88304 | SCH EX WB Exit 339 (US 1 S - City Ave) to Exit 338 | 076 | 13 | 3432 | 7518 | 15 |
| | | | | | | | | | | | | |
| 0076 | 3414 | 2640 | 38 | 3 | 61839 | 125049 | SCH EX EB Exit 341 to Exit 343 | 076 | 7 | 3092 | 6253 | 16 |
| 0076 | 3420 | 2640 | 66 | 3 | 61839 | 125049 | SCH EX EB Exit 341 to Exit 343 | 076 | 7 | 3092 | 6253 | 16 |
| 0076 | 3424 | 2640 | 38 | 3 | 61839 | 125049 | SCH EX EB Exit 341 to Exit 343 | 076 | 7 | 3092 | 6253 | 16 |
| 0076 | 3430 | 2640 | 38 | 3 | 61839 | 125049 | SCH EX EB Exit 341 to Exit 343 | 076 | 7 | 3092 | 6253 | 16 |
| 0076 | 3415 | 2575 | 38 | 3 | 63210 | 125049 | SCH EX WB Exit 343 to Exit 341 | 076 | 7 | 3161 | 6253 | 16 |
| 0076 | 3421 | 2579 | 66 | 3 | 63210 | 125049 | SCH EX WB Exit 343 to Exit 341 | 076 | 7 | 3161 | 6253 | 16 |
| 0076 | 3425 | 2731 | 38 | 3 | 63210 | 125049 | SCH EX WB Exit 343 to Exit 341 | 076 | 7 | 3161 | 6253 | 16 |
| 0076 | 3431 | 2584 | 38 | 3 | 63210 | 125049 | SCH EX WB Exit 343 to Exit 341 | 076 | 7 | 3161 | 6253 | 16 |
| | | | | | | | | | | | | |
| 0076 | 3390 | 2852 | 24 | 2 | 36031 | 75210 | SCH EX EB US 1 N to Exit 340 A (Phila Co.) | 076 | 16 | 2161 | 6079 | 17 |
| 0076 | 3391 | 2902 | 24 | 2 | 39179 | 75210 | SCH EX WB Exit 340 A (Phila Co.) to US 1 S | 076 | 16 | 3918 | 6079 | 17 |

Note:

1. DEL EX: Delaware Expressway; SCH EX: Schuylkill Expressway
2. Northbound (NB); Southbound (SB); Eastbound (EB); Westbound (WB)

### Fleet Equivalent Metric

In order to more easily compare one road segment to another, particularly when those road segments have a varied amount of both total traffic volume and heavy-duty vehicle volume, the EPA recommends the use of a unique *metric that accounts for both total traffic volume and fleet mix for comparison purposes*, called Fleet Equivalent (FE) AADT. With the FE AADT metric, roads can be re-ranked in an order that reflects both AADT and fleet mix within one numerical value. *Re-ranking by FE AADT presents a prioritized list of road segments that are more likely representative of estimated or potential NOX emissions than either AADT or fleet mix alone.* The determination of FE AADT per segment depends on three variables: (1) total traffic volume, presented as AADT counts, (2) fleet mix, presented as HD vehicle number counts, and (3) the heavy-duty to light-duty vehicle NOX emission ratio. The following equation can be used to determine a Fleet-Equivalent AADT value for each road segment:

**Fleet-Equivalent (FE) AADT = (AADT – HDc) + (HDm * HDc)**

Where: AADT is the total traffic volume count for a particular road segment;
*HDc* is the total number of heavy-duty vehicles for a particular road segment; and
*HDm* is a multiplier that represents the heavy-duty to light-duty NOx emission ratio for a particular road segment.

The *HDm* multiplier can be obtained from national average motor vehicle emission factors, from local emissions estimates obtained in a given CBSA that can provide a specific *HDm* value across the CBSA or for each individual road segment, or a national default value of 10 can be used. Philadelphia County is using the national default *HDm* equal to 10, where the assumption is made that the NOx emissions from one HD vehicle are equivalent to the NOx emissions from ten LD vehicles operating on the same road segment and under the same environmental and relative operating conditions. The equation can be simplified to: **FE-AADT = (AADT – HDc) + (10 * HDc)**
**Table 4,** below, is updated from Table 3 with an additional column to reflect FE AADT. The road segments have been re-ranked based on the FE AADT value.

**Table 4 - Rank by FE AADT (The Top 10 Ranks)**

| SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0250 | 3226 | 65 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 |
| 0254 | 2453 | 52 | 5 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 |
| 0260 | 1535 | 55 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95 N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 |
| 0245 | 1814 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 |
| 0251 | 3242 | 65 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 |
| 0255 | 2414 | 60 | 5 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 |
| 0261 | 1537 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 |
| | | | | | | | | | | | | | |
| 0214 | 2259 | 36 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0220 | 1682 | 48 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0224 | 3284 | 66 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0230 | 3680 | 59 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0234 | 2619 | 57 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0240 | 1829 | 50 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0244 | 1808 | 60 | 5 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 |
| 0211 | 3043 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| 0215 | 2274 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| 0221 | 1728 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| 0225 | 3378 | 48 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |

| SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0231 | 3680 | 59 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| 0235 | 2619 | 57 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| 0241 | 1835 | 50 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 |
| | | | | | | | | | | | | | |
| 0114 | 1917 | 48 | 4 | 58330 | 124338 | DEL EX NB Boundary with Delaware Co. to Exit 12 | 095 | 8 | 7583 | 14844 | 5 | 257934 | 3 |
| 0115 | 2300 | 61 | 4 | 66008 | 124338 | DEL EX SB Exit 12 to boundary with Delaware Co. | 095 | 8 | 7261 | 14844 | 5 | 257934 | 3 |
| | | | | | | | | | | | | | |
| 0320 | 2744 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 |
| 0324 | 2793 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 |
| 0330 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 |
| 0334 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 |
| 0340 | 2651 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 |
| 0321 | 2781 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 |
| 0325 | 2782 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 |
| 0331 | 2546 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 |
| 0335 | 2633 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 |
| 0341 | 2628 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 |
| | | | | | | | | | | | | | |
| 0164 | 3923 | 52 | 4 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 | 248661 | 5 |
| 0170 | 5233 | 52 | 3 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 | 248661 | 5 |
| 0165 | 3927 | 52 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 |
| 0171 | 5163 | 52 | 3 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 |
| 0181 | 2435 | 60 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 |
| | | | | | | | | | | | | | |
| 0264 | 4229 | 67 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0270 | 2710 | 43 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0274 | 2270 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0280 | 2728 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0284 | 2681 | 36 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0290 | 1990 | 48 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 |
| 0265 | 4254 | 67 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |
| 0271 | 2750 | 36 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |
| 0275 | 2226 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |

| SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0281 | 2731 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |
| 0285 | 2695 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |
| 0291 | 1944 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 |
| | | | | | | | | | | | | | |
| 3394 | 2416 | 41 | 3 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 |
| 3400 | 2691 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 |
| 3404 | 2655 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 |
| 3410 | 2640 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 |
| 3395 | 2303 | 76 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 |
| 3401 | 2937 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 |
| 3405 | 2705 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 |
| 3411 | 2667 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 |
| | | | | | | | | | | | | | |
| 3434 | 2640 | 38 | 3 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 |
| 3440 | 2651 | 25 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 |
| 3444 | 3156 | 27 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 |
| 3441 | 2112 | 25 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 |
| 3445 | 3156 | 27 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 |
| 3435 | 2687 | 38 | 3 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 |
| | | | | | | | | | | | | | |
| 0294 | 2975 | 55 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 |
| 0300 | 2814 | 57 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 |
| 0304 | 2759 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 |
| 0310 | 2640 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 |
| 0314 | 2615 | 36 | 3 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 |
| 0295 | 3017 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 |
| 0301 | 2745 | 57 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 |
| 0305 | 2788 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 |
| 0311 | 2640 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 |
| 0315 | 2638 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 |
| | | | | | | | | | | | | | |
| 0134 | 3021 | 73 | 4 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 | 221037 | 10 |
| 0140 | 2677 | 74 | 3 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 | 221037 | 10 |

| SEG NO. | SEG LNGTH | WIDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEHICLE AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0135 | 3244 | 74 | 4 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 | 221037 | 10 |
| 0141 | 2679 | 74 | 3 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 | 221037 | 10 |

FE-AADT = (AADT – HDc) + (10 * HDc)

Note:

1. DEL EX: Delaware Expressway; SCH EX: Schuylkill Expressway
2. Northbound (NB); Southbound (SB); Eastbound (EB); Westbound (WB)

### *3.3 Using Congestion Pattern Indicators to Supplement Road Segment Rankings*

The EPA does not recommend that any of the congestion indicators be used in a quantitative manner to further re-rank or re-prioritize the whole list of candidate road segments resulting from Steps 3.1 and 3.2. Instead, such data are believed to be more useful as a qualitative measure by which one road segment might be selected over other relatively similar candidate road segments in the overall selection process. In such a situation, *it is recommended that when using AADT per lane data, a higher priority should be placed on road segments with higher AADT per lane values.*

**Table 5 below,** is an updated form of Table 4 with a column displaying congestion information in the form of AADT per lane data

**Table 5 - Rank by FE AADT with AADT by Lane Displayed (Sites A - J)**

| SEG NO. | SEG LNGTH | WDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEH AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK | AADT BY LANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SITE A** | | | | | | | | | | | | | | |
| 0250 | 3226 | 65 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 | 18161 |
| 0254 | 2453 | 52 | 5 | 72642 | 137713 | DEL EX NB Exit 25 to I-95N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 | 14528 |
| 0260 | 1535 | 55 | 4 | 72642 | 137713 | DEL EX NB Exit 25 to I-95N - Trenton | 095 | 4 | 12349 | 23411 | 1 | 348412 | 1 | 18161 |
| 0245 | 1814 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 | 16268 |
| 0251 | 3242 | 65 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 | 16268 |
| 0255 | 2414 | 60 | 5 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 | 13014 |
| 0261 | 1537 | 48 | 4 | 65071 | 137713 | DEL EX SB I-95 N - Trenton to Exit 25 | 095 | 4 | 11062 | 23411 | 1 | 348412 | 1 | 16268 |
| **SITE B** | | | | | | | | | | | | | | |
| 0214 | 2259 | 36 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 25700 |
| 0220 | 1682 | 48 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 19275 |
| 0224 | 3284 | 66 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 19275 |
| 0230 | 3680 | 59 | 3 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 25700 |
| 0234 | 2619 | 57 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 19275 |
| 0240 | 1829 | 50 | 4 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 19275 |
| 0244 | 1808 | 60 | 5 | 77099 | 159799 | DEL EX NB Exit 22 to Exit 25 | 095 | 1 | 7710 | 15153 | 3 | 296176 | 2 | 15420 |
| 0211 | 3043 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 27567 |
| 0215 | 2274 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 27567 |
| 0221 | 1728 | 36 | 3 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 27567 |
| 0225 | 3378 | 48 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 20675 |
| 0231 | 3680 | 59 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 20675 |
| 0235 | 2619 | 57 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 20675 |
| 0241 | 1835 | 50 | 4 | 82700 | 159799 | DEL EX SB Exit 25 to Exit 22 | 095 | 1 | 7443 | 15153 | 3 | 296176 | 2 | 20675 |

| SEG NO. | SEG LNGTH | WDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEH AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK | AADT BY LANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **SITE C** | | | | | | | | | | | | | | |
| 0114 | 1917 | 48 | 4 | 58330 | 124338 | DEL EX NB Boundary with Delaware Co. to Exit 12 | 095 | 8 | 7583 | 14844 | 5 | 257934 | 3 | 14583 |
| 0115 | 2300 | 61 | 4 | 66008 | 124338 | DEL EX SB Exit 12 to boundary with Delaware Co. | 095 | 8 | 7261 | 14844 | 5 | 257934 | 3 | 16502 |
| | | | | | | | | | | | | | | |
| **SITE D** | | | | | | | | | | | | | | |
| 0320 | 2744 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 | 21464 |
| 0324 | 2793 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 | 21464 |
| 0330 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 | 21464 |
| 0334 | 2640 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 | 21464 |
| 0340 | 2651 | 36 | 3 | 64393 | 126564 | DEL EX NB Exit 32 to Exit 33 | 095 | 6 | 7083 | 14544 | 6 | 257460 | 4 | 21464 |
| 0321 | 2781 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 | 20724 |
| 0325 | 2782 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 | 20724 |
| 0331 | 2546 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 | 20724 |
| 0335 | 2633 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 | 20724 |
| 0341 | 2628 | 36 | 3 | 62171 | 126564 | DEL EX SB Exit 33 to Exit 32 | 095 | 6 | 7461 | 14544 | 6 | 257460 | 4 | 20724 |
| **SITE E** | | | | | | | | | | | | | | |
| 0164 | 3923 | 52 | 4 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 | 248661 | 5 | 13104 |
| 0170 | 5233 | 52 | 3 | 52414 | 101799 | DEL EX NB Exit 17 to Exit 19 | 095 | 11 | 8910 | 16318 | 2 | 248661 | 5 | 17471 |
| 0165 | 3927 | 52 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 | 12346 |
| 0171 | 5163 | 52 | 3 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 | 16462 |
| 0181 | 2435 | 60 | 4 | 49385 | 101799 | DEL EX SB Walt Whitman Br to Exit 17 | 095 | 11 | 7408 | 16318 | 2 | 248661 | 5 | 12346 |
| **SITE F** | | | | | | | | | | | | | | |
| 0264 | 4229 | 67 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 21272 |
| 0270 | 2710 | 43 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 21272 |
| 0274 | 2270 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 21272 |

| SEG NO. | SEG LNGTH | WDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEH AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK | AADT BY LANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0280 | 2728 | 36 | 3 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 21272 |
| 0284 | 2681 | 36 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 15954 |
| 0290 | 1990 | 48 | 4 | 63816 | 127760 | DEL EX NB I-95 N - Trenton to Exit 30 | 095 | 5 | 5105 | 11499 | 12 | 231251 | 6 | 15954 |
| 0265 | 4254 | 67 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N – Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 21315 |
| 0271 | 2750 | 36 | 3 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N – Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 21315 |
| 0275 | 2226 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N – Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 15986 |
| 0281 | 2731 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 15986 |
| 0285 | 2695 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 15986 |
| 0291 | 1944 | 48 | 4 | 63944 | 127760 | DEL EX SB Exit 30 to I-95 N - Trenton | 095 | 5 | 6394 | 11499 | 12 | 231251 | 6 | 15986 |
| **SITE G** | | | | | | | | | | | | | | |
| 3394 | 2416 | 41 | 3 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 | 19777 |
| 3400 | 2691 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 | 14833 |
| 3404 | 2655 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 | 14833 |
| 3410 | 2640 | 50 | 4 | 59331 | 118699 | SCH EX EB Exit 340A to Exit 341 | 076 | 9 | 5933 | 11870 | 9 | 225529 | 7 | 14833 |
| 3395 | 2303 | 76 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 | 14842 |
| 3401 | 2937 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 | 14842 |
| 3405 | 2705 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 | 14842 |
| 3411 | 2667 | 50 | 4 | 59368 | 118699 | SCH EX WB Exit 341 to Exit 340A | 076 | 9 | 5937 | 11870 | 9 | 225529 | 7 | 14842 |
| **SITE H** | | | | | | | | | | | | | | |
| 3434 | 2640 | 38 | 3 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 | 24135 |
| 3440 | 2651 | 25 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 | 36203 |

| SEG NO. | SEG LNGTH | WDTH | LANE CNT | CUR AADT | TOTAL AADT | LOCATION | TRAF RT. N1 | TOTAL AADT RANK | HEAVY DUTY (HD) VEH AADT | TOTAL HD VEH AADT | HD VEH AADT RANK | FE AADT | FE AADT RANK | AADT BY LANE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3444 | 3156 | 27 | 2 | 72405 | 145780 | SCH EX EB Exit 343 to Exit 346A | 076 | 2 | 4344 | 8747 | 13 | 224503 | 8 | 36203 |
| 3441 | 2112 | 25 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 | 36688 |
| 3445 | 3156 | 27 | 2 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 | 36688 |
| 3435 | 2687 | 38 | 3 | 73375 | 145780 | SCH EX WB Exit 346A to Exit 343 | 076 | 2 | 4403 | 8747 | 13 | 224503 | 8 | 24458 |
| **SITE I** | | | | | | | | | | | | | | |
| 0294 | 2975 | 55 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 | 14996 |
| 0300 | 2814 | 57 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 | 14996 |
| 0304 | 2759 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 | 14996 |
| 0310 | 2640 | 47 | 4 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 | 14996 |
| 0314 | 2615 | 36 | 3 | 59984 | 117876 | DEL EX NB Exit 30 to Exit 32 | 095 | 10 | 5998 | 11787 | 10 | 223959 | 9 | 19995 |
| 0295 | 3017 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 | 19297 |
| 0301 | 2745 | 57 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 | 14473 |
| 0305 | 2788 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 | 14473 |
| 0311 | 2640 | 48 | 4 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 | 14473 |
| 0315 | 2638 | 36 | 3 | 57892 | 117876 | DEL EX SB Exit 32 to Exit 30 | 095 | 10 | 5789 | 11787 | 10 | 223959 | 9 | 19297 |
| **SITE J** | | | | | | | | | | | | | | |
| 0134 | 3021 | 73 | 4 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 | 221037 | 10 | 12262 |
| 0140 | 2677 | 74 | 3 | 49048 | 95937 | DEL EX NB Exit 13 to W. Fort Mifflin Rd | 095 | 12 | 6867 | 13900 | 7 | 221037 | 10 | 16349 |
| 0135 | 3244 | 74 | 4 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 | 221037 | 10 | 11722 |
| 0141 | 2679 | 74 | 3 | 46889 | 95937 | DEL EX SB Exit 15 to Bartram Ave | 095 | 12 | 7033 | 13900 | 7 | 221037 | 10 | 15630 |

FE-AADT = (AADT – HDc) + (10 * HDc)

Note: 1. DEL EX: Delaware Expressway; SCH EX: Schuylkill Expressway

2. Northbound (NB); Southbound (SB); Eastbound (EB); Westbound (WB)

### *3.4 Road Segment Ranking Process*

Completion of steps 3.1 through 3.3 resulted in a prioritized list of candidate road segments in which the highest-ranked road segments are the locations where traffic volume, fleet mix, and congestion patterns combine to contribute to a greater potential for and/or more frequent occurrences of peak $NO_2$ concentrations in the near-road environment. ***In Table 5, the group of roadway segments grouped under the designation "SITE A" ranked as the highest and, based on this information alone, either site A (the Delaware Expressway roadway segments near the Betsy Ross Bridge), site B or other site following those two sites would be the recommended selection depend on the availability of the space.*** *However, Table 5 is recommended to guide* ***subsequent*** *evaluation processes (described in the following sections of this document) to determine where the permanent near-road* $NO_2$ *monitoring station will be installed.*

Several roadway maps are attached to this report to better identify the Table 5 road segments and Sites A – J.

## Section 4 - Physical Considerations for Candidate Near-Road Monitoring Sites

*With an initial list of candidate sites created, selected segments should be further evaluated* to determine adequacy for a near-road monitoring station. *Specifically, candidate road segments need to be inspected to account for roadway design, terrain, and meteorological factors, and also for safety and logistical considerations, and possibly for population exposure potential.*

This section provides a brief review of the three, non-traffic related data considerations listed in the CFR: roadway design (including related roadside structures), terrain, and meteorology.

**Table 6 - Summary of Physical Considerations for Near-Road Candidate Sites**

| Physical Site Component | Impact on Site Selection | Desirable Attributes | Less Desirable Attributes | Potential Information Sources |
|---|---|---|---|---|
| Roadway design or configuration | Feasibility of monitor placements; affects pollutant transport and dispersion | Near ramps, intersections, lane merge locations/ interchanges; at grade with surrounding terrain | Cut-section/below grade; above grade (bridge) | Field reconnaissance; satellite imagery |
| Roadside Structures | Feasibility of monitor placement; affects pollutant transport and dispersion | No barriers present besides low (<2 m in height) safety features such as guardrails | Presence of sound walls, high vegetation, obstructive buildings | Field reconnaissance; satellite imagery |
| Terrain | Affects pollutant dispersion, local atmospheric stability | Flat or gentle terrain, within a valley, or along road grade | Along mountain ridges or peaks, hillsides, or other naturally windswept areas | Field reconnaissance; digital elevation models and vegetation files; satellite imagery |
| Meteorology | Affects pollutant transport and dispersion | Relative downwind locations – winds from road to monitor | Strongly predominant upwind positions | Local data; NOAA/NWS; AQS |

## *4.1 Roadway Design*

The design (or configuration) of a roadway can influence the amount of emissions generated from motor vehicles and the transport and dispersion of those emissions along and/or away from the road. Roadway design includes features of the road itself, such as the slope or grade of a roadbed (which is often a reflection of local terrain or topography), the presence of access ramps, intersections, interchanges, or other such locations where traffic may merge or disperse, and a roadbed‘s position relative to the immediate surrounding terrain. In particular, road grades create an increased load on vehicles ascending a grade, leading to increased exhaust emissions as the vehicle does more work to continue its forward motion. In addition, the presence of ramps, intersections, and lane merge locations can lead to increased but localized emissions due to the propensity for acceleration and potential for stop-and-go vehicle operations resulting from traffic congestion.

The relative position of a road to the immediate terrain around the roadway can have a significant influence on pollutant transport and dispersion along and/or away from the source road. The three general types of roadway design discussed here are at-grade, cut-section, and elevated roads.

### 4.1.1 At-Grade Roads

At-grade roads are those where the roadway surface (on which the vehicles are travelling) is generally at the same elevation as the surrounding terrain.

### 4.1.2 Below-Grade or Cut-Section Roads

Cut-section roads are those where the roadway surface elevation is below the surrounding terrain. Under perpendicular wind conditions (normal to the road), cut-section roads tend to cause lofting of the traffic plume as wind flows through, up, and out of the depressed road canyon. With wind conditions parallel or near-parallel to the source road, on-road emissions may be funneled downwind for some distance with emissions contained, akin to what happens in an urban street canyon. Channeling of winds may also occur within the cut section as a result of turbulence and wind flow generated from the vehicles operating on the road.

### 4.1.3 Above Grade or Elevated Roads

Elevated roadways are those where the roadway surface is higher, in the vertical, than the surrounding topography. Elevated roads can be elevated on an earthen berm or other solid material, where such earth or material may be referred to as "fill", with no open space underneath the road surface for airflow, or on pilings or supports with open space underneath, where air may flow both above and beneath the road surface, such as a bridge.

- Elevated roads over solid fill material can have similar dispersion patterns as at-grade roads with winds normal to the road. However, some fill configurations (e.g., those with vertical or sharply sloped walls) can cause the traffic plume to loft above the ground immediately adjacent to the vertical or sharply sloped wall, with the core of the emission plume impacting the ground further downwind from the vertical or sharply sloped wall.
- Elevated roads which are open underneath can have enhanced dispersion of on-road emissions with all wind directions. In these cases, emissions are more readily dispersed. Because of this, ground-level concentrations downwind of the elevated roadbed may not be as high as concentrations found at at-grade roads or similar roads which are elevated on fill.

### 4.1.4 Relative Desirability in Roadway Designs

Under wind conditions normal to the source road, flat terrain, which would be representative of at-grade roads, shows the least disruption in dispersion, with a Gaussian-type gradient, where concentrations decrease with increasing distance from the source roadway. *At-grade road configurations would have the least complicated dispersion scenarios to consider while targeting maximum* $NO_2$ *concentrations, and thus be the* *most desirable setting for near road $NO_2$ monitoring stations.* The second most desirable near-road monitoring location is adjacent to elevated roads on fill material, where maximum concentrations are found that are very close in value to concentrations found at at-grade locations. Those roadway designs that may be less preferable when considering near-road $NO_2$ monitor locations would be adjacent to elevated road that are open underneath, or cut (or depressed) road beds (where deeper cuts or depressions likely present increasingly more significant impacts or complications on pollutant dispersion). Recommendations on siting a monitor probe near above and below grade roads are discussed in Section 5.

### 4.2 Roadside Structures

In addition to the manner in which roadway design affects pollutant transport and dispersion, roadside structures may be present that also affect near-road pollutant concentrations. These structures include sound walls or noise barriers, vegetation, and buildings. Physical barriers affect pollutant concentrations around the structure by blocking initial dispersion and increasing turbulence and initial mixing of the emitted pollutants. Road configurations with noise barriers have the largest impacts on pollutant dispersion, relative to flat, at-grade roadway designs.

Roadside structures can trap pollutants upwind of the structure, the effects are very localized and likely do not contribute to peak $NO_2$ exposures for the nearby, adjacent population. In other situations, such as when winds blow along the roadway, the barriers may channel emissions downwind, without much dispersion occurring normal to the road. As such, even if siting criteria can be met at a site, *the EPA suggests that monitor placement adjacent to these structures be avoided when possible, particularly if other, similar candidate near-road locations are available that do not have such roadside structures.*

### 4.3 Terrain

As mentioned in Section 4.1 (on roadway design), local topography is often a part of roadway design and can greatly influence pollutant transport and dispersion. However, large-scale terrain features, beyond the local roadway configuration, may also impact where peak $NO_2$ concentrations from on-road mobile sources can occur. The consideration of large-scale terrain in the siting process is more of a case-by-case issue for individual sites. In terms of making sure that larger scale terrain is considered in the near-road $NO_2$ site selection process, one example could be identifying multiple air basins within a single CBSA, and considering how individual basins may affect pollutant build-up and dispersion. Another example might be considering roads through valleys, where, due to the increased potential for inversion conditions within the valley, higher near-road $NO_2$ concentrations may be found than what is found along alignments on the tops of hills, along hillsides, or in open terrain.

### 4.4 Meteorology

Evaluating historical meteorological data could be useful in determining whether certain candidate locations may experience a higher proportion of direct traffic emission impacts from a given target road segment due to the local winds. More specifically, an evaluation of local meteorology may also provide some indication on which side of an individual road segment under consideration, might experience a higher proportion of direct traffic emission impacts from a given target road segment. Most studies showing elevated pollutant concentrations near roads have focused on measurements when winds were from the road to the downwind monitor or receptor (typically along a line normal to the roadbed). In addition to relatively small scale impacts on a candidate road segment, other meteorological impacts, such as the frequency of inversions, which can lead to increased potential for pollutant build-up due to limited atmospheric mixing, may also be considered. In the preamble to the final $NO_2$ rulemaking, it is noted that downwind monitoring is not required, but the EPA strongly encouraged it. Some evidence suggests that wind direction may not always be a major factor in leading to peak concentrations in close proximity to a major roadway. Often, peak $NO_2$ concentrations may occur during stable, low wind speed conditions. In addition, the turbulence created by vehicles on the road can lead to “upwind meandering” of pollutants, where a monitor upwind of the target road would still be characterizing on-road emissions. However, there are situations where meteorological patterns may warrant strong consideration for the relative downwind side of a target road segment. An example might be roads in valley areas which are subject to air flows driven by diurnal mountain air flow patterns. Thus, historical wind directions should be considered in establishing $NO_2$ monitoring sites. In most cases, monitor placement on the climatologically down-wind side of a road segment is preferred; however this should not preclude consideration of sites located in the predominant climatologically upwind direction in light of applicable site access, safety, and other logistical issues.

## Section 5 - Siting Criteria

The primary requirements related to horizontal and vertical probe placement for near-road $NO_2$ monitors are specified by the EPA in 40 CFR Part 58, Appendix E. Horizontal placement of near-road $NO_2$ monitor probes, with respect to the target roadway, are required to be installed so *"…the monitor probe shall be as near as practicable to the outside nearest edge of the traffic lanes of the target road segment; but shall not be located at a distance greater than 50 meters, in the horizontal, from the outside nearest edge of the traffic lanes of the target road segment." The key component of this passage is that the monitoring probes are to be placed "* as near as practicable" to the target road segment. Baldauf et al. (2009) note that a distance of 10 to 20 meters should be considered for near-roadway monitoring, and as such, the EPA strongly encourages state and local agencies to try to place near-road $NO_2$ monitor probes within 20 meters from target road segments when possible. Key requirements from 40 CFR Part 58, Appendix E are shown in here:

**Table 7 - Key Near-Road Siting Criteria**

| Near-Road NO2 Siting Criteria (per 40 CFR Part 58, Appendix E) | |
|---|---|
| Horizontal spacing | As near as practicable to the outside nearest edge of the traffic lanes of the target road segment; but shall not be located at a distance greater than 50 meters, in the horizontal, from the outside nearest edge of the traffic lanes of the target road segment. **The recommended target distance for near-road $NO_2$ monitor probes from the target road is within 20 meters whenever possible.** |
| Vertical spacing | Microscale near-road $NO_2$ monitoring sites are required to have sampler inlets between 2 and 7 meters above ground level. |
| Spacing from supporting structures | The probe must be at least 1 meter vertically or horizontally away from any supporting structure, walls, parapets, penthouses, etc., and away from dusty or dirty areas. |
| Spacing from obstructions | For near-road $NO_2$ monitoring stations, the monitor probe shall have an unobstructed air flow, where no obstacles exist at or above the height of the monitor probe, between the monitor probe and the outside nearest edge of the traffic lanes of the target road segment. |

Vertical placement requirements of near-road $NO_2$ monitoring probes are *"… to have the sampler inlet between 2 and 7 meters above ground level."* There are several situations where the limits of the allowable vertical range for inlet probe heights may be appropriate. For example, if a candidate monitoring site is nearly at-grade with the target road, or if the target road is a cut-section road, the state and local air agency should consider placing the inlet probe closer to the 2 meter height limit above ground level. This recommendation is based on the information presented in Section 4.1, where the impact of the roadway designs will likely lead to peak concentrations more frequently occurring closer to ground level. Further, monitor probe placement at or near a 2 meter height above ground level is generally considered to be at or near "breathing height," which is a human exposure consideration.

Alternatively, if a near-road monitoring station is being considered for placement adjacent to an elevated fill section of road, particularly where the elevated roadbed has vertical or sharply sloped walls, the state or local air agency should consider placing the inlet probe higher in the 2 to 7 meter range above the ground level so that the sampler inlet might be closer to the elevation of the target road surface, if they are immediately adjacent to the target road. This follows the rationale, as discussed in Section 4.1, where emission plumes from elevated roads may be aloft in winds normal to the roadway (due to eddy formation immediately downwind of the roadbed) with the core of the emission plume impacting the ground further downwind from the vertical or sharply sloped wall. In this situation, depending on the relative difference in height between the target road surface and ground-level at the monitor probe location, and the steepness of the grade between the two locations, the state or local air agency could also consider placing the monitor probe slightly further away from the target road to avoid situations where the inlet probe may be in the eddy cavity downwind of the elevated road structure, causing the emission plume to potentially pass over the inlet probe.

Finally, per 40 CFR Part 58 Appendix E, near-road $NO_2$ monitor probes need to be spaced away from certain supporting structures and have an open, unobstructed fetch to the target road segment. In a majority of monitoring sites, gas analyzer inlet probes such as those used for $NO_2$, are placed on a monitoring shelter or on a tower on or adjacent to a monitoring shelter. However, for some monitoring site configurations, inlet probes may be placed upon walls, parapets, or other existing infrastructure, which could include a noise barrier in the near-road environment. In these cases, *the probe must be at least 1 meter vertically and/or horizontally away from any supporting structure, and away from dusty or dirty areas*. Further, for near-road $NO_2$ monitors, there will likely be some distance between the target road segment and the $NO_2$ inlet probe. *It is required that there is an unobstructed air flow, or open fetch, where no obstacles exist at or above the height of the monitor probe and the outside nearest edge of the traffic lanes of the target road segment.* Technically speaking, open fetch would be observed along a path directly between the road and the $NO_2$ inlet, normal to the roadbed. However, as the EPA noted in the preamble to the final $NO_2$ NAAQS rule, the $NO_2$ inlet will likely be influenced by various parts of the target road segment that are at a relative angle compared to the normal transect between the road and the $NO_2$ inlet.

*When considering site locations, the recommended approach is to consider more than one linear pathway between the target road segment and the monitor probe, and to choose sites where the monitor probe will be clear of obstructions*.

## Section 6 - Using Exploratory Air Quality Monitoring to Identify Roadway Segments for Near-Road Site Selection Evaluation

To provide increased confidence of the likelihood for measuring peak $NO_2$ concentrations at a particular location, agencies may elect to conduct air quality monitoring to either identify candidate near-road monitoring sites or evaluate candidate monitoring sites identified through the process described in Sections 3 to 5. A variety of fixed and/or mobile monitoring techniques can be used to accomplish this task, other exploratory monitoring studies might use a more focused approach to create data for comparison or evaluation at a smaller number of sites, such as those derived from the process in Section 3 using traffic data, and considering any subsequent physical reconnaissance.

*AMS performed no exploratory air quality monitoring to indentify roadway segments for its evaluation.*

## Section 7 - Using Air Quality Modeling to Identify Roadway Segments for Near-Road Site Selection Evaluation

*AMS performed no air quality modeling for its selection evaluation.*

## Section 8 - Field Reconnaissance: Physical Characteristics of Candidate Near-Road Sites

Using the list of prioritized candidate near-road segments produced in the process discussed in Section 3, AMS is now in a position to perform a more detailed evaluation of potential near-road sites to further characterize and prioritize the list of candidate near-road site locations. Such characterizations and evaluations can be carried out through the use of electronic data resources including satellite imagery (e.g., Google Earth), mapping resources (e.g., Bing Maps or Google Maps), and/or ArcGIS, for example. In addition to these resources, *AMS will make efforts to conduct reconnaissance in the field to characterize candidate sites.* This section provides a checklist to use in the reconnaissance. Some information suggested to be gathered to characterize any given road segment may already be reflected in the traffic data analysis that has been conducted.

## 8.1 Road Segment Identification

The road segment identifier is part of the traffic analysis data. However, in some cases the identifying terms in the traffic analysis may not be the most commonly used or known terms. For practical means of understanding and communicating information about candidate near-road sites, *a combinations of given road identifiers along with more useful identification will be used in labeling* to aid in the site identification process. This should allow interested parties to more easily identify and understand which road segments are being described or characterized.

## 8.2 Road Segment Type

During reconnaissance AMS will note whether the road is a controlled access roadway, limited access expressway, limited or full access arterial, or other type of road. Controlled access roads (also referred to as freeways or sometimes expressways) are divided highways with full control of access. The control of access is established two ways: 1) by a lack of access to the roadway by any adjoining property (e.g., no driveways), and 2) the traffic on the road is free-flowing, where traffic flow is unhindered because there are no traffic signals or intersections that might cause traffic to stop. Access to these roads is typically provided by on and off ramps at interchanges with other roads. Limited access roads may have traffic signals, intersections, and access to adjoining properties; however, these access points are limited in number and location. Understanding the type of road for a candidate road segment can help determine the likelihood of safe, feasible monitoring shelter access. Controlled and limited access segments should not be avoided for monitoring site consideration; however, the evaluation of these segments should consider how potential monitoring sites will be accessed and maintained.

## 8.3 Interchanges

AMS will note the presence of interchanges or road junctions within or at the ends of a particular road segment. Information could include the identification of the intersecting or connecting road(s) and the type of interchange. There are multiple types of interchanges including four-way (i.e., cloverleaf, stack, and diamonds) and three-way interchanges, among others. Information on the types of interchanges transportation agencies use in building transportation facilities can be found on the web at: http://en.wikipedia.org/wiki/Interchange_(road).

## 8.4 Roadway Design

As discussed above in Section 4.1, the roadway design can have a significant impact on pollutant transport and dispersion. During the reconnaissance of a road segment, AMS will note the design of the candidate road segment (e.g., at-grade, above-grade - on fill or open underneath, below-grade, or even a mix) including the notation of changes in design and the related local terrain along the length of the segment if present. In those cases where the road is above or below grade, attempts should be made to characterize the nature of the cut road or elevated road. For example, if a road is below grade, estimate the depth of the cut below the surrounding terrain and note what type walls – sloped or vertical. For elevated roads, note whether the road bed is on a bridge or fill section, the height of the roadbed above the surrounding land, and for a fill section, whether the road is supported by vertical or sloped walls.

## *8.5 Terrain*

AMS will note the type of terrain on which a candidate road lays, the terrain immediately adjacent to the candidate road segment, and any larger scale terrain features within which the road may lie, or is potentially influenced by. Examples of terrain features that might be noted include whether the road segment is along a grade, along its length or for a portion of its length. Another example might be noting a road segment's proximity to hills, bluffs, canyons, ridges or other topographical features that can influence local meteorology.

## *8.6 Roadside Structures*

Roadside structures can have a significant impact on pollutant transport and dispersion. Further, roadside structures can seriously impact the candidacy of a road segment to host a near-road monitoring station. During the reconnaissance of a road segment, AMS will note all roadside structures throughout the length of the candidate road segment. Notation on the existence, type, location, length, and approximate height of any structures will be captured for any sound walls, vegetation, earthen berms, buildings, or other structure along each side of the segment.

## *8.7 Existing Safety Features*

Safety in the near-road environment is a very important consideration in the installation of a near-road monitoring station (a more detailed discussion on safety issues is presented below in Section 11.3). Safety of the travelling public on the road, the air monitoring staff members who services a near-road monitoring station and the monitoring station itself should be a top priority. During the reconnaissance of a candidate road segment, AMS will note of existing safety features along parts or all of the road segment, on each side of the road, including ditches, berms, guard rails, cable barriers, jersey barriers, or other features. Placement of a monitoring station behind such safety features would be preferable when possible.

## *8.8 Existing Infrastructure*

AMS will note structures, traffic related monitoring systems, and other highway maintenance facilities that may already exist in the near-road environment along some candidate road segments. These pieces of infrastructure may provide a leveraging opportunity for a near-road monitoring site at a location that may already be accessible, have safety features, have power, and/or have other utilities, which might ease the installation of a possible near-road $NO_2$ station. Such infrastructure can include sign supports (traffic or billboard), light poles, automatic traffic counters, traffic camera installations, dynamic message signs, Road Weather Information System (RWIS) installations, truck weigh stations, and weigh-in-motion locations.

## *8.9 Surrounding Land Use*

AMS will note the general or mixed use of land (e.g., urban or suburban residential, commercial, industrial, agricultural, forested) around candidate road segments during the reconnaissance process. Specific information (e.g., presence of schools, hospitals, low-rise or high-rise buildings) is also useful to note. In addition to the traditional land use categories noted above, AMS will also determine and note (through field reconnaissance and possibly emissions inventory review) if any significant sources (off-road mobile or otherwise stationary in nature) are nearby.

## 8.10 Current Road Construction

The potential for future road construction on candidate road segments is discussed in Section 9. However, during candidate road segment reconnaissance, AMS will note any ongoing road construction along with any immediately apparent preparations for road construction.

## 8.11 Frontage Roads

During candidate road segment analysis, AMS will note the presence of frontage roads. Also called service roads or access roads, frontage roads typically run parallel to major highways, and may be considered part of the major highway, thus they may be controlled access or limited access roads. They are often one-way roads with traffic flowing in the same direction of the adjacent lanes of the partnering major roadway. They can provide access to property adjacent to major roads and connect these properties with roads which have direct access to the main roadway. Frontage roads can also provide a means for traffic in and around the properties adjacent to a major road to access that road, most often at interchanges.

## 8.12 Meteorology

AMS will attempt to understand the general climatological wind rose for candidate road segments, which can be used to aid in the determination of what might be dominant upwind and downwind locations along a particular segment. This can likely be determined by reviewing local and regional weather and climatological data collected by NOAA and any data collected by air agencies themselves at existing air monitoring stations in the area.

## Section 9 - Monitoring Site Logistics in the Near-Road Environment

A key component in the determination of whether a candidate near-road monitoring site is truly feasible is determining if AMS will be able to access the desired location, whether the site would be safe for site operators and the public during routine operations, and whether there is sufficient availability of power and telecommunications services, or the ability to procure and install those services. With emphasis on being "as near as practicable" to the target road segment and not more than 50 meters away, a number of candidate near-road sites are *expected to fall within right-of-way properties under the jurisdiction and maintenance of PennDOT* or other transportation authorities.

If a candidate near-road site is accessible without AMS having to use the right-of-way (i.e., on property not otherwise managed or governed by a transportation agency), AMS will more than likely be able to treat the site access investigation as they would for any other traditional ambient air monitoring site.

### *9.1 Accessing the Right-of-Way*

The feasibility of a potential near-road $NO_2$ site requires the determination of whether a given location can be accessed. If the prospective location is located within the right-of-way (ROW) of an existing road, AMS will need to engage PennDOT to gain access to the air rights of that property. This would be most likely accomplished through *a permitting process that would ultimately lead to the development and establishment of an* ***air space lease***. The right to use space within the ROW by public entities or private parties for interim non-highway uses may be granted in airspace leases, as long as such uses will not interfere with the construction, operation or maintenance of the transportation facility; anticipated future transportation needs; or the safety and security of the facility for both highway and non-highway users. This means that AMS, in considering potential near-road sites within the ROW, would need to work with PennDOT to consider near and long-term construction plans, potential interference with routine highway operations and maintenance due to the presence of a monitoring station, safety, and security of the highway ROW during the development of the lease agreement. The permitting and lease agreement process will take some amount of time to complete, before physical access is granted to the AMS. The U.S. Federal Highway Administration (FHWA) maintains information on airspace access on the web at http://www.fhwa.dot.gov/realestate/airguide.htm .

When considering a site within the ROW, AMS should consider several different factors that may impact the ease of negotiating an air space lease. *The first factor is physical access*. It is anticipated that PennDOT will prefer that any potential near-road $NO_2$ site in the ROW be planned in a manner that the site be made accessible from outside the ROW, *or have accommodations that preclude the need to access the site from the primary travel lanes* of the target highway.

If it is determined during the evaluation of a candidate site that the installation of a locked access point (such as a gate) is required to access the ROW, PennDOT must submit justifications and obtain approval from FHWA, which is a formal federal action*, if the facility is an interstate facility*. FHWA's policies on changes in access to the interstate highway ROW are maintained on the web at http://www.fhwa.dot.gov/programadmin/fraccess.cfm. It is noted that this requirement does not preclude the establishment of a monitoring station where access is only feasible from the target highway; however, an approach requiring the use of a new locked access point may be more preferable to a transportation agency in an air space lease negotiating process than a plan relying upon access solely from the target road.

*A second factor to be considered* for site feasibility and the impact on negotiating an air space lease is *the availability of utilities.* AMS needs to determine whether utilities are already present, need to be relocated, or need to be installed to support the air monitoring station. *Any activity to change or install utilities will require approval from PennDOT.* If the road segment in question is part of a federal-aid highway, PennDOT must ensure that any permits to install necessary utilities must comply with the appropriate federal regulation and

FHWA policies. However, identifying potential site locations adjacent to, or otherwise near, existing infrastructure within the ROW with existing power may avoid some permitting procedures and possibly reduce utility related installation costs. More information on utility considerations, particularly with respect to bringing utilities into the ROW, can be found at http://www.fhwa.dot.gov/programadmin/utility.cfm.

## *9.2 Safety in the Near-Road Environment*

Near-road $NO_2$ monitoring sites must be safely sited for both the traveling public on the roadway and the personnel operating the monitoring site. Near-road monitoring sites must be accessible to station operators in a safe and legal manner, and not pose safety hazards to drivers, pedestrians, or nearby residents. Safety hazards to drivers can include obstructions to sight lines and distractions, which can lead to accidents. Safety hazards to pedestrians include obstructions that block safe movement along the road or walkways. Safety hazards to monitoring site operators include factors which inhibit the safe entrance to or egress from a site and factors that could allow vehicles to encroach upon and damage the site infrastructure. Since near-road $NO_2$ sites may be located on PennDOT maintained ROW, as discussed above, it is anticipated that AMS will engage PennDOT regarding access to such locations. During discussions on the potential access and use of locations within the ROW, safety should be a primary concern.

PennDOT deals with multiple roadway safety issues when building and maintaining traffic facilities. FHWA maintains a safety program addressing safety issues, on which information can be found at http://safety.fhwa.dot.gov. However, of the multiple safety categories that are dealt with, *the one category that may be most relevant with regard to the near-road $NO_2$ monitoring network is "roadway departure" safety*. FHWA defines a roadway departure accident as a non-intersection crash which occurs after a vehicle crosses an edge line or a center line, or otherwise leaves the traveled way. Since near-road $NO_2$ monitoring stations are not on the road, but relatively near the outside edge of travel lanes, *the roadway departure of vehicles likely poses the biggest safety risk to the travelling public, the air monitoring staff working at a near-road site, and the monitoring site infrastructure.* Depending upon roadway design and terrain, there are multiple means by which transportation agencies can improve or increase safety within the ROW or at the edge of ROW space. Examples include roadway paving techniques (e.g., rumble strips or safety edging), increasing pavement friction, the use of retaining barriers, and maintaining open areas within the ROW which are called "clear zones." With respect to near-road $NO_2$ monitoring stations, existing safety features provided by the local terrain, man-made barriers, or clear zones should be considered as positive attributes to a potential site in the site selection process.

The terrain of a road segment can, in some cases, increase safety by reducing roadway departures that impact a near-road monitoring site. Such examples are ditches or berms made of earthen fill, which might exist between the roadway and the monitoring station. *So long as these terrain features do not obstruct the fetch between the monitor probe and the target road, they may be viewed as positive attributes for a given candidate road site*.

Man-made barriers or retainers in the ROW come in many forms, most of which can generically be referred to as longitudinal barriers. FHWA maintains a list of crash-worthy longitudinal barriers on the web at http://safety.fhwa.dot.gov/roadway_dept/policy_guide/road_hardware/barriers/ .

The presence of any type of longitudinal barrier, so long as it does not obstruct the fetch between the monitor probe and the target road, may be viewed as a positive attribute for a given candidate near-road site.
Clear zones are defined by FHWA to be an unobstructed, traversable roadside area that allows a driver to stop safely, or regain control of a vehicle that has left the roadway. The width of the clear zone (e.g., the distance between the outside edge of the road to an obstacle) is based on risk, which is derived from a roadway's traffic volume, vehicle speeds, and the slope of the underlying and adjacent terrain. In practice, a clear zone is free of obstructions (including safety barriers) and would denote an area or distance from the road that a near-road monitoring station would be placed outside of, measured from the outside edge of the travel lanes.

As a rule of thumb, highways with no natural or man-made obstructions alongside the travel lanes typically might be prescribed to have a clear zone on the order of 10 meters. Although FHWA provides a summarization of clear zones on the web (http://safety.fhwa.dot.gov/roadway_dept/clear_zones/#zones ), clear zone guidance is created by the American Association of State Highway and Transportation Officials (AASHTO). The guidance material is not free to the public.

Safety is a top priority in all field operations. Ambient air monitoring operations in the near-road environment present additional safety issues that must be addressed in the site selection process. As such, *AMS will fully evaluate the presence of existing protection or safety features along candidate road segments*. If appropriate safety features are not present, *AMS will consult with PennDOT to determine whether there is a need, and if so what the design and installation process might be for infrastructure additions or enhancement to ensure safety for all highway and monitoring station users.*

## *9.3 Engaging the Transportation Agency – PennDOT*

*AMS will need to obtain permission from PennDOT if a monitoring site is to be located within a ROW.* This permission will come in the form of an airspace lease negotiated with PennDOT. The following sets of questions and issues are relevant, including those that will need to be answered by AMS, PennDOT, and potentially FHWA.

- Who is the public authority responsible for the ROW?
- What are the Penn DOT requirements for considering and approving leases (or permits) to allow for the subject installation?
- Is the near-road site within interstate highway ROW? If so, the request for a lease or permit to PennDOT for the ROW must include information FHWA requires to be addressed in the review and approval of such an action. These issues will likely include the air rights agreement, locked-gate access (as necessary), and compliance with applicable utilities accommodation and relocation policy.
- What other policies, procedures, standards, leases/permits required or desired by PennDOT will need to be addressed?

In addition to the overarching questions listed above, there are some anticipated questions that PennDOT may have about a potential ambient air monitoring station, and some suggested questions that AMS should consider asking their PennDOT counterparts regarding individual candidate road segments.

### 9.3.1 Information to Provide PennDOT

There are a number of questions that PennDOT may have when first approached by a local air agency such as AMS, regarding the placement of an ambient air monitoring station in the near-road environment. Some anticipated questions might include, but are not limited to the following:

- Who will own the monitoring equipment?
- How long would the air monitoring site be used/needed?
- What are the physical dimensions of the monitoring site and shelter? (AMS needs to consider the potential for multi-pollutant monitoring when preparing this information. Multi-pollutant monitoring in near-road $NO_2$ sites is discussed in Sections 10.2 and 12.)
- What type of structure (shelter) will be installed at the site? (Pictures are useful here.)
- How often would air monitoring staff need to access the site?
- If there are no existing utilities at the candidate site location, who will prepare the request for permit, and subsequently pay for the installation of required utilities?
- Who will be financially responsible for the upkeep of the monitoring station? This includes routine operations, and the inspection, maintenance, and security of the site.
- Who would be responsible for any closure, removal, and relocation of the station, if necessary?

### 9.3.2 Questions to Ask PennDOT

*There are a variety of questions that AMS, as the local air agency, may want to ask of PennDOT about the long-term feasibility and access of a site within the highway ROW.* Some general questions might include:

- What, if any, construction is planned along the candidate road segment that might impact traffic operations on the road, the safety of the monitoring site, or safe and efficient access to the monitoring site?
- What, if any, construction is planned on nearby road segments or to the CBSA transportation network that might impact traffic operations along the candidate site road segment?
- In the future, if access to the monitoring site is either temporarily or permanently affected by a highway project, what contingencies might be available for alternative access to the site or alternative sites along the same road segment?
- Will an air space lease, if awarded, be a one-time process, or will that lease need to be renewed on some interval? If it would require renewal, are there any particular criteria that might cause the renewal to be disapproved in the future?
- Under what conditions should or could safety features be added to a road segment if a near-road station is to be installed in the ROW? If a clear zone is currently in use, is that sufficient, or would additional safety features be allowed to be installed?
- If safety feature installation or improvements are desired, what types of features are available to be considered for installation (such as guardrails, barriers, etc.)?
- Are there any other safety provisions that AMS would need to conform to if it routinely accesses and works on and within a monitoring station in the ROW?

## Section 10 - Prioritizing Candidate Near-Road Locations for Monitoring Site Selection

If, after performing the traffic analysis procedures and evaluating select candidate road segments through reconnaissance, possible use of optional evaluation tools (e.g., exploratory monitoring or modeling), and possible discussions with PennDOT, there are a relative wide array of candidate sites to choose from, it will be necessary to begin narrowing the options by placing weight on one or more road segment characteristics over others. It is at this point in the site selection process that two other considerations come into play, population exposure and the potential for multi-pollutant monitoring.

### *10.1 Considering Population Exposure as a Selection Criterion*

Per 40 CFR Part 58, Appendix D, section 4.3.2(a)(1), *"where a state or local air monitoring agency **identifies multiple acceptable candidate sites** where maximum hourly $NO_2$ concentrations are expected to occur, the monitoring agency shall consider the potential for population exposure in the criteria utilized to select the final site location."* Therefore, when considering all the available information (particularly AADT, fleet mix, congestion patterns, roadway design, terrain, meteorology, and siting criteria) for which candidate locations are suitable for a required near-road $NO_2$ station, population exposure should be given subsequent consideration. Specifically, amongst a pool of otherwise similar candidate near-road sites, the site that may represent a higher population exposure should be given increased consideration.

**AMS anticipates a singularly acceptable site will be identified and population exposure will not need to be considered to make the selection.**

## *10.2 Potential for Multi-pollutant Monitoring*

A number of pollutants and measureable metrics of interest that exist in the near-road environment, other than $NO_2$, are discussed in some detail in Section 12. The EPA also encourages state and local air agencies to consider the potential of a site to house other pollutant monitors and measurement devices. This would specifically be accomplished in the site selection process by considering the footprint and layout of the infrastructure of a near-road monitoring station. *The EPA believes that the footprint of a typical NCore station* (which houses analyzers for carbon monoxide, ozone, sulfur dioxide, total oxides of nitrogen ($NO_Y$), a variety of PM instruments [including $PM_{2.5}$ and lead samplers], and meteorological gear, along with all the associated support equipment) *may be a conservative approximation of a multi-pollutants site footprint.* Although this NCore type footprint can be bigger than a single pollutant shelter, the EPA believes, based on research experiences, that this should not typically create additional burden or restrictions for site installation versus a single gas pollutant monitoring shelter.
**AMS does anticipate installing other monitors at the selected site.**

## *10.3 Candidate Site Comparison Matrix*

Upon the completion of traffic data analysis, field reconnaissance, and the conclusion of any other evaluation efforts, a site comparison matrix will be created to consolidate the data collected in the evaluation process and present that information in a comparable format, *creating a foundation for the rationale of why one site might be selected over other candidate sites*.

The candidate site comparison matrix includes at a minimum, traffic data, surveilled field information, site feasibility information such as permission of, or lack of, access for individual candidate sites, safety issues (if applicable), probable distance between the inlet probe and the outside edge of the target road, and any other collected ambient data and/or modeled data. The matrix can be used to represent individual points along a road segment or for whole road segments under consideration. Here is includes a list of variables that could be included in the matrix:

**Table 8 - Suggested Data for Each Candidate Site Entry in a Site Comparison Matrix**

| Site/Segment Parameters | Description of Parameter |
|---|---|
| Location | Describe if the entry is for a specific point along a road segment or if the entry is representative of a whole road segment. If the entry is for a point, provide a moniker and the latitude and longitude. |
| Road segment name | Provide given road name and common name if applicable |
| Road type | Type of road (controlled access freeway, limited access arterial, etc.) |
| AADT | Provide AADT, source of data, and vintage |
| HD counts | As available, provide HD counts, source of data, and vintage |
| FE AADT | As available, provide FE AADT, noting $HD_m$value used |
| Congestion information | Denote value and type (e.g., LOS, $^{v}/_{c}$, or AADT by lane) and vintage |
| Terrain | Denote the nature of the terrain immediately around the road and also any larger scale terrain features of note |
| Meteorology | If the entry is for a point, denote the predominate winds and whether the point is relatively upwind or downwind. If the entry is for a whole segment, denote the orientation of the segment to the predominant winds. |
| Road segment end points | Denote the location of the road segment end points, including any given names, common names, and the latitude and longitude of each individual end point. |
| Population exposure | Denote any assessment of potential for population exposure |
| Roadway design | Denote design type or types present (flat, elevated-fill, cut, etc.) |
| Roadside structures | Denote the presence of any roadside structures |
| Safety features | Denote any safety features present |
| Infrastructure | Denote any existing infrastructure (light poles, billboards, etc.) |
| Interchanges | Denote the presence of any interchanges within or at the end points of the target road segment |
| Surrounding land use | Denote surrounding land use (residential, commercial, etc.) |
| Nearby sources | If applicable, note nearby $NO_x$ sources (type, tonnage, and distance) |
| Current road construction | Denote any visible or known road construction at the candidate site location or along the target road segment |
| Future road construction | If known, denote transportation agency plans for any future road construction (including time frame for completion) |
| Frontage roads | Denote the presence of frontage roads, and whether those roads are included as part of the target road segment. |
| Available space – site footprint | Denote any limitations in the space available for a multipollutant monitoring station |
| Property type | Is it ROW or private property? |
| Property owner | Who manages or owns the property under evaluation? |
| Likelihood of access | Note the level of confidence and any uncertainties regarding the acquisition of access to a particular property |
| Other details | List any other pertinent details that may have bearing on why a particular candidate site may or may not be selected |

## Section 11 - Final Near-Road Site Selection

AMS has engaged the EPA Regional staff as necessary during the site selection process and will do so when a choice is made that is intended to be reflected in annual monitoring plans due July 1, 2012.

*The EPA indicates that they will provide feedback on any near-road site selection listed in the annual monitoring plan before issuing a network plan approval letter, as is typically done.* ***The availability of data supporting the rationale behind a site selection, such as that within the candidate site comparison matrix, will facilitate the review process.***

Once a location has been selected for the installation, AMS, as the EPA suggests in its TAD, will prepare and include site record metadata about the near-road location (along with monitor record data) which would eventually be input into AQS for inclusion in annual monitoring plans. For new near-road $NO_2$ sites, the EPA requires that certain metadata are entered into AQS, as is the case for any new State and Local Air Monitoring Station (SLAMS) site.

## Section 12 – Multipollutant Monitoring at Near-Road Monitoring Stations

### *12.1 Meteorological Measurements*

Meteorological data measured on-site at a near-road monitoring station can provide important information that can be used to characterize the pollutant data being measured at the station. As part of the CASAC AAMMS review, the panel stated that meteorological parameters (wind speed and direction) should be one of the highest tier measurements considered as part of [the near-road $NO_2$] network. A key advantage to having meteorological data collected on site would be the ability to correlate the occurrence of peak $NO_2$ concentrations to wind conditions. Data analysis of the collected data will be greatly enhanced by knowing if winds are calm, parallel to the road, or at any other angle making the monitoring site relatively upwind or downwind when peak $NO_2$ concentrations are measured.
Although meteorological measurements were proposed to be required at near-road $NO_2$ sites, the EPA did not require them. However, the EPA strongly encourages the measuring of meteorological parameters at near-road sites whenever possible. The EPA suggests that state and local air agencies try to measure wind speed, wind direction, temperature, and relative humidity, at a minimum (which matches those parameters required at NCore stations). If possible, other measurements such as precipitation, solar radiation, and barometric pressure, among others should be considered as well.
**AMS will not take meteorological measurements.**

### *12.2 Traffic Counters and/or Cameras*

Traffic counting devices and/or traffic cameras are another non-pollutant measurement that could be useful to an air agency to aid in characterizing measured pollutants at a near-road monitoring site. Understanding the traffic behavior can allow for correlation to measured pollutant concentrations, such as the correlation of peak $NO_2$ readings to time periods when traffic is heaviest and/or experiencing increased congestion, for example. There are remote sensing methods available to characterize traffic that use radar or camera based technology. These methods are able to be installed along-side of roads (such as on a meteorological tower or monitoring shelter) and can look down on the target road segment to characterize the traffic. The sophistication of remotely sensing instruments is variable, but the EPA suggest that if such a device is investigated for use, it should be capable of making total traffic counts for at least an hourly interval. Other data metrics that would also be useful include the ability to segregate HD from LD vehicle counts and those methods with sub-hourly time resolution capability.

In some cases, the local transportation agency might be in a position to collaborate with an air agency that is looking to collect traffic data for a particular road segment where no traffic data is currently being collected.

In such a case, there may be a synergistic advantage for both the air agency and the transportation agency; allowing the air agency to gather traffic data for air quality analysis with the support of a transportation agency, while the transportation agency may gain another source of traffic data for their use as well, at no cost to them. The EPA encourages state and local air agencies to pursue such collaboration if traffic data collection is pursued at near-road monitoring sites.
http://www.dot.state.pa.us/Penndot/Districts/district6.nsf/District6WebcamsList?OpenPage
**AMS will not use traffic counters or cameras**.

## *12.3 Multi-pollutant Monitoring at Near-Road Monitoring Stations*

The EPA has expressed the intent to pursue the integration of monitoring networks and programs through the encouragement of multi-pollutant monitoring wherever possible. Multi-pollutant monitoring is viewed by the EPA as a means to broaden the understanding of air quality conditions and pollutant interactions, furthering its capability to evaluate air quality models, develop emission control strategies, and support research, including health studies.

This section discusses a number of pollutants of interest in the near-road environment; they are of interest due to their direct emission by on-road mobile sources, or the formation from or interaction with on-road mobile source emissions. The pollutants discussed in this section are presented in the relative order of priority the CASAC AAMMS suggested to EPA in their near-road review.

**AMS will monitor the following additional pollutants at the Near-Road $NO_2$ Monitoring Station:**

### 12.3.1 Carbon Monoxide (CO)

CO is a colorless, odorless gas emitted from combustion processes. CO can cause harmful health effects by reducing oxygen delivery to the body's organs (like the heart and brain) and tissues. In addition, CO is a useful indicator of the transport and dispersion of inert, primary combustion emissions from on-road mobile sources, as CO does not react in the near-road environment. (**Near-road CO monitoring is now required**)

### 12.3.2 Particulate Matter (PM) – Mass

PM is a complex mixture of small particles and liquid droplets comprised of sulfates, nitrates, acids, ammonium, elemental carbon, organic carbon compounds, trace elements such as metals, and water. The size of particles is directly linked to their potential for causing health problems. Particles that are 10 micrometers in diameter or smaller ($PM_{10}$) are of concern because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. Motor vehicles emit significant amounts of PM through combustion, brake wear, and tire wear. Motor vehicles may also contribute to elevated near-road PM concentrations by re-suspending dust present on the road surface.

Both $PM_{10}$ and $PM_{2.5}$ mass measurements and any speciation of PM mass at near-road sties can be very informative in furthering the understanding of the concentrations, properties, and behavior of PM in the near-road environment. However, per Federal Register Vol 78. No. 10, published in January 15, 2013, EPA only requires a single near-road $PM_{2.5}$ monitor installed within CBSA.

**AMS will not monitor the following additional pollutants at the $NO_2$ Near Road Monitoring Station:**

### 12.3.3 Particulate Matter (PM) - Number Concentration

PM emitted through the combustion process occurs initially in the ultrafine size range (i.e., less than 0.1 µm in diameter) and a very large number of these small particles are emitted. Despite the large number of ultrafine particles emitted, the impact on PM mass is negligible. Research has shown that PM number concentration measurements often provide a good indication of primary PM exhaust emissions from motor vehicles. Several health studies suggest that ultrafine particles may lead to adverse health effects

### 12.3.4 Black (or Elemental) Carbon

The graphitic-containing portion of PM, represented by black carbon (BC) or elemental carbon (EC), also referred to as 'soot,' is emitted in motor vehicle exhaust. BC and EC are operationally-defined. BC and EC are of interest because they serve as a measure of diesel particulate matter (DPM). Long-term (i.e., chronic) inhalation exposure to diesel exhaust (combination of gases and particles) is likely to pose a lung cancer hazard to humans, as well as damage the lung in other ways depending on exposure. Short-term (i.e., acute) exposures can cause irritation and inflammatory symptoms of a transient nature, these being highly variable across the population

### 12.3.5 Organic Carbon (OC)

OC is a complicated mixture of thousands of individual molecules and is a combination of both primary particulate emissions and gaseous precursors that can form secondary aerosol. Some of the OC compounds, such as polycyclic aromatic hydrocarbons (PAHs), are known or suspected carcinogens. OC is often the largest component of PM in urban areas in the Western U.S. and especially in near-roadway environments. Motor vehicle fuel combustion is an important contributor of OC.

### 12.3.6 $CO_2$

Fossil fuel combustion is the primary source of $CO_2$ emissions, with the transportation sector contributing about 33% of U.S. $CO_2$ emissions. $CO_2$ is of concern as the most important greenhouse gas contributing to climate change. Continuous $CO_2$ measurements are typically made using a non-dispersive infrared system with which sub hourly sampling duration can be achieved. $CO_2$ concentrations can be elevated near roads, so high resolution measurement methods with good precision (high signal to noise ratios) would be needed to quantify near road impacts to relative background concentrations.

### 12.3.7 Ozone ($O_3$)

$O_3$ is not usually emitted directly into the air, but at ground-level is created by a chemical reaction between oxides of nitrogen ($NO_X$) and volatile organic compounds (VOCs) in the presence of sunlight. $NO_X$ and VOCs are emitted by mobile sources. O3 can trigger a variety of respiratory health problems; worsen bronchitis, emphysema, and asthma; reduce lung function; and inflame the linings of the lungs.

$O_3$ measurements are not typically collected for near-road applications. However, the presence of elevated NO concentrations in the near-road microenvironment may lead to lower $O_3$ concentrations due to 'ozone scavenging' as part of the formation of $NO_2$ from NO and $O_3$. $O_3$ measurements may be useful in select circumstances to support health studies investigating the role of ozone and other co-pollutants on adverse health effects given the potentially lower concentrations of this pollutant relative to other pollutants in this microenvironment. $O_3$ measurements may also aid in understanding $NO_2$ concentrations in the near road environment.

### 12.3.8 Sulfur Dioxide ($SO_2$)

Sulfur dioxide emissions from the transportation sector include the burning of high sulfur containing fuels by locomotives, large ships, and non-road equipment. On road diesel fueled vehicles emit little $SO_2$ because of limits to the amount of sulfur that can be present in the fuel. $SO_2$ is linked with a number of adverse effects on the respiratory system. $SO_2$ is usually measured using ultraviolet fluorescence techniques. Similar to ozone, $SO_2$ measurements are not typically collected for near-road applications. $SO_2$ measurements may be useful in select circumstances to support health studies investigating the role of $SO_2$ and other co-pollutants on adverse health effects given the potentially lower concentrations of this pollutant relative to other pollutants in this microenvironment.

### 12.3.9 Air Toxics

In addition to criteria pollutants, motor vehicles emit a large number of other compounds which can cause adverse health effects such as air toxics (or hazardous air pollutants). A discussion and listing of potential air toxics of concern for near-road monitoring can be found in the U.S. EPA's Mobile Source Air Toxics (MSAT) Rule (U.S. EPA, 2007). These pollutants include volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and organic and inorganic PM constituents. Reasons for monitoring these pollutants for a near-road program include concerns over adverse human health effects, ecological effects, and the evaluation of the effectiveness of mobile source control programs. Air toxics span the entire range of pollutants present in the atmosphere; they are present as particles, gases, and in semi-volatile form. No one measurement method captures all air toxics of interest in a near road environment.

### 12.3.10 Lead (Pb)

Before the introduction of unleaded gasoline throughout much of the world, motor vehicle lead emissions were a major public health concern. While lead is no longer added to gasoline in many countries, motor vehicle fuels still contain trace amounts of Pb from crude oil. Lead is also present in trace amounts in lubricating oil. Other sources that may contribute to ambient Pb concentrations in the near-road environment include brake wear, tire wear, and the degradation of wheel weights used for aftermarket tire balancing. Re-suspended road dust may also contain Pb from historically deposited industrial or mobile source emissions. Depending on the level of exposure, lead can adversely affect the nervous system, kidney function, immune system, reproductive and developmental systems and the cardiovascular system. Lead exposure also affects the oxygen carrying capacity of the blood. Lead is typically measured through total suspended particulate (TSP) sampling with filter collection and subsequent chemical analysis.

**Figure 1 - Sites A, B, D, F, I (Northeast of Philadelphia)**

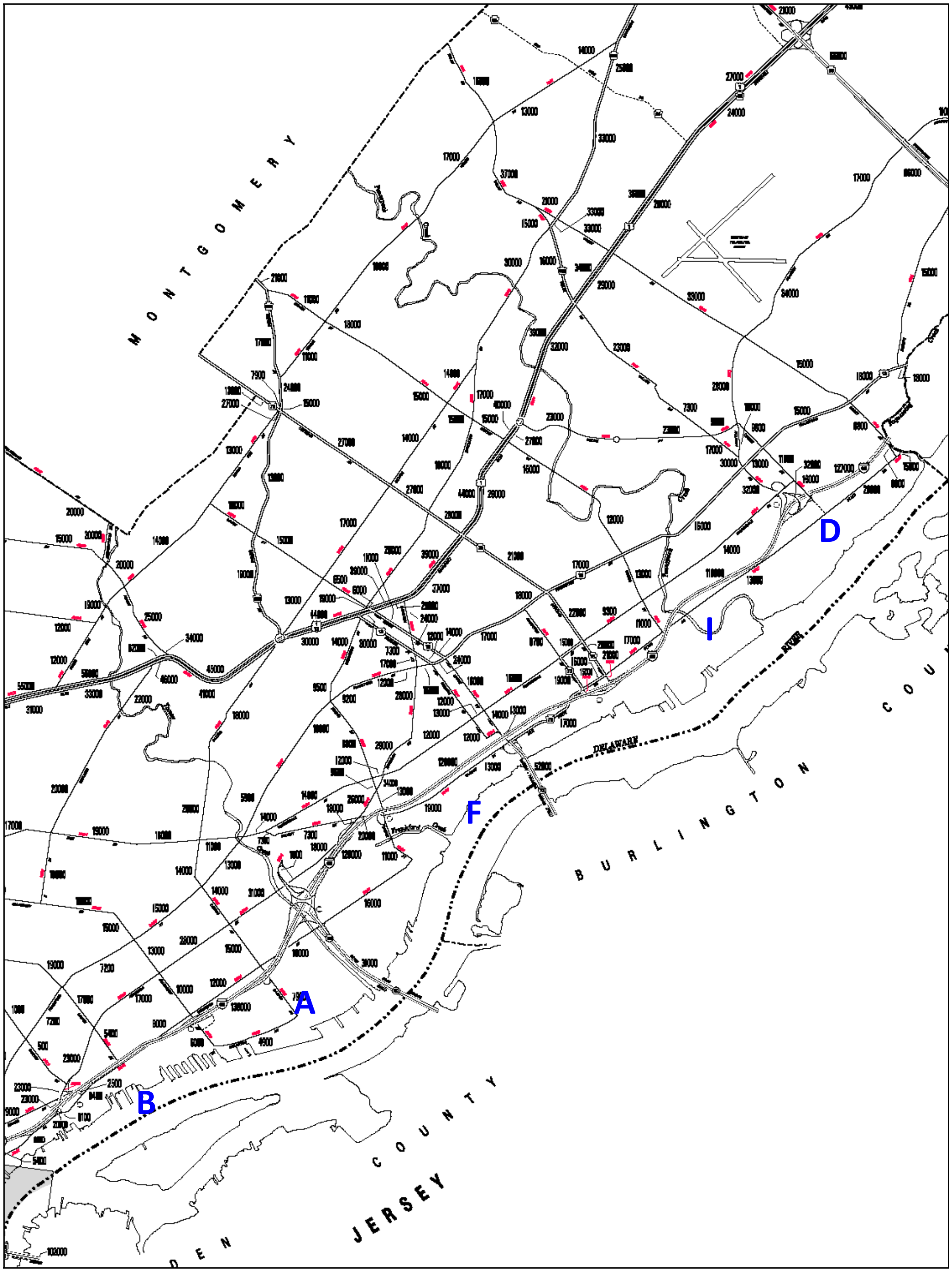


**Figure 2 - Sites G, H (Northwest of Philadelphia)**

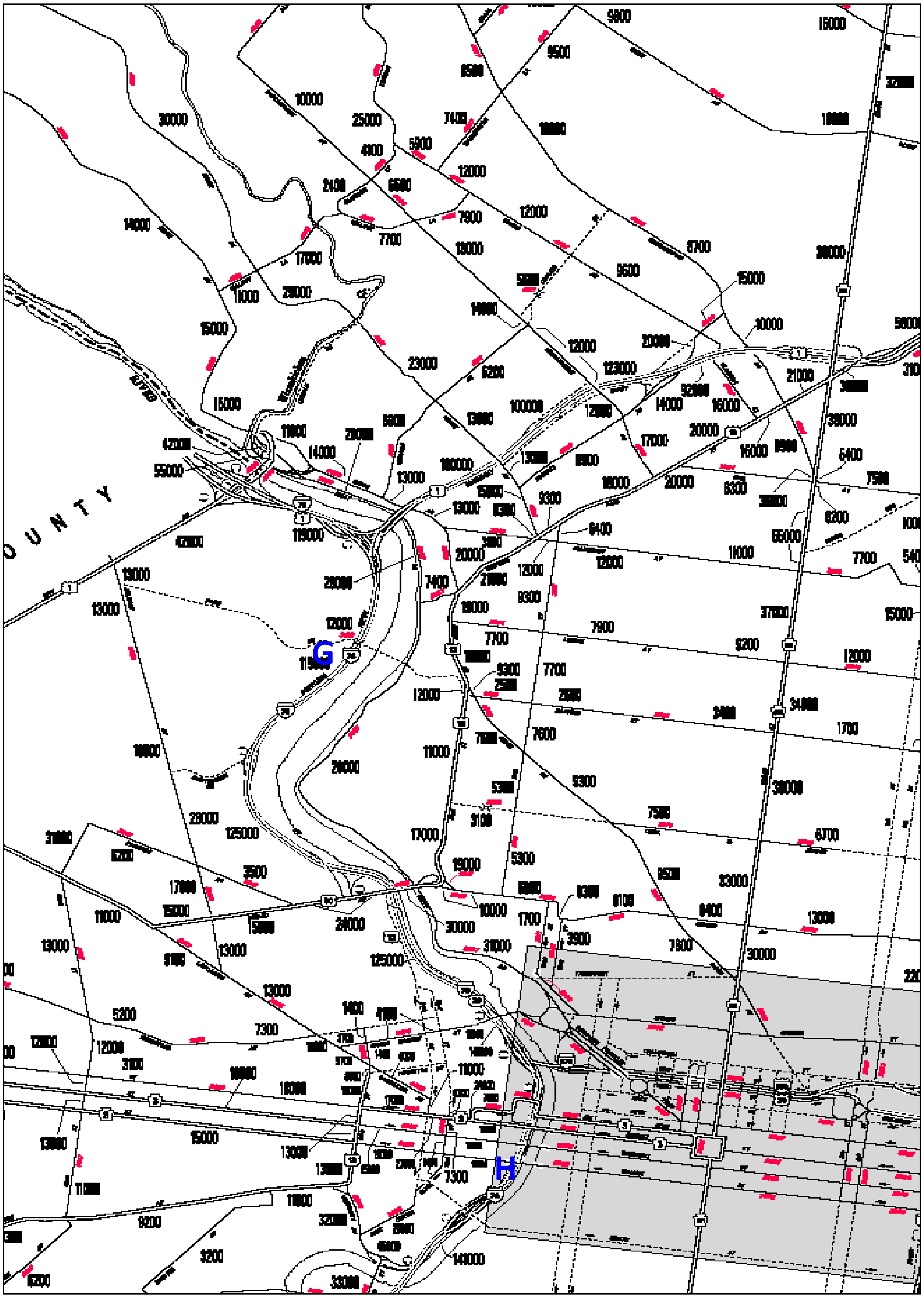


**Figure 3 - Sites C, E, J (South and Southwest of Philadelphia)**

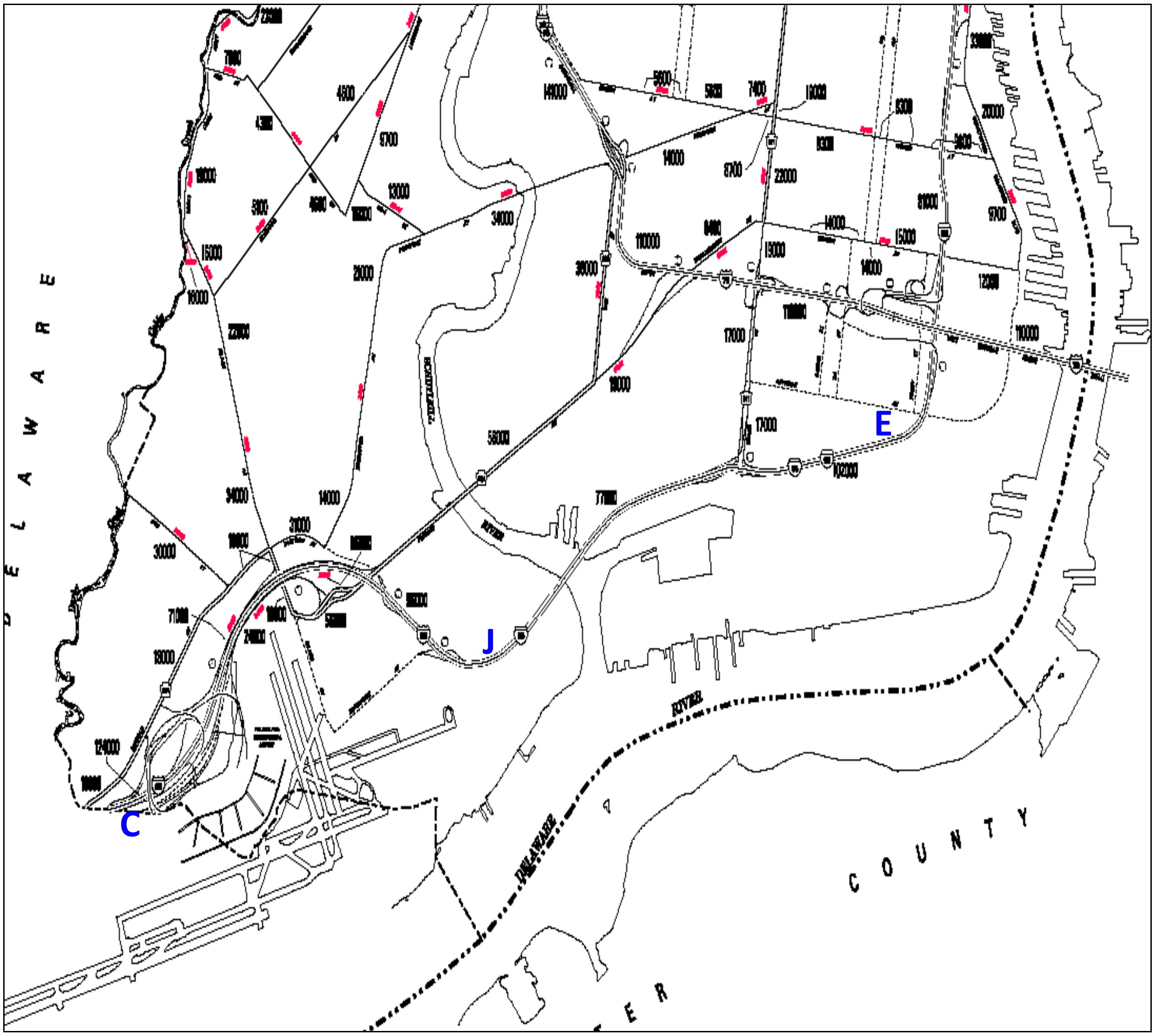
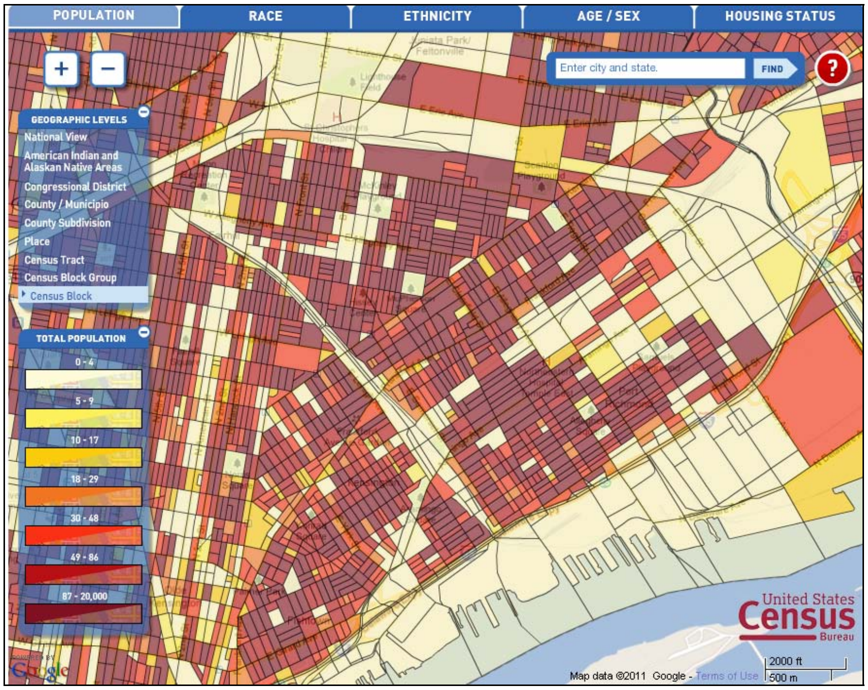
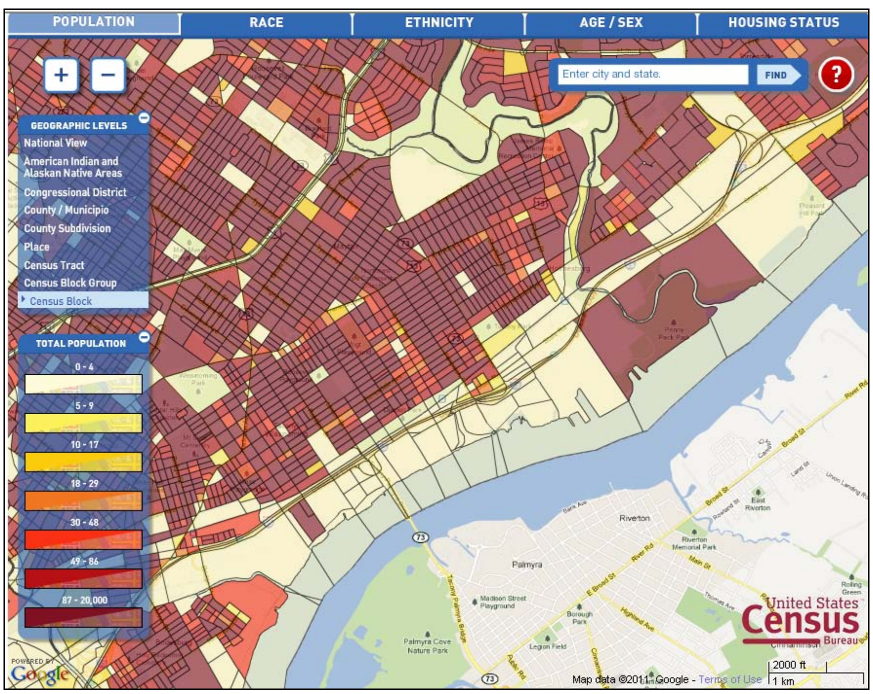


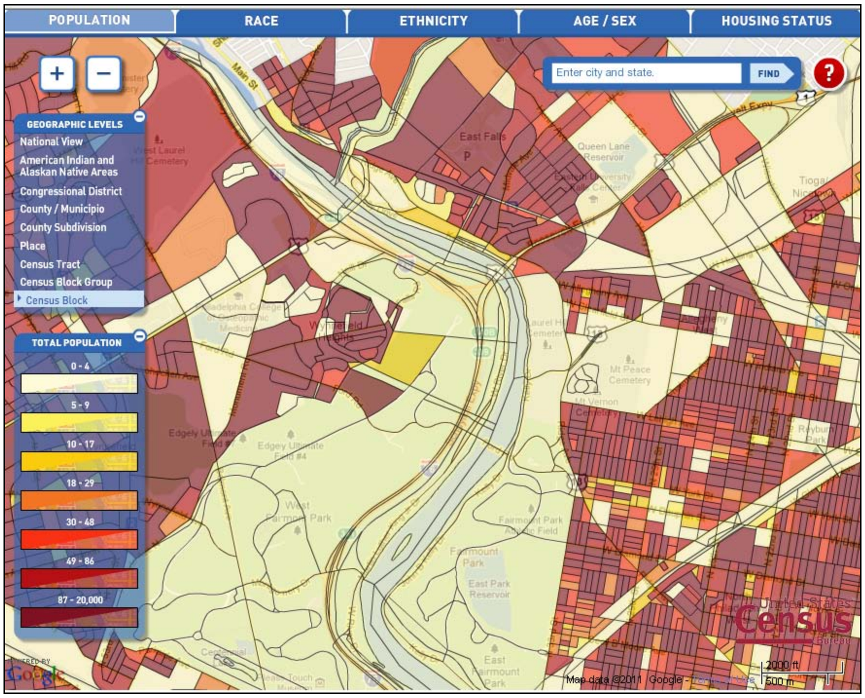
**Table 9 - The Ten Sites Information**

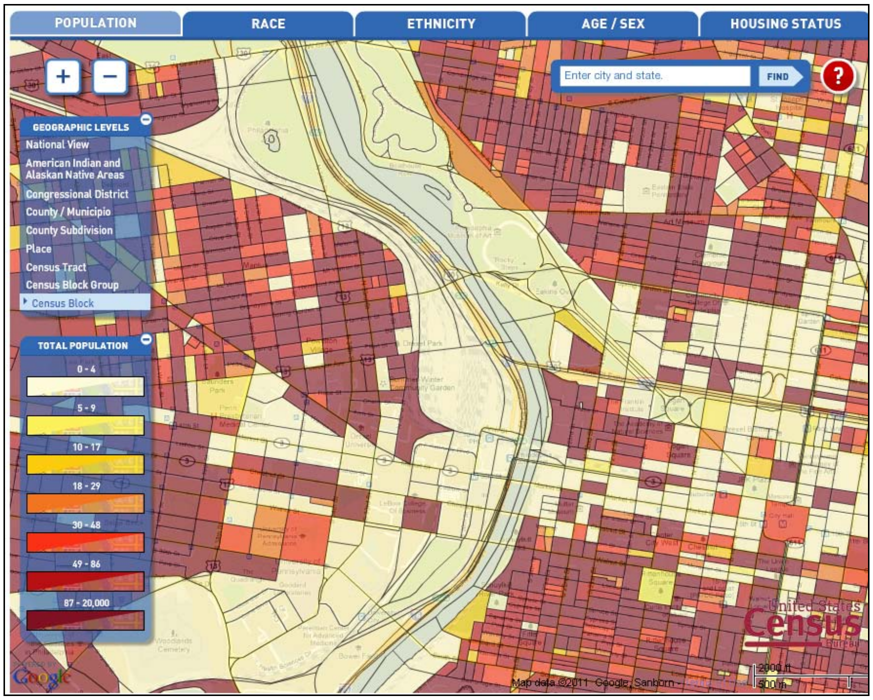
| SITE | TRAF RT. N1 | LATITUDE | LONGITUDE | STREET NAME | LOCATION |
|---|---|---|---|---|---|
| A | 095 | 39.9885873 | -75.0886013 | Delaware Expwy | Between Exit 25 (Allegheny Ave/Castor Ave) & I-95 North - Trenton |
| B | 095 | 39.9673059 | -75.1336301 | Delaware Expwy | Between Exit 22 (I-676/US 30 - Central Phila/Callowhill St) & Exit 25 (Allegheny Ave/Castor Ave) |
| C | 095 | 39.8770215 | -75.2543225 | Delaware Expwy | Between Boundary with Delaware Co. & Exit 12 (PA 291 - Cargo City) |
| D | 095 | 40.0521040 | -74.9886233 | Delaware Expwy | Between Exit 32 (Academy Rd/ Linden Ave) & Exit 33 (Grant Ave - Boundary with Bucks Co.) |
| E | 095 | 39.9008931 | -75.1561691 | Delaware Expwy | Between Exit 17 (PA 611 N.Broad St/Pattison Ave) & Exit 19 (I-76 E - Walt Whitman Br/Packer Ave) |
| F | 095 | 40.0118437 | -75.0607437 | Delaware Expwy | Between I-95 North - Trenton & Exit 30 (Cottman Ave/Rhawn St) |
| G | 076 | 39.9989843 | -75.1966814 | Schuylkill Expwy | Between Exit 340A (Lincoln Dr/Kelly Dr) & Exit 341 (Montgomery Dr/West River Dr) |
| H | 076 | 39.9535118 | -75.1818019 | Schuylkill Expwy | Between Exit 343 (Spring Garden St/Harverford Ave) & Exit 346A (South St) |
| I | 095 | 40.0378049 | -75.0127084 | Delaware Expwy | Between Exit 30 (Cottman Ave/Rhawn St) & Exit 32 (Academy Rd/ Linden Ave) |
| J | 095 | 39.8884509 | -75.2180358 | Delaware Expwy | Between Exit 13 (to I-76 W/PA 291-Valley Forge/Island Ave) & W. Fort Mifflin Rd |

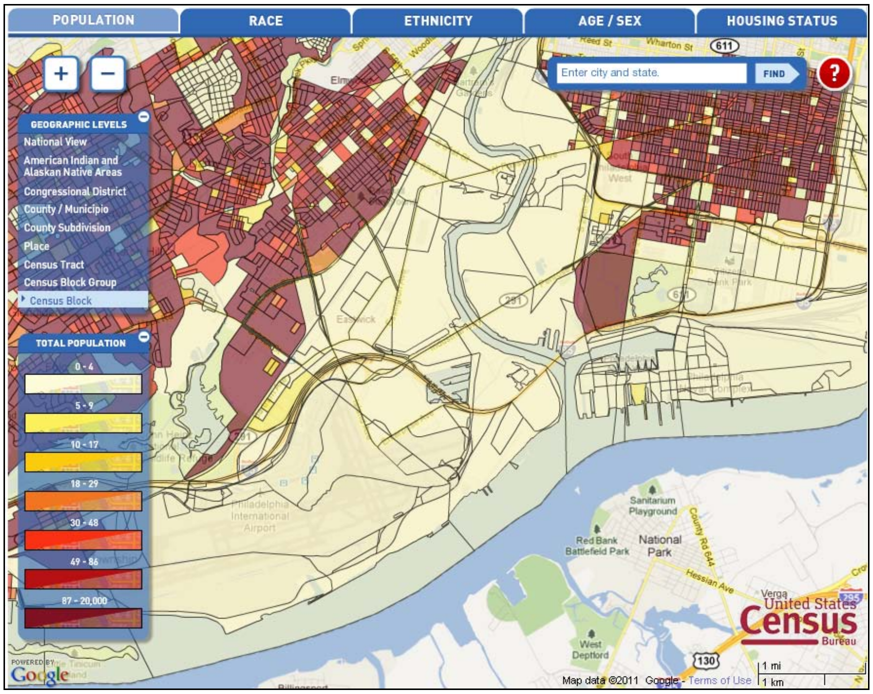
**Figure 4 - Population Census Maps for Areas Near Proposed Sites**




POPULATION
RACE
ETHNICITY
AGE / SEX
HOUSING STATUS
Enter city and state.
FIND
GEOGRAPHIC LEVELS
National View
American Indian and Alaskan Native Areas
Congressional District
County / Municipio
County Subdivision
Place
Census Tract
Census Block Group
Census Block
TOTAL POPULATION
0 - 4
5 - 9
10 - 17
18 - 29
30 - 48
49 - 86
87 - 20,000
Census
Map data ©2011 Google


POPULATION
RACE
ETHNICITY
AGE / SEX
HOUSING STATUS
Enter city and state.
FIND
GEOGRAPHIC LEVELS
National View
American Indian and Alaskan Native Areas
Congressional District
County / Municipio
County Subdivision
Place
Census Tract
Census Block Group
Census Block
TOTAL POPULATION
0 - 4
5 - 9
10 - 17
18 - 29
30 - 48
49 - 86
87 - 20,000
Census
Map data ©2011 Google, Sanborn


POPULATION
RACE
ETHNICITY
AGE / SEX
HOUSING STATUS
Enter city and state.
FIND
GEOGRAPHIC LEVELS
National View
American Indian and Alaskan Native Areas
Congressional District
County / Municipio
County Subdivision
Place
Census Tract
Census Block Group
Census Block
TOTAL POPULATION
0 - 4
5 - 9
10 - 17
18 - 29
30 - 48
49 - 86
87 - 20,000
Philadelphia International Airport
Sanitarium Playground
Red Bank Battlefield Park
National Park
West Deptford
United States Census Bureau
Map data ©2011 Google - Terms of Use
1 mi
1 km

# Summary of Potential Sites for Near-Road $NO_2$ Monitor

City of Philadelphia
Department of Public Health
Air Management Services

December 2011

# Table of Contents



## Tables



## Figures

## Summary of Potential Site for Near-Road $NO_2$ Monitor

Over a two week period in December 2011, several potential sites were evaluated based on satellite imagery through Google Earth and through field work. Prior to field work, Meyliana had identified 10 possible road segments where a monitor can be placed based on FE-AADT rankings, which account for traffic volume and fleet mix. The 10 road segments are listed in table 1 below. These segments were also mapped on Google Earth using the Placemark tool.

| SITE | TRAF. RT. NO | STREET NAME | LOCATION | FE AADT |
|---|---|---|---|---|
| A | I-95 | Delaware Ex | Between Exit 25 (Allegheny Ave/Castor Ave) & I-95 North – Trenton | 348412 |
| B | I-95 | Delaware Ex | Between Exit 22 (I-676/US 30 - Central Phila/Callowhill St) & Exit 25 (Allegheny Ave/Castor Ave) | 296176 |
| C | I-95 | Delaware Ex | Between Boundary with Delco & Exit 12 (PA 291 - Cargo City) | 257934 |
| D | I-95 | Delaware Ex | Between Exit 32 (Academy Rd/ Linden Ave) & Exit 33 (Grant Ave - Boundary with Bucks Co.) | 257460 |
| E | I-95 | Delaware Ex | Between Exit 17 (PA 611 N.Broad St/Pattison Ave) & Exit 19 (I-76 E - Walt Whitman Br/Packer Ave) | 248661 |
| F | I-95 | Delaware Ex | Between I-95 North - Trenton & Exit 30 (Cottman Ave/Rhawn St) | 231251 |
| G | I-95 | Schuylkill Ex | Between Exit 340A (Lincoln Dr/Kelly Dr) & Exit 341 (Montgomery Dr/West River Dr) | 225529 |
| H | I-95 | Schuylkill Ex | Between Exit 343 (Spring Garden St/Harverford Ave) & Exit 346A (South St) | 224503 |
| I | I-95 | Delaware Ex | Between Exit 30 (Cottman Ave/Rhawn St) & Exit 32 (Academy Rd/ Linden Ave) | 223959 |
| J | I-95 | Delaware Ex | Between Exit 13 (to I-76 W/PA 291-Valley Forge/Island Ave) & W. Fort Mifflin Rd | 221037 |

**Table 1 -** Rank of proposed sites based on FE AADT.

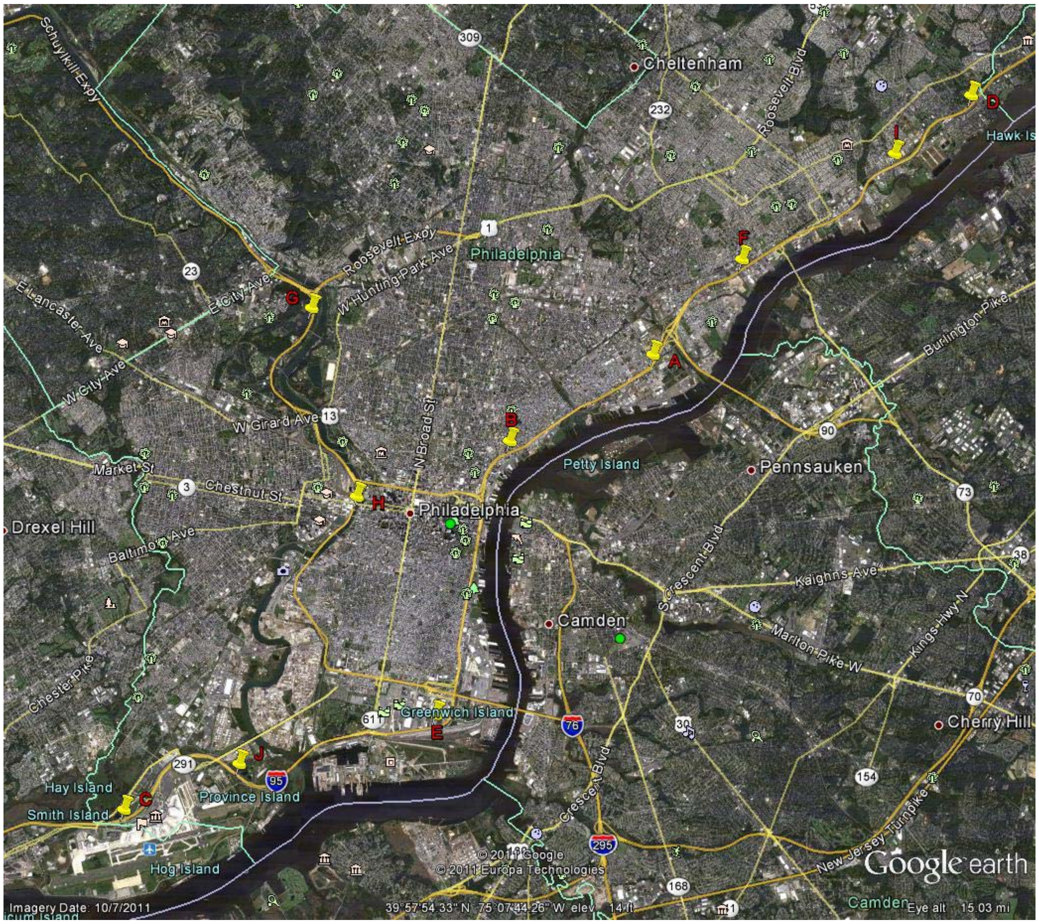



**Figure 1 -** Aerial view of the 10 segments from Google Earth

Possible sites along each road segment were identified and also mapped on Google Earth while its coordinates were identified and recorded. Possible locations were chosen based on the criteria in section 6 of EPA's Near-Road $NO_2$ Monitoring TAD dealing with physical considerations. Table 2 below illustrates the considerations for selecting candidate sites. Favorable sites for monitors include those along at grade roads (or above grade roads with fills), low (or no) barriers and flat terrain. After different locations were identified, field work was conducted to assess each site's potential, advantages and disadvantages. The distance from the proposed site to the road segment and sources of power were also taken into account. As noted in the TAD, monitors must be placed at a certain distance (no more than 50m) horizontally from the edge of the selected road segment (40 CFR Part 58, Appendix E). Calculations of the distance from the road segment were made using the Ruler tool in Google Earth and give a rough estimate. For the power source an assumption was made: if there are light fixtures or any other electrical fixtures near or around the site, then there is likely a power source. On site, the area was surveyed and pictures were taken for better analysis of the site.

| Physical Site Component | Impact on Site Selection | Desirable Attributes | Less Desirable Attributes | Potential Information Sources |
|---|---|---|---|---|
| Roadway design or configuration | Feasibility of monitor placements; affects pollutant transport and dispersion | Near ramps, intersections, lane merge locations/ interchanges; at grade with surrounding terrain | Cut-section/below grade; above grade (bridge) | Field reconnaissance; satellite imagery |
| Roadside Structures | Feasibility of monitor placement; affects pollutant transport and dispersion | No barriers present besides low (<2 m in height) safety features such as guardrails | Presence of sound walls, high vegetation, obstructive buildings | Field reconnaissance; satellite imagery |
| Terrain | Affects pollutant dispersion, local atmospheric stability | Flat or gentle terrain, within a valley, or along road grade | Along mountain ridges or peaks, hillsides, or other naturally windswept areas | Field reconnaissance; digital elevation models and vegetation files; satellite imagery |
| Meteorology | Affects pollutant transport and dispersion | Relative downwind locations – winds from road to monitor | Strongly predominant upwind positions | Local data; NOAA/NWS; AQS |

**Table 2 -** Summary of physical considerations for near-road candidate sites. EPA Near-Road $NO_2$ Monitoring TAD

## Site Evaluation

### Site A:

**Figure 2 -** Site A, proposed location

6

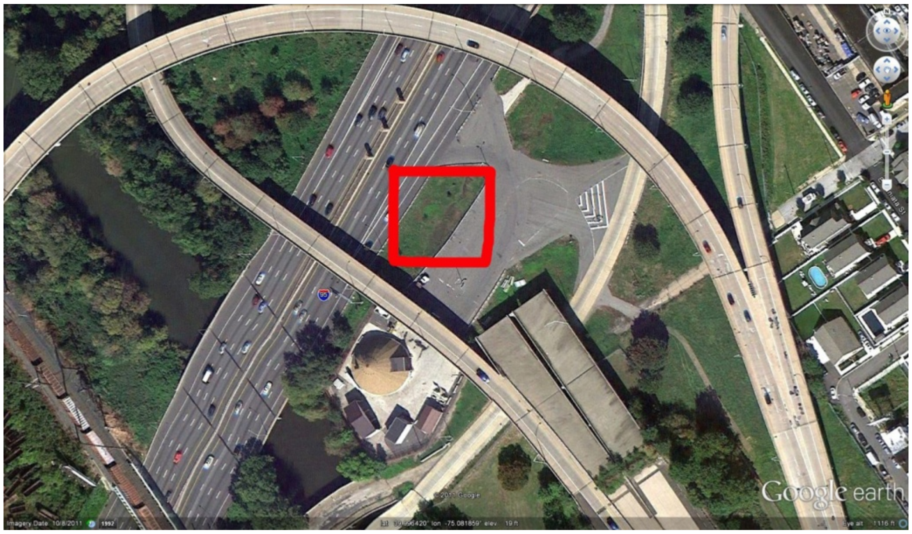



**Figure 3 -** Aerial view from Google Earth

The location for site A is near a road salt storage facility and is restricted to authorized vehicles and there are highway police who frequently patrol the area. Entering the site is not difficult though requires slowing down a bit to enter as the curb along the guardrails feels uneven and bumpy. Caution should be taken when pulling over as traffic is still moving. Exiting the location requires the same caution.

The road along the site for the most part is at grade. However there are a couple of overpasses above the site. The passes are for one lane traffic leaving the freeway. Each overpass is supported by columns which leave an open area below in which enhanced dispersion may lead to lower recorded emissions. There are no major road structures except for guardrails. On another portion of the site, the columns are the only obstructions. In addition there is (very) light vegetation. The terrain is flat (for the most part) but concaves downward a bit. At one possible spot, there is a dip in the terrain (almost crater-like). Another spot farther down at one end is flat but closer to the columns of the overpass. The site also meets the requirements in 40 CFR Part 58, Appendix E as it is well within 50m of the road segment. With a light fixture present, it is likely that there is a power source for the monitor.

**Figure 4 -** View of slightly concave terrain of one proposed location and overpass in the background

**Figure 5 -** View of second proposed location, overpasses and guardrails

This location would be a good spot for a monitor as its close proximity to an at grade road would ensure good readings.

## Site B:

**Figure 6 -** Site B, proposed location at Beach St and Richmond St

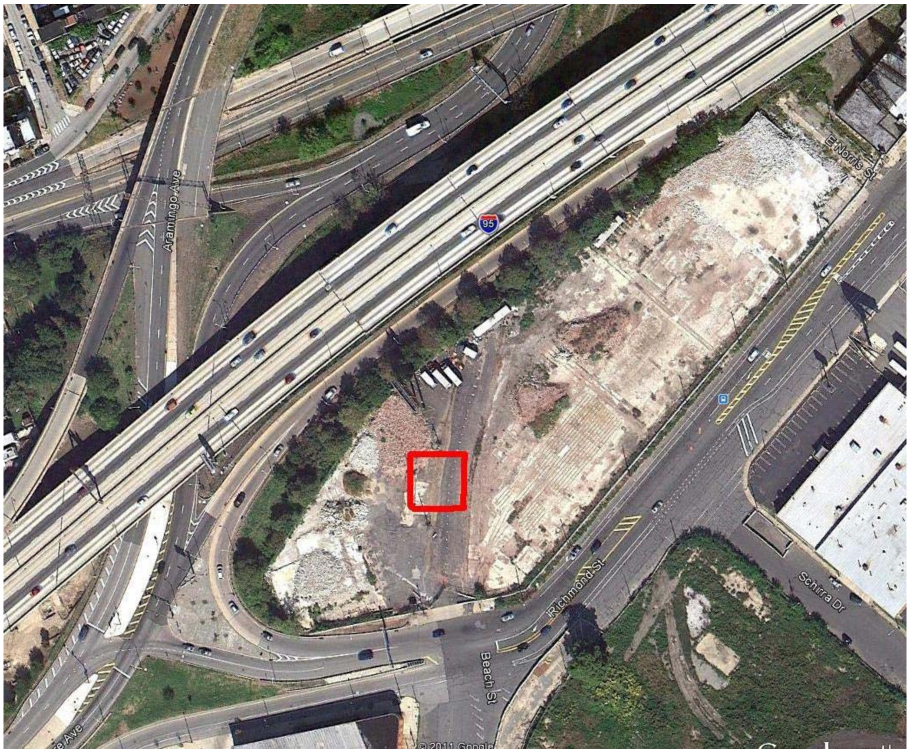



**Figure 7 -** Aerial view from Google Earth

**Figure 8 -** Site B, proposed location at E Columbia Ave and N Delaware Ave


**Figure 9 -** Aerial view from Google Earth

Two locations along the road segment for site B were visited and assessed. The first location is located at an abandoned site at an intersection between Richmond St. and Beach St. The second location was at an intersection between E. Columbia Ave and N. Delaware Ave.

Reaching both locations require exiting the freeway and, after a few turns, driving along Richmond St. (abandoned site) or E. Columbia Ave (second site). The abandon lot is the easiest to enter while the second location is difficult as the location is fenced. Leaving both sites is relatively easy as well.
The road near the abandoned site is above grade but also near a ramp entering the freeway. The road is held up by columns, leaving open space below the road. Due to the openness underneath, enhanced dispersion may lead to lower recorded emissions. The site itself contains various obstructions: mounds of dirt/debris/rocks, high vegetation, large trucks. These obstructions are dispersed throughout the site. Work could be going on there to remove debris as there was a building as indicated by an old Google Earth image. The terrain where the site is located is flat. As the site is very wide, the monitor would have to be placed closer to the edge of the lot near the freeway to meet the 50m requirement in 40 CFR Part 58, Appendix E. There are light fixtures on the freeway and a power line close by.

**Figure 10 -** View of debris and vegetation at one location for Site B

The road near the second site is above grade with some parts filled and some a portion open underneath. There is also an overpass which is above grade and supported by columns. Enhanced dispersion may lead to lower recorded emissions. The main obstructions are trees located at one end of the location and some close to the road. The next obstruction is the overpass. The area is surrounded by a fence and as indicated accessing the location may be a bit difficult. The terrain is flat and open in some parts of the field. The site falls within the 50m required for monitor placement and there are street lamps and traffic lights, indicating a power source.

**Figure 11 -** View of trees and overpass at a Site B location

Both locations present their on major disadvantages and it is likely that none of these spots would be good for a monitor.

## Site C:

**Figure 12 -** Site C, proposed location near PHL


**Figure 13** - Aerial view from Google Earth

The spot along site C is near Philadelphia International Airport and requires pulling over to the side of the freeway. The location is easy to reach but easy to miss if one is not paying attention as traffic moves very quickly. Once again, the curb is a bit uneven and requires slowing down and caution should be exercised when entering and leaving the site. Returning to central Philadelphia requires driving further along the freeway and either exiting and returning northbound or driving through the suburbs.

The road is at grade with the proposed site. Along the road there are overpasses supported by columns which could lead to enhanced dispersion, lowering recorded emissions. There are no major structures except for the overpass, which begins at one end of the site. The terrain for the most part is flat and becomes elevated closer to the overpass. There is lots of vegetation in the surrounding area. The site falls well within the requirement for monitor placement (50m from road segment) and a power source may be located under the overpass.

**Figure 14 -** View of surroundings of Site C

This location would be a good spot for the monitor as there is good traffic along the freeway. The place is open to the road though caution should be used when driving back onto the freeway.

## Site D:

**Figure 15 -** Site D, proposed location near Exit 32

**Figure 16 -** Aerial view from Google Earth

The proposed location is located just after Exit 32 (close to Baxter) along I-95 as there is a place to pull over and an open field. Enter the location is easy but exiting requires more caution. Getting back to central Philadelphia requires driving up further to another exit and then re-entering the freeway southbound.

The road is at grade level with this proposed location. The road has exit lanes and another lane that merges into the freeway further northbound. The trees may obstruct the monitors at one end but the area is big enough. Terrain is open and the area slightly concaves down. The site is adjacent to the road segment, easily meeting the requirement in 40 CFR Part 58, Appendix E. There is a light fixture next to the road, indicating a power source.

**Figure 17 -** View of Site D's surroundings

Overall, this seems to be one of the best locations for the monitor as the space is easy to reach and very open.

## Site E:


**Figure 18 -** Site E, proposed location near I-76 E

**Figure 19 -** Aerial view from Google Earth

**Figure 20 -** Site E, proposed location near I-95

**Figure 21 -** Aerial view from Google Earth


**Figure 22 -** Site E, proposed location near I-95 entrance

18

**Figure 23 -** Aerial view from Google Earth

Three spots were considered in finding a location along the road segment for site E for the monitor. One is located near the entrance to I-76 E heading toward Walt Whitman Bridge, the second located behind the parking lot of a grocery store near Lincoln Financial Field and the third just near the entrance to I-95 heading toward the airport. The first spot is easy to locate but hard to enter as the area is fenced. The second location can be entered through S. Lawrence St. The last spot is fenced but can be entered through their driveway. The last two spots are private property so permission may be needed to install a monitor if the site is chosen.

The road near the first location is slightly above grade with fill below and an opening farther down. There are lanes merging onto the freeway which adds to the traffic. There are no road structures that could greatly affect emissions and the terrain is flat. However, the place is hard to enter.

The road near the second location is above grade and is supported by columns. Any enhanced dispersion may lower recorded emissions. There are no major roadway structures. On the other side of the freeway there is construction that may affect any readings. However it is uncertain how long the construction will go on. The terrain is flat and there is (at the moment) light vegetation in the surrounding area.

**Figure 24 -** View of construction near and under I-95

The third location is similar to the first though the road is at grade. There are lanes that merge into the freeway. There is relatively light vegetation with a few trees present that could affect emissions.

All three sights fall within the requirement in 40 CFR Part 58, Appendix E. there is a light fixture next to the road, indicating a power source. In addition, a power source can be found near each site.

Overall, any one of the three, while not the best, presents a decent location for the monitor.

## Site F:


**Figure 25 -** Site F, proposed location near Tacony St and Comly St

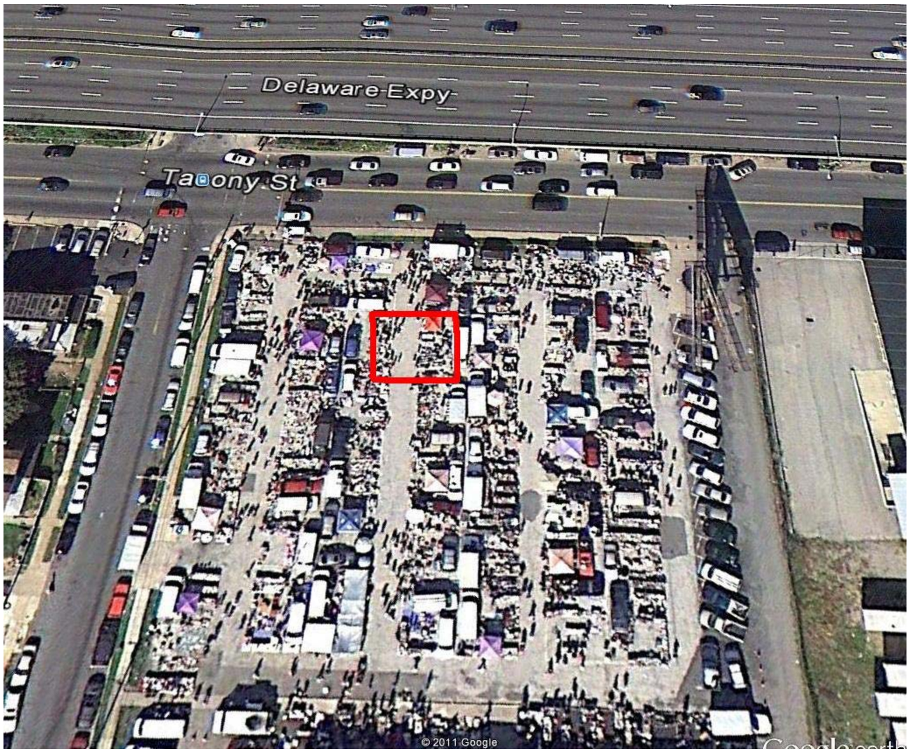



**Figure 26 -** Aerial view from Google Earth

The location near site F is easy to reach and requires exiting the freeway and driving along Tacony St. The site is at the intersection between Tacony St. and Comly St.

The road is above grade with no open space underneath for a good stretch of the road though at the intersection, there is now fill (to allow traffic to move through Comly St). There are few major obstructions. One possible obstruction comes from a building nearby. The terrain is very flat and very open however the location is the site of a flea market. The site is close to the road segment, meeting the requirement in 40 CFR Part 58, Appendix E. There are light fixtures next to the road, indicating a power source.

**Figure 27** - View of hollow overpass

The site present one of the best locations but permission may be needed from those operating the flea market.

## Site G:

The location for the monitor sites between two lanes that merge (one from I-76E/Central Phila and the other from US-1/Lincoln Highway).

The road is at grade with the site and the terrain is flat but on a slight incline. The only road structures present are guardrails and other obstructions that could possibly affect dispersion are trees along the right side of I-76 E/Central Phila. The site meets the 50m requirement but lacks a nearby power source.

While the site provided a good location for the monitor, it is very dangerous to enter and exit as the site sits between two lanes that merge. Entering the site is the most hazardous as it requires slowing down with oncoming traffic behind. From US-1/Lincoln Highway to I-76 E/Central Phila, the site has to be entered from the right lane ("slow lane") and from the I-76 E/Central Phila the site has to be entered from the left lane ("fast lane").

## Site H:

**Figure 28 -** Site H, proposed location near 30 St Station


**Figure 29 -** Aerial view from Google Earth

The spot near site H is located near 30th St Station/Amtrak and is easily reached by driving near Race St from 30 St Station. The site is opened only to authorized vehicles and entering and exiting the site is relatively easy as well.

The road is at-grade level with the proposed site. The site is situated between the freeway and a ramp that exits from the freeway. The ramp is elevated with space underneath. A part of the ramp is walled but at a small distance from the site. Otherwise, the site is completely open to the freeway. The obstructions include various vehicles (light and heavy vehicles) that park in that area as there is a small parking lot. The terrain for the most part is flat and open. The site is adjacent to the road segment, easily meeting the requirement in 40 CFR Part 58, Appendix E. There are power sources near the site that can be utilized.

## Site I:

Not visited since a location along D was close enough.

## Site J:

Not visited since a location along C was close enough.

**Site Ranking**

Best Sites:
1. A
2. D
3. H
4. C

Decent Sites:
1. E
2. B

Worst Sites:
1. F
2. G

June 5, 2013

Mr. Henry Kim
Chief of Program Services
Air Management Services
321 University Avenue, 2nd Floor
Philadephia, PA 19104
Phone: 215-685-9439
Email: henry.kim@phila.gov

Re: Comments on 2013-2014 Philadelphia Annual Air Monitoring Network Plan

Dear Mr. Kim,

The Natural Resources Defense Council and the Clean Air Council write regarding the 2013-2014 Air Monitoring Network Plan for the City of Philadelphia. As your agency is intimately aware, the air monitoring network is of paramount importance in determining compliance with federal clean air standards. Of particular importance, our organizations want to see the new deployment of near roadway monitors in appropriate locations that truly will provide the necessary data and information to address the serious issue of high pollution levels near major roadways. In reviewing the 2013-2014 Air Monitoring Network Plan ("Plan"), we are concerned that the City of Philadelphia Air Management Services ("AMS") did not meet the requirements of 40 C.F.R. § 58.10(a)(5) in deciding to place the microscale near-road $NO_2$ monitor at the Torresdale site. We are also concerned that AMS plans to use Federal Equivalent Method rather than Federal Reference Method at PM monitors without demonstrating compliance with 40 C.F.R. § 58.13. In addition, not all air toxics recommended by EPA and prioritized by AMS have been monitored. Lastly, AMS has not properly justified the closure of the CHS monitoring site.

## I. The proposed $NO_2$ site is not sufficiently documented and is potentially faulty.

By July 1, 2013, EPA requires a plan for establishing a near-road $NO_2$ monitor in Core Based Statistical Area (CBSAs) with 1,000,000 or more persons pursuant to 40 C.F.R Part 58, Appendix D, section 4.3.2. The plan must provide for the monitor to be operational by January 1, 2014.[1] 40 C.F.R. Part 58 requires the following:

1. One microscale near-road $NO_2$ monitoring station in each CBSA with 500,000 persons or more, to monitor expected maximum hourly concentrations near a high major road with high Annual Average Daily Traffic ("AADT"). To select near-road $NO_2$ monitoring stations, agencies must rank all road segments within a CBSA by AADT, identify a location or locations near the highest ranked road segments, considering fleet mix, roadway design, congestion patterns, terrain, and meteorology, where maximum hourly $NO_2$ concentrations are expected to occur and siting criteria in Appendix E can be met. Where there are multiple candidate sites where maximum hourly $NO_2$ concentrations are expected to occur, the agency must consider the potential for population exposure in the criteria for final site selection. Where a

[1] 40 C.F.R. § 58.10 (a)(5)(iii) (2013).

CBSA must have two near-road $NO_2$ monitoring stations, the sites must be differentiated from each other by one of more of these factors: fleet mix; congestion patterns; terrain; geographic area within the CBSA; or a different route, interstate, or freeway designation.[2]

2. A second near-road $NO_2$ monitoring station is required for any CBSA with population over 2,500,000 persons or more, or in any CBSA with 500,000 or more persons that has at least one road segment with AADT over 250,000.[3]

We are concerned with the choice of the Torresdale station for several reasons. First, the Plan does not follow EPA's recommended four-step process in ranking road segments for evaluation as near-roadway $NO_2$ monitors. In fact, this year's plan is devoid of information regarding the four-step process and the selection of the Torresdale site. Second, in evaluating candidate sites in 2012-2013, AMS did not explain which seven candidate sites were removed for logistical reasons, or the specific reasons for removing each site, and should do so in the 2013-2014 Plan. Third, AMS does not explain why the Torresdale station was selected among the remaining three stations. And fourth, AMS should discuss its efforts to collaborate with other agencies in establishing the second monitor.

AMS is required to include in each plan "a statement of purposes for each monitor and *evidence* that siting and operation of each monitor meets the requirements of Appendices A, C, D, and E."[4] AMS fails to provide such evidence in the areas listed above.

We appreciate AMS's efforts to select the first near-road $NO_2$ station using Fleet Equivalent AADT in the 2012-2013 Plan. However, in the 2013-2014 Plan, AMS should fully document its decision according to the EPA's Near-Road $NO_2$ Technical Assistance Document. EPA recommends a four-step process for ranking road segments for evaluation as near-roadway $NO_2$ monitors. The steps are as follows:

STEP 1 – Generate a list of road segments in the CBSA in descending order, where the segment with the highest AADT is ranked first. This list should include at a minimum the road segment ID, location information, road information, and AADT value.
STEP 2 – Link the total volume of heavy-duty vehicles to the AADT list generated in Step 1, matching the two data sets by segment.
STEP 3 – Calculate the Fleet-Equivalent AADT values for each road segment, re-prioritize the candidate list based on the FE-AADT.
STEP 4 – Add the congestion indicator to the candidate site list. This data is to be used as a qualitative metric to aid in site selection over other similarly ranked candidates.[5]

AMS only complied with Step 3 in its 2012-2013 Plan but does not provide evidence of Steps 1, 2, or 4. None of this is documented in its 2013-2014 Plan. This evidence is necessary to

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[2] See 40 C.F.R. § 58 Appendix D, §4.3.2(a) (2013).
[3] Id.
[4] 40 C.F.R. § 58.10 (a)(1) (2013) (emphasis added).
[5] EPA, NEAR-ROAD $NO_2$ MONITORING TECHNICAL ASSISTANCE DOCUMENT 21-35 (June 2012) [hereafter "EPA $NO_2$ TAD"].

ensure AMS's conclusions are correct and to inform the public. For example, compliance with Step 1 would allow EPA and the public to ensure that AMS has listed all road segments, and not just a few selected ones. We respectfully request AMS to provide this information.

AMS states in the 2012-2013 Plan that after road segments were ranked by FE-AADT, and possible site locations were chosen, AMS conducted site visits. Based on the visits, seven of the ten sites were removed due to logistical issues, such as safety issues, unavailability of a power source, locations of the sites that are further than required, and roadside structures.[6] AMS did consider physical characteristics of the sites and the requirements in 40 C.F.R. Part 58, Appendix E, but does not explain how each consideration came out for each site.

Before selecting each site, EPA recommends that state and local agencies collect all the data to be considered in a "candidate site comparison matrix," which is useful for agency decision-makers to use to select sites, and for public dissemination.[7] This matrix is absent from the 2012-2013 Plan, and should be in the 2013-2014 Plan.

According to CFR Part 58, Appendix D, Section 4.3.2(a)(1), "where a state or local air monitoring agency identifies multiple acceptable candidate sites where maximum hourly $NO_2$ concentrations are expected to occur, the monitoring agency shall consider the potential for population exposure in the criteria utilized to select the final site location." Since AMS did not create a "candidate site comparison matrix," it is difficult to tell if there are multiple acceptable sites. AMS should state this clearly. If there are, AMS must consider population exposure in its selection.

Finally, in making the final near-road $NO_2$ site selection, EPA expects that state and local air agencies will work with EPA Regional staff during site selection, and include the selected site in the annual Plan. EPA regions will at a minimum provide feedback on the site selection before approving the Plan. In reviewing the Plan, EPA considers "the availability of data supporting the rationale behind selection of a site, such as that within the candidate site comparison matrix."[8] The candidate site comparison matrix should be provided in the Plan. If this consultation with EPA has occurred, more information should be included in the plan to denote what transpired during these discussions.

We agree with AMS that the Philadelphia-Camden-Wilmington area needs two near-road $NO_2$ monitors, since the population of the CBSA exceeds 2,500,000.[9] When multiple agencies cover the same CBSA, EPA encourages state and local agencies to work together and determine where the additional site(s) should be located. The agencies should also engage EPA Regional staff in this process. However, the state and local air agencies must "take the lead on the decision making."[10] AMS should engage the appropriate air agencies to establish the second monitoring location.

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[6] CITY OF PHILADELPHIA, 2012-2013 AIR MONITORING NETWORK PLAN 73 (2012) [hereafter "Philadelphia 2012 Plan"].

[7] EPA $NO_2$ TAD at 12, 71.

[8] EPA $NO_2$ TAD at 77.

[9] *See* Philadelphia 2012 Plan at 70.

[10] EPA $NO_2$ TAD at 7-8.

We respectfully request that if AMS fails to address these comments and provide sufficient data supporting its choice of Torresdale as the near-road $NO_2$ site, that EPA disapprove the Plan until these comments are addressed.

## II. The Plan Should Include $PM_{2.5}$ Monitoring at the $NO_2$ Sites

Given the harms associated with $PM_{2.5}$ pollution, we also suggest that the new near-road $NO_2$ sites include monitoring for this pollutant as well. This will provide important data to further protect communities overburdened by highway pollution.

## III. AMS Must Justify Using the Federal Reference Method (FRM) rather than the Federal Equivalent Method (FEM) at PM Monitors

"AMS plans to replace all primary $PM_{2.5}$ FRMs with $PM_{2.5}$ continuous FEMs," [11] however, it is not clear that the $PM_{2.5}$ FEMs are suitable to replace the FRMs. AMS explains that it is "not yet at a point where the comparability of the $PM_{2.5}$ continuous FEM operated in [its] network compared to collocated FRM is acceptable such that [it is] comfortable using the continuous FEM data for comparison to the NAAQS." [12] Pursuant to 40 C.F.R. § 58.10(b)(13), when $PM_{2.5}$ FEMs data are not of sufficient quality,

> "the monitoring agency must ensure that an operating FRM or filter-based FEM meeting the sample frequency requirements described in § 58.12 or other Class III $PM_{2.5}$ FEM or ARM with data of sufficient quality is operating and reporting data to meet the network design criteria described in appendix D to this part.[13]"

AMS has not made clear that a sufficient quantity of quality data will be available to comply with 40 C.F.R. § 58.13. AMS must ensure in its plan that enough FRMs or filter-based FEMs are available to provide quality data.

## IV. Monitoring for Air Toxics

AMS must monitor for air toxics, some of which EPA has recommended that state and local agencies monitor at near-road sites. AMS explains that "diesel emissions are a significant, but not quantified, contributing factor to health risks from toxic emissions,"[14] but fails to indicate which pollutants it will monitor near roadways. According to AMS,

> [a]ir toxics that are being measured in Philadelphia that show an excess lifetime cancer risk of 1 or more out of a million are:

[11] CITY OF PHILADELPHIA, 2013-2014 AIR MONITORING NETWORK PLAN 18 (2012) [hereafter "Philadelphia 2013 Plan"]. "AMS plans to replace all primary $PM_{2.5}$ FRMs with $PM_{2.5}$ continuous FEMs, starting with RIT, CHS, and FAB. As of April 1, 2013, RIT and CHS have designated the FEM monitor as then primary monitor. The projected date for designating the FEM as the primary monitor at FAB is July 1, 2013." Id.
[12] Philadelphia 2013 Plan at 69.
[13] 40 C.F.R. § 58.10(b)(13) (2013).
[14] Philadelphia 2013 Plan at 63.

**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.
**acetaldehyde** (Cas RN 75-07-0) - A colorless liquid or gas with a fruity odor. It is used to manufacture many other chemicals.
**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.
**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.
**tetrachloroethylene** (Cas RN 127-18-4) - A clear liquid with a sweet, chloroform-like odor. It is used in dry cleaning and metal degreasing. Its other common name is perchloroethylene.[15]

EPA includes air toxics as a priority within its Near-road $NO_2$ Monitoring Technical Assistance Document. Among the air toxics, EPA suggests that "at least benzene, toluene, ethyl benzene, and xylenes" be monitored at near roadway sites.[16] Accordingly, AMS should ensure that these air toxics—and any others it has independently prioritized—are monitored alongside $NO_2$ and $PM_{2.5}$.

## V. Closure of the Community Health Services (CHS) Monitor

AMS must properly justify the closing of the CHS monitoring site. The agency indicated its intention to close the CHS monitor: "[t]he 2008 plan documented changes to the $PM_{2.5}$ monitoring network that impacted the location of a violating $PM_{2.5}$ monitor at 500 S. Broad Street (CHS)."[17]

"CHS is one of five $PM_{2.5}$ monitoring sites that historically has experienced the highest $PM_{2.5}$ concentration."[18] Although AMS does not indicate which air toxics have elevated readings at CHS, several air toxics, including 1,3-butadiene, acetaldehyde, benzene, carbon tetrachloride, formaldehyde, and tetrachloroethylene, have elevated readings in Philadelphia.[19] Additional pollutants, including $NO_2$, nitrogen monoxide (NO), and heavy metals are also measured at the site.

"All proposed additions and discontinuations of SLAMS monitors in annual monitoring network plans and periodic network assessments are subject to approval according to § 58.14."[20]

[15] Philadelphia 2013 Plan at 62.
[16] EPA $NO_2$ TAD at 82.
[17] Philadelphia 2013 Plan at 18.
[18] Philadelphia 2013 Plan at 62.
[19] Philadelphia 2013 Plan at 64.
[20] 40 C.F.R. § 58.10(e) (2013).

Monitor station discontinuations are "subject to the review of the Regional Administrator."[21] EPA will approve a discontinuation if "any of the following criteria are met and if the requirements of appendix D to this part, if any, continue to be met." [22] EPA may approve other discontinuation requests if it "does not compromise data collection needed for implementation of a NAAQS and if the requirements of appendix D to this part, if any, continue to be met." EPA can approve a discontinuation if any of these criteria are met:

> (1) Any $PM_{2.5}$, $O_3$, CO, $PM_{10}$, $SO_2$, Pb, or $NO_2$ SLAMS monitor which has shown attainment during the previous five years, that has a probability of less than 10 percent of exceeding 80 percent of the applicable NAAQS during the next three years based on the levels, trends, and variability observed in the past, and which is not specifically required by an attainment plan or maintenance plan. In a nonattainment or maintenance area, if the most recent attainment or maintenance plan adopted by the State and approved by EPA contains a contingency measure to be triggered by an air quality concentration and the monitor to be discontinued is the only SLAMS monitor operating in the nonattainment or maintenance area, the monitor may not be discontinued.
>
> (2) Any SLAMS monitor for CO, PM10, SO2, or NO2 which has consistently measured lower concentrations than another monitor for the same pollutant in the same county (or portion of a county within a distinct attainment area, nonattainment area, or maintenance area, as applicable) during the previous five years, and which is not specifically required by an attainment plan or maintenance plan, if control measures scheduled to be implemented or discontinued during the next five years would apply to the areas around both monitors and have similar effects on measured concentrations, such that the retained monitor would remain the higher reading of the two monitors being compared.
>
> (3) For any pollutant, any SLAMS monitor in a county (or portion of a county within a distinct attainment, nonattainment, or maintenance area, as applicable) provided the monitor has not measured violations of the applicable NAAQS in the previous five years, and the approved SIP provides for a specific, reproducible approach to representing the air quality of the affected county in the absence of actual monitoring data.
>
> (4) A PM2.5 SLAMS monitor which EPA has determined cannot be compared to the relevant NAAQS because of the siting of the monitor, in accordance with § 58.30.
>
> (5) A SLAMS monitor that is designed to measure concentrations upwind of an urban area for purposes of characterizing transport into the area and that has not recorded violations of the relevant NAAQS in the previous five years, if discontinuation of the monitor is tied to start-up of another station also characterizing transport.

[21] 40 C.F.R. § 58.14(c) (2013).
[22] 40 C.F.R. § 58.14(c) (2013).

> (6) A SLAMS monitor not eligible for removal under any of the criteria in paragraphs (c)(1) through (c)(5) of this section may be moved to a nearby location with the same scale of representation if logistical problems beyond the State's control make it impossible to continue operation at its current site.[23]

AMS has not indicated which criteria it intends to use for approval nor shown that discontinuation of CHS will not compromise data collection needed for implementation of a NAAQS. The agency cannot receive approval of its discontinuation request from EPA until it has demonstrated satisfaction of a criterion or shown that data collection will not be compromised.

## VI. Conclusion

For the reasons above, undersigned respectfully request that AMS revise its monitoring network plan to fully comply with the requirements of 40 C.F.R. Part 58, including providing evidence that it ranked all road segments according to AADT, why each site was removed for logistical reasons, an candidate site comparison matrix, and why the Torresdale site was selected. We also request that AMS demonstrating compliance with 40 C.F.R. § 58.13 before changing PM monitors from FRM to FEM, that all air toxics recommended by EPA and prioritized by AMS be monitored, and that AMS justifies the closure of the CHS monitoring site under 40 C.F.R. 58.14. Since these comments are forwarded to EPA, if AMS fails to address these comments, we respectfully request that EPA disapprove the Monitoring Plan and request that the agency provide a response to the comments provided. We are more than happy to work with AMS and EPA to address these concerns. Please do not hesitate to contact us.

Sincerely,

/s/
Adrian Martinez
Staff Attorney
Natural Resources Defense Council

/s/
Xiao Zhang
Legal Fellow
Natural Resources Defense Council

/s/
David Presley
Staff Attorney
Clean Air Council

[23] 40 C.F.R. § 58.14(c) (2013).

**The City of Philadelphia Department of Public Health, Air Management Services Division (AMS) Response to June 5, 2013 Comments on 2013-2014 Philadelphia Annual Air Monitoring Network Plan Submitted by Natural Resources Defense Council and the Clean Air Council**

AMS is in receipt of the comments, dated June 5, 2013, from the Natural Resources Defense Council (NRDC) and the Clean Air Council (CAC) on the 2013-2014 Philadelphia Annual Air Monitoring Network Plan (Plan). These comments are addressed below.

## I. The proposed NO2 site is not sufficiently documented and is potentially faulty

The NRDC and CAC commented that the 2013-2014 Plan did not adequately document the decision to place the $NO_2$ Near-Road Air Monitor at the Torresdale site pursuant to the requirements of 40 CFR Part 58, and recommendations included in the EPA Near-Road NO2 Technical Assistance Document (NO2 TAD). Specifically, NRDC and CAC assert that the 2013-2014 Plan did not: 1) rank all road segments within Philadelphia by Annual Average Daily Traffic (AADT), 2) fully explain why certain potential NO2 monitoring sites were discounted for logistical reasons, 3) include a candidate site comparison matrix, and 4) explain why the Torresdale site was chosen over other potential $NO_2$ monitoring sites.

AMS Response

The 2013-2014 Plan does not address many aspects of the Near-Road $NO_2$ Air Monitor site selection because the selection process was documented in Appendix D of the 2012-2013 Plan that was subsequently approved by EPA on February 21, 2013. AMS followed the recommendations set forth in the $NO_2$ TAD to determine the top 10 Fleet Equivalent (FE)-AADT road segments within the CBSA. See 2012-2013 Plan, Appendix D. Nonetheless, AMS has amended Appendix C of the 2013-2014 Plan, to include additional information pertinent to this selection process. This information includes the AADT rankings of road segments in Philadelphia, and a comparison matrix with specific information from the 3 final potential monitoring locations.

## II. Inclusion of $PM_{2.5}$ monitoring at the new Near-Road $NO_2$ Air Monitoring Site

The NRDC and CAC commented that the 2013-2014 Plan should have provided for $PM_{2.5}$ monitoring at the new, Near-Road $NO_2$ Air Monitor site.

AMS Response

Pursuant to 40 CFR § 58.13(f)(1) and EPA's final rule "National Ambient Air Quality Standards for Particulate Matter" published in the Federal Register Volume 78 No. 10 on January 15, 2013, $PM_{2.5}$ monitors must be installed at near-road $NO_2$ monitoring sites by January 1, 2015. Accordingly, installation of a PM2.5 monitor at the Near-Road $NO_2$ Air Monitor site that will be established pursuant to the 2013-2014 Plan will be addressed in the 2014-2015 Plan.

## III. Justification for using the Federal Reference Method (FRM), rather than the Federal Equivalent Method (FEM), at $PM_{2.5}$ Monitors

The NRDC and CAC commented that the 2013-2014 Plan did not adequately justify using FRM rather than FEM at $PM_{2.5}$ monitors.

AMS Response

The EPA Office of Air Quality Standards has concluded that $PM_{2.5}$ FEMs are suitable replacements for FRMs. See, e.g. Memorandum from EPA Office of Air Quality Standards to Regional Air Division Directors on Implementing Continuous $PM_{2.5}$ Federal Equivalent Methods (FEMs) and Approved Regional Methods (ARMs) in State or Local Air Monitoring Station (SLAMS) Networks, (July 24, 2008), available at:
http://www.epa.gov/ttn/amtic/files/ambient/pm25/datamang/FEMSandARMsinSLAMS.pdf.
To ensure that AMS produces quality data for comparison to the NAAQS, AMS will meet the co-located requirement in section 3.2.5 of Appendix A to 40 CFR Part 58, and the minimum data capture percent as required in Appendix N to 40 CFR Part 50.

Note, AMS's concerns pertaining to the comparability of data from $PM_{2.5}$ continuous FEMs and collocated FRMs for determining compliance with the NAAQS as recounted in the 2013-2014 Plan were limited to the specific data set collected from the LAB site from 2011 to March 2013.

## IV. Monitoring for air toxics at Near-Road $NO_2$ Air Monitor site

The NRDC and CAC commented that the 2013-2014 Plan did not provide for the monitoring of air toxics at the Near-Road $NO_2$ Air Monitor site.

AMS Response

There is no EPA requirement to monitor air toxics at the near-road $NO_2$ monitoring site. AMS currently monitors air toxics at 1501 E. Lycoming Street (LAB); Eva and Dearnley Streets (ROX); 500 S. Broad Street (CHS); 24th and Ritner Streets (RIT); and 8200 Enterprise Avenue (SWA) sites. AMS will review air toxics monitoring network annually and adjust the location / air toxics that are monitored as needed.

## V. Closure of the Community Health Services (CHS) Monitor

The NRDC and CAC commented that the 2013-2014 Plan does not justify the closure of the CHS Monitor as required pursuant to 40 C.F.R. § 58.14.

AMS Response

AMS has not made a request to EPA to discontinue air monitoring at CHS, and is planning on operating CHS for the near future. The 2013-2014 Plan outlines possible changes to the Air Monitoring Network in the advent that CHS is to be closed. If and when monitoring is discontinued at CHS, AMS will justify the closure pursuant to the requirements outlined in 40 CFR § 58.14. Note, closure of the CHS site will not compromise any data collection needed for implementation of the $PM_{2.5}$ NAAQS. In 1999, CHS was the highest design value monitor for the Philadelphia area but the 2010-2012 design value for CHS meets both the annual and 24-hour NAAQS for PM2.5.