

2017-2018 Air Monitoring Network Plan

City of Philadelphia
Department of Public Health
Air Management Services

July 1, 2017

Executive Summary

Philadelphia has an air monitoring network of eleven 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- Camden- Wilmington, 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.ecfr.gov/cgi-bin/text-idx?SID=86f79e0c1262e76604e10118aa3cc0ec&mc=true&node=pt40.6.58&rgn=div5>.

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.

Air monitoring data is submitted to the EPA on a quarterly basis. EPA's AirData website (<http://www.epa.gov/airdata/>) provides access to air quality data collected at the monitors. On May 1st of the current year, AMS certifies the prior year's data. The annual data certification process is outlined in 40 CFR Part 58.15.

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 Appendix A, B, C, D & E:

- 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. **Current Network at a Glance** - This section shows the location of the monitoring sites and the pollutants measured at each site.
4. **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.
5. **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.
6. **Proposed 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.
7. **NCore Monitoring Network** - This section documents the NCore monitoring network codified in 40 CFR Part 58.10(a)(3) and 40 CFR Appendix D section 3.
8. **Pb Monitoring Network** - This section documents the Pb monitoring network codified in 40 CFR Part 58.10(a)(4) and 40 CFR Appendix D section 4.5.
9. **NO₂ Monitoring Network** - This section documents the NO₂ monitoring network codified in 40 CFR Part 58.10(a)(5) and 40 CFR Appendix D section 4.3.
10. **SO₂ Monitoring Network** - This section documents the SO₂ monitoring network codified in 40 CFR Part 58.10(a)(6) and 40 CFR Appendix D section 4.4.
11. **CO Monitoring Network** - This section documents the CO monitoring network codified in 40 CFR Part 58.10(a)(7) and 40 CFR Appendix D section 4.2.
12. **PM_{2.5} Monitoring Network** - This section documents the PM_{2.5} monitoring network codified in 40 CFR Part 58.10(a)(8) and 40 CFR Appendix D section 4.7.
13. **O₃ Monitoring Network** - This section documents the O₃ monitoring network codified in 40 CFR Appendix D section 4.1.
14. **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.

- 15. Appendix A - PAMS Monitoring Implementation Plan Draft**
- 16. Appendix B - Philadelphia Air Quality Survey & Quality Assurance Project Plan**
- 17. Appendix C - US EPA SO₂ Data Requirements Rule Documentation**
 - Includes letters to US EPA and Philadelphia Energy Solutions Ref/PES
- 18. Appendix D - TSP Lead Shutdown at NEW**
- 19. Appendix E - Public notice proof of publication**

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

- **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 ($NO/NO_2/NO_y$), 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 (O₃)**
 - **Sulfur Dioxide (SO₂)**
 - **Carbon Monoxide (CO)**
 - **Nitrogen Dioxide (NO₂)**
 - NO means nitrogen oxide.
 - NO_x means oxides of nitrogen and is defined as the sum of the concentrations of NO₂ and NO.
 - NO_y means the sum of all total *reactive* nitrogen oxides, including NO, NO₂, 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.
 - PM₁₀ means particulate matter with an aerodynamic diameter less than or equal to a nominal 10 micrometers.
 - PM Coarse means particulate matter with an aerodynamic diameter greater than 2.5 micrometers and less than 10 micrometers.
 - Ultrafine Particulate Matter means particulate matter with an aerodynamic diameter less than 0.1 micrometers.
 - **Lead (Pb)**
- **BaP** – means Benzo(a)Pyrene, a polycyclic aromatic hydrocarbon that is a product of incomplete combustion or burning organic (carbon-containing) items.
- **Black Carbon** – Black Carbon is a major component of "soot", a complex and most strongly absorbing component of particulate matter (PM), that is formed by the incomplete combustion of fossil fuels, biofuels, and biomass.
- **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.

- **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. The VOC compounds are analyzed by GC/MS; carbonyls are analyzed by HPLC, and metals by ICP-MS(WV).
- **PAMS 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. These compounds are analyzed by GC-FID.

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 ¹⁴C 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 PM₁₀ 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 PM₁₀ 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 and GC-MS.
- **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. NO₂ 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 SO₂ 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°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°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.
- **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.

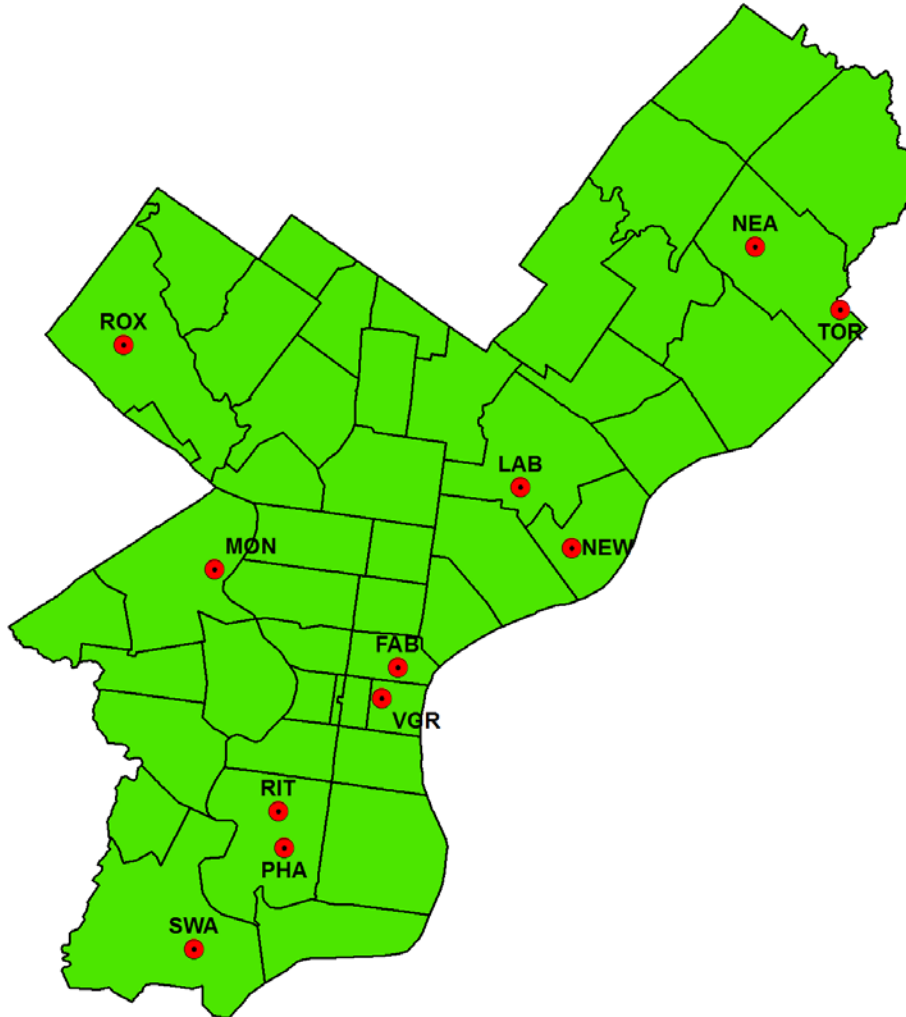
Current Network at a Glance

The City of Philadelphia is served by a network of eleven air monitoring sites located throughout the City that measure the criteria pollutants: ozone (O₃), carbon monoxide (CO), nitrogen dioxide (NO₂), sulfur dioxide (SO₂), particulate matter (PM₁₀ and PM_{2.5}), and lead (Pb). Four 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.

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Figure 1 - 2017 Philadelphia Air Monitoring Network as of July 1, 2017

2017 PHILADELPHIA AIR MONITORING NETWORK



| AQS Site Code | AMS Site | Address | Parameter | | | | | | | | | | | | | | | | AMS Site |
|------------------|-------------|---------------------------|-----------|-----------------|-------|-----------------|--------|-------------------|--------------------------------|-----------|--------------------------------|-----------|----------|-----|---|-------------|-----|---------------------|-------------|
| | | | CO | SO ₂ | Ozone | NO ₂ | NOy/NO | PM _{2.5} | Speciated PM _{2.5} | PM Coarse | Black Carbon / Ultrafine PM | Carbonyls | PAMS VOC | BaP | TSP Metals (Be, Cr, Mn, Ni, As, Cd, Pb) | Toxics TO15 | MET | Comm. Air Toxics | |
| 421010004 | LAB | 1501 E. Lycoming St | | | X | | | X | | | | | | | | | | | LAB |
| 421010014 | ROX | Eva & Dearnley Sts | | | | | | | | | | X | | | | X | | | ROX |
| 421010024 | NEA | Grant Ave & Ashton Rd | | | X | | | | | | | | | | | | | | NEA |
| 421010048 | NEW | 2861 Lewis St | X | X | X | | X | X | X | X | | X | X | | | X | X | | NEW |
| 421010055 | RIT | 24th & Ritner Sts | | X | | | | X | X | | | X | | | X | X | | | RIT |
| 421010057 | FAB | 3rd & Spring Garden Sts | | | | | | X | | | | | | | | | | | FAB |
| 421010063 | SWA | 8200 Enterprise Ave | | | | | | | | | | X | | | | X | | | SWA |
| 421010075 | TOR | 4901 Grant Ave & James St | X | | | X | | X | | | | | | | | | X | | TOR |
| 421010076 | MON | I-76 & Montgomery Drive | X | | | X | | X | | | X | | | X | X | | | | MON |
| | PHA | 3100 Penrose Ferry Rd | | | | | | | | | | | | | | | | X | PHA |
| | VGR | 6th & Arch Sts | | | X | | | X | | | | | | | | | X | | VGR |

7/1/17

Summary of Current Sites

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

State: Pennsylvania

City: Philadelphia

County: Philadelphia

Metropolitan Statistical Area (MSA): Philadelphia – Camden - Wilmington, PA-NJ-DE-MD

MSA number: 37980

Population: 6,069,875 (2015 annual estimate)¹

EPA Region: III, Philadelphia

Class I area: Brigantine Natural Wildlife Preserve near Atlantic City, NJ

City population: 1,567,442 (2015 annual estimate)²

Time zone: EST

UTM zone: 18

DRAFT

¹ MSA population estimates from: <http://www.census.gov/popest/data/metro/totals/2015/index.html>

² Philadelphia County population estimates from:
<http://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t#none>

Table 1 – Site Summary Table

| AQS Site Code | AMS Site | Address | Statement of Purpose |
|----------------------|-----------------|--------------------------------------|--|
| 421010004 | LAB | 1501 E. Lycoming St. | Built in 1964, is a good site to test new or complex monitoring methods as laboratory staff are readily available. |
| 421010014 | ROX | Eva & Dearnley Sts. | Periphery site. |
| 421010024 | NEA | Grant Ave & Ashton Rd. | Periphery site. High Ozone. |
| 421010048 | NEW | 2861 Lewis St. | Originally sited to measure the impact of Franklin Smelting and Refining (now closed), MDC (now closed), and the waste water treatment plant. In 2013, the NCore site was re-located here and in 2017 is a designated PAMS site. |
| 421010055 | RIT | 24 th & Ritner Sts. | 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. |
| 421010057 | FAB | 3 rd & Spring Garden Sts. | 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. |
| 421010063 | SWA | 8200 Enterprise Ave. | 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. |
| 421010075 | TOR | 4901 Grant Ave & James St. | This site was established as the 1 st near-road NO ₂ monitor in the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area . |
| 421010076 | MON | I-76 & Montgomery Drive | This site was established as the 2nd near-road NO ₂ monitor in the Philadelphia-Camden-Wilmington, PA-NJ-DE-MD Metropolitan Statistical Area. |
| | PHA | 3100 Penrose Ferry Road | This site was selected as a Community Scale Air Toxics Monitoring to continuously monitor air toxics pollutants such as benzene and hydrogen fluoride (HF) in the South Philadelphia community, used to evaluate new monitoring technology. |
| | VGR | 6 th & Arch Sts. | EPA's Village Green Air Monitoring Station. Utilizes solar and wind turbine power as energy sources. Sited to increase community awareness of environmental conditions. |

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 the following:

- Maximize the monitoring network to be more efficient (i.e., utilizing continuous equipment to replace filter based equipment, downsize monitoring to reduce overlapping, etc)
 - The agency will re-evaluate the number and monitoring locations for toxics due to decreased EPA funding.
- Improve the understanding of particulate and air toxic pollutants in Philadelphia.
 - The agency plans to pursue negotiations with the port entities in order to implement monitoring and emission inventory efforts in this location.
- Philadelphia Air Quality Survey
 - Set up street-level, neighborhood-oriented air sampling sites throughout the city to sample the air for about two years, and capture the seasonal changes and neighborhood-to-neighborhood spatial variances in air quality.
 - Measure PM_{2.5}, NO₂ (as vehicle emission indicator and ozone precursor), diesel vehicle emissions (using black carbon as indicator), and residual oil burning (using indicators such as SO₂, nickel and vanadium).
 - Obtain quality assured and reliable data results that can serve as basis for future work; provide policy recommendations for reducing pollution from congested city traffic, diesel vehicles and winter time fuel burning.

Proposed Changes to the Network

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

- March 2017 – December 2018
 - MON
 - Added CO monitor as of 1/10/17.
 - LAB
 - CO monitor to be shutdown as of 7/1/17.
 - NO, NO_y, & NO₂ monitors to be shutdown as of 7/1/17.
 - Shut down Carbonyls and Toxics monitors as of 10/1/16.
 - NEW
 - Added Carbonyls and Toxics monitors as of 10/21/16.
 - PAMS has been moved from LAB to NEW as of 3/1/17.
 - TSP Lead
 - TSP Lead is shutdown at NEW as of 12/31/16.
 - Philadelphia Air Quality Survey
 - Set up street-level, neighborhood-oriented air sampling sites throughout the city to sample the air for about two years, and capture the seasonal changes and neighborhood-to-neighborhood spatial variances in air quality.
 - Measure PM_{2.5}, NO₂ (as vehicle emission indicator and ozone precursor), diesel vehicle emissions (using black carbon as indicator), and residual oil burning (using indicators such as SO₂, nickel and vanadium) .
 - AMS plans to establish a monitoring site (PAC) near the Port of Philadelphia.
 - A monitor to measure PM_{2.5}, toxics, carbonyls, and metals will be placed to assess the river port.

NCore Monitoring Network

The requirements for the NCore air monitoring network are codified in 40 CFR Part 58.10(a)(3) and 40 CFR Part 58 Appendix D section 3.

The NCore station is located at NEW.

The recently revised monitoring rule (80 FR 65292; October 26, 2015) requires PAMS measurements June 1 through August 31 at NCore sites that are located in Core-Based Statistical Areas (CBSAs) with populations of 1,000,000 or more as codified in 40 CFR 58 Appendix D section 5(a).

PAMS has been moved from LAB to NEW as of 3/1/17.

DRAFT

Pb Monitoring Network

The requirements for the Pb air monitoring network are codified in 40 CFR Part 58.10(a)(4) and 40 CFR Part 58 Appendix D section 4.5.

Philadelphia County has no source oriented Pb sources that emit 0.50 or more tons per year.

TSP Lead has been shutdown at NEW as of 12/31/16. The procedures and waiver letter requesting this shutdown can be found in Appendix D.

DRAFT

NO₂ Monitoring Network

The requirements for the NO₂ air monitoring network are codified in 40 CFR Part 58.10(a)(5) and 40 CFR Part 58 Appendix D section 4.3.

AMS currently operates an NO₂ monitor that meets the area-wide monitoring requirements. The first near-road NO₂ monitor was established at TOR and started operation on January 1, 2014. The second near-road NO₂ monitor is located at MON and started operation on July 20, 2015.

DRAFT

SO₂ Monitoring Network

The requirements for the SO₂ air monitoring network are codified in 40 CFR Part 58.10(a)(6) and 40 CFR Part 58 Appendix D section 4.4.

Based on the PWEI, two monitors are required for the Philadelphia-Camden-Wilmington, PA-NJDE-MD CBSA. There are two NCore monitors in the Philadelphia CBSA that meet the monitoring requirements. Philadelphia County currently operates two SO₂ monitors.

SO₂ Data Requirements Rule

On August 21, 2015, US EPA published the SO₂ Data Requirements Rule (DRR) in the Federal Register (80 FR 51052). US EPA developed the SO₂ DRR to address the need for additional air quality data to be used for implementing the must follow to gather air quality data and information in areas around large SO₂ sources, where currently-available data is insufficient to characterize the area as in attainment or nonattainment of the SO₂ NAAQS.

This final rule establishes that, at a minimum, air agencies must characterize air quality around sources that emit 2,000 tons per year (tpy) or more of SO₂, using either modeling of actual source emissions or using appropriately sited ambient air quality monitors. Alternately, an air agency may avoid the requirement for air quality characterization near a source by adopting enforceable emission limits that ensure that the source will not emit more than 2,000 tpy of SO₂³. Under the SO₂ DRR, air agencies will provide additional air quality data characterizing 1-hour peak concentrations and source-oriented impacts.

The procedures to satisfy SO₂ DRR requirements, along with the mandated deadlines are attached in Appendix C.

On January 15, 2016, the Pennsylvania Department of Environmental Protection (PADEP) submitted to the US EPA, a list of SO₂ emitting sources in the Commonwealth which will undergo "air quality characterization" as required under the SO₂ DRR. This list of facilities was updated on March 9, 2016, via a letter from PADEP to US EPA. These facilities and the original letters are attached in Appendix A. In order to determine the list of facilities, the PADEP utilized the 2014 actual SO₂ emission inventory. The SO₂ facilities listed either (1) had 2014 emission rates over 2,000 tpy, or (2) are located in proximity to other SO₂ sources, such that the combined emission from the cluster of sources have the potential to exceed the SO₂ NAAQS.

In a letter dated January 28, 2016, PADEP advised Philadelphia Energy Solutions Ref/PES (PES) as being identified as a large source of SO₂ emissions according to the criteria outlined in the SO₂ DRR. PES was identified as a cluster of facilities (including Exelon Power Generation Company/Eddystone, Kimberly-Clark PA LLC, and Convanta Delaware Valley LP – all located in Delaware County, PA) with cumulative 2014 actual emissions greater than or equal to 2000 tpy and was also identified to be located within 5 kilometers of an environmental justice community. Based on the 2014 emission inventory, PES had SO₂ emissions of 355 tpy.

³ Fact Sheet, Final Data Requirements Rule for the 2010 1-Hour Sulfur Dioxide (SO₂) Primary National Ambient Air Quality Standard (NAAQS), EPA, http://www3.epa.gov/airquality/sulfurdioxide/pdfs/so2_drr_fs_081215.pdf

The SO₂ DRR requires PADEP to indicate to US EPA by July 1, 2016 whether it will complete its "air quality characterization" by air quality modeling, ambient air monitoring or a federally enforceable emission limitation that will keep the facility wide emission limit below the 2000 tpy threshold.

In December 2016, PES submitted air dispersion modeling to demonstrate their model results are below the 1-hour SO₂ NAAQS and the three(3) ppb significant impact level (SIL) of the 1-hour SO₂ NAAQS for the SO₂ DRR. The modeling analysis and results are currently being reviewed by PADEP.

DRAFT

CO Monitoring Network

The requirements for the CO air monitoring network are codified in 40 CFR Part 58.10(a)(7) and 40 CFR Part 58 Appendix D section 4.2.

The Philadelphia-Camden-Wilmington, PA-NJ-DE-MD CBSA has a CO monitor collocated with the near-road NO₂ monitor at TOR and has been operational since January 1, 2014.

DRAFT

PM_{2.5} Monitoring Network

The requirements for the PM_{2.5} air monitoring network are codified in 40 CFR Part 58.10(a)(8) and 40 CFR Part 58 Appendix D section 4.7.

The requirement for at least one PM_{2.5} monitor to be collocated at a near-road NO₂ station for CBSAs with a population of 1,000,000 or more persons is met at the TOR monitoring site.

DRAFT

O₃ Monitoring Network

The requirements for the O₃ air monitoring network are codified in 40 CFR Part 58 Appendix D section 4.1.

AMS currently operates three O₃ monitors.

PAMS Monitoring Implementation Plan

The Photochemical Assessment Monitoring Station (PAMS) program (required by the Clean Air Act requires areas to collect enhanced ambient air measurements related to ozone. The rulemaking for the final 2015 ozone NAAQS included significant revisions to PAMS requirements (80 FR 65292; October 26, 2015).

Philadelphia Air Management Services formerly operated one Photochemical Assessment Monitoring Stations (PAMS) site in the air monitoring network in 2016, at the LAB site. However, the recently revised monitoring rule (80 FR 65292; October 26, 2015) requires PAMS measurements June 1 through August 31 at NCore sites that are located in Core-Based Statistical Areas (CBSAs) with populations of 1,000,000 or more.

As a result, PAMS site at the LAB has been moved to the NCore site NEW as of 3/1/17 as per 40 CFR 58 Appendix D section 5.

A draft of the PAMS Monitoring Implementation Plan has been submitted as part of this 2017-2018 Air Monitoring Network Plan located in Appendix A.

Enhanced Monitoring Plan

Enhanced Monitoring Plans (EMP) are required as per 40 CFR 58 Appendix D section 5. to be developed and implemented by monitoring agencies with moderate and (above) 8-hour ozone nonattainment areas and states that fall under the Ozone Transport Region which AMS currently does. Draft EMPs should be submitted to EPA Regional office by May 1, 2018. The Final EMP shall be submitted to the EPA Regional Administrator no later than October 1, 2019 or two years following the effective date of a designation to a classification of Moderate or above O₃ nonattainment, whichever is later. At a minimum, the EMP shall be reassessed and approved as part of the 5-year network assessments required under 40 CFR 58.10(d). The EMP will include monitoring activities deemed important to understanding the O₃ problems in the state. Such activities may include, but are not limited to, the following:

- (1) Additional O₃ monitors beyond the minimally required under paragraph 4.1 of 40 CFR 58 Appendix D.
- (2) Additional NO_x or NO_y monitors beyond those required under 4.3 of 40 CFR 58 Appendix D.

(3) Additional speciated VOC measurements including data gathered during different periods other than required under paragraph 5(g) of 40 CFR 58 Appendix D, or locations other than those required under paragraph 5(a) of 40 CFR appendix D,

and

(4) Enhanced upper air measurements of meteorology or pollution concentrations

DRAFT

Detailed Information on Each Site

The tables that follow provide detailed information for each of the 11 monitoring stations in Philadelphia County. As per 40 CFR § 58.10(a)(1), the siting and operation of each monitor in the 2017-2018 Plan meets the requirements of 40 CFR 58 and Appendices A, C, D, and E of this part where applicable.

DRAFT

Table 2 Detailed LAB Information with Monitoring Station Picture

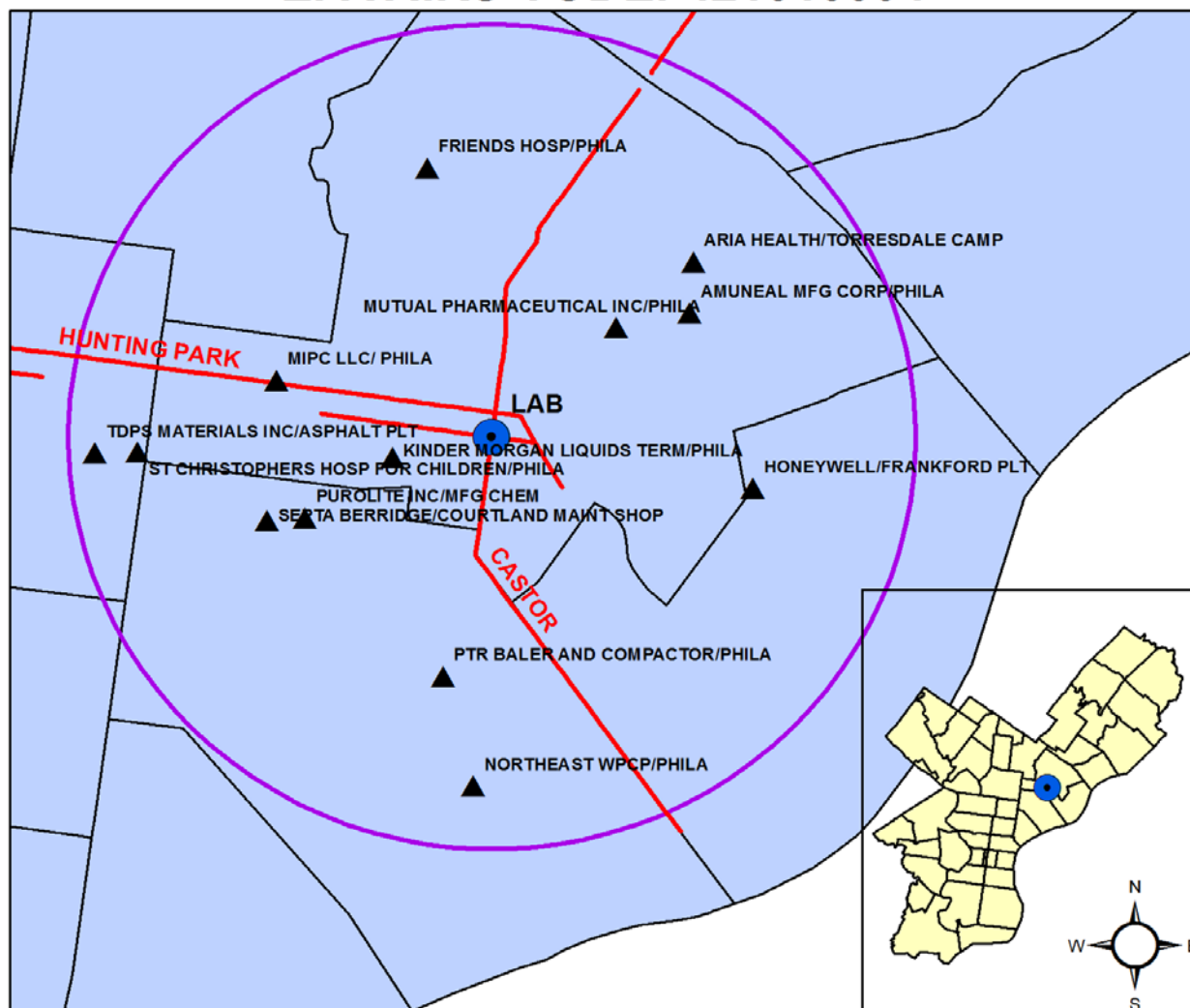
AMS SITE ID: LAB
 AQS Site ID: 421010004
 Street Address: 1501 E. Lycoming Street, 19124
 Geographical Coordinates
 Latitude: 40.008889
 Longitude: -75.09778



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------|-----------------|-----------------------------|--------------------|-------------------|------------------------|----------------------|----------------|-----|------------|---------------|----------------------|------------------|------------|
| Ozone | SLAMS | PAMS | Continuous | Instrumental | Ultraviolet Absorption | Year-round operation | 44201 | 1 | 087 | Neighborhood | Population Exposure | 7 | 1/1/1974 |
| PM2.5 FRM | SLAMS | | 1/3 days | R&P PM2.5 | Gravimetric | | 88101 | 1 | 145 | Neighborhood | Population Exposure | 7 | 7/1/2014 |
| PM2.5 FRM | SLAMS | | 1/3 days | R&P PM2.5 | Gravimetric | | 88101 | 2 | 145 | Neighborhood | Population Exposure | 7 | 1/1/2011 |

Figure 2 – LAB Monitoring Site Map with Major Streets and Major Emission Sources

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



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|---|-----------------------|-----------------------|-------|--------|-------|-------|-------|--------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101416 | TDPS MATERIALS INC/ASPHALT PLT | 3870 N 2ND ST | 0.0000 | 6.81 | 1.35 | 1.27 | 0.20 | 0.18 | 1.66 |
| 4210101551 | HONEYWELL/FRANKFORD PLT | 4700 BERMUDA ST | 0.0000 | 67.37 | 282.93 | 67.69 | 53.91 | 40.90 | 107.92 |
| 4210101617 | PUROLITE INC/MFG CHEM | 3620 G ST | 0.0000 | 2.14 | 2.55 | 0.19 | 0.19 | 0.02 | 2.34 |
| 4210102258 | MUTUAL PHARMACEUTICAL INC/PHILA | 1100 ORTHODOX ST | 0.0000 | 1.18 | 1.40 | 0.11 | 0.00 | 0.01 | 1.71 |
| 4210103506 | PTR BALER AND COMPACTOR/PHILA | 2207 E ONTARIO ST | 0.0000 | 0.08 | 0.10 | 0.01 | 0.01 | 0.00 | 15.16 |
| 4210104172 | SEPTA BERRIDGE/COURTLAND MAINT SHOP | 200 W WYOMING AVE | 0.0000 | 1.51 | 3.69 | 4.36 | 4.36 | 0.01 | 4.55 |
| 4210105003 | KINDER MORGAN LIQUIDS TERM/PHILA | 3300 N DELAWARE AVE | 0.0000 | 4.58 | 4.97 | 0.35 | 0.27 | 0.04 | 39.52 |
| 4210105004 | MIPC LLC/ PHILA | 4210 G ST | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 14.01 |
| 4210108031 | FRIENDS HOSP/PHILA | 4641 ROOSEVELT BLVD | 0.0000 | 1.82 | 2.20 | 0.17 | 0.17 | 0.02 | 0.12 |
| 4210108076 | ARIA HEALTH/TORRESDALE CAMP | RED LION & KNIGHTS RD | 0.0000 | 2.96 | 4.32 | 0.32 | 0.00 | 0.09 | 0.27 |
| 4210108576 | ST CHRISTOPHERS HOSP FOR CHILDREN/PHILA | ERIE AVE & FRONT ST | 0.0000 | 2.97 | 4.52 | 0.34 | 0.34 | 0.11 | 0.28 |
| 4210109513 | NORTHEAST WPCP/PHILA | 3899 RICHMOND ST | 0.0000 | 3.75 | 7.67 | 1.48 | 1.48 | 2.13 | 13.25 |
| 42101T0034 | AMUNEAL MFG CORP/PHILA | 4737 DARRAH ST | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 |

Figure 3 – LAB North Aerial View



Table 3 Detailed ROX Information with Monitoring Station Picture

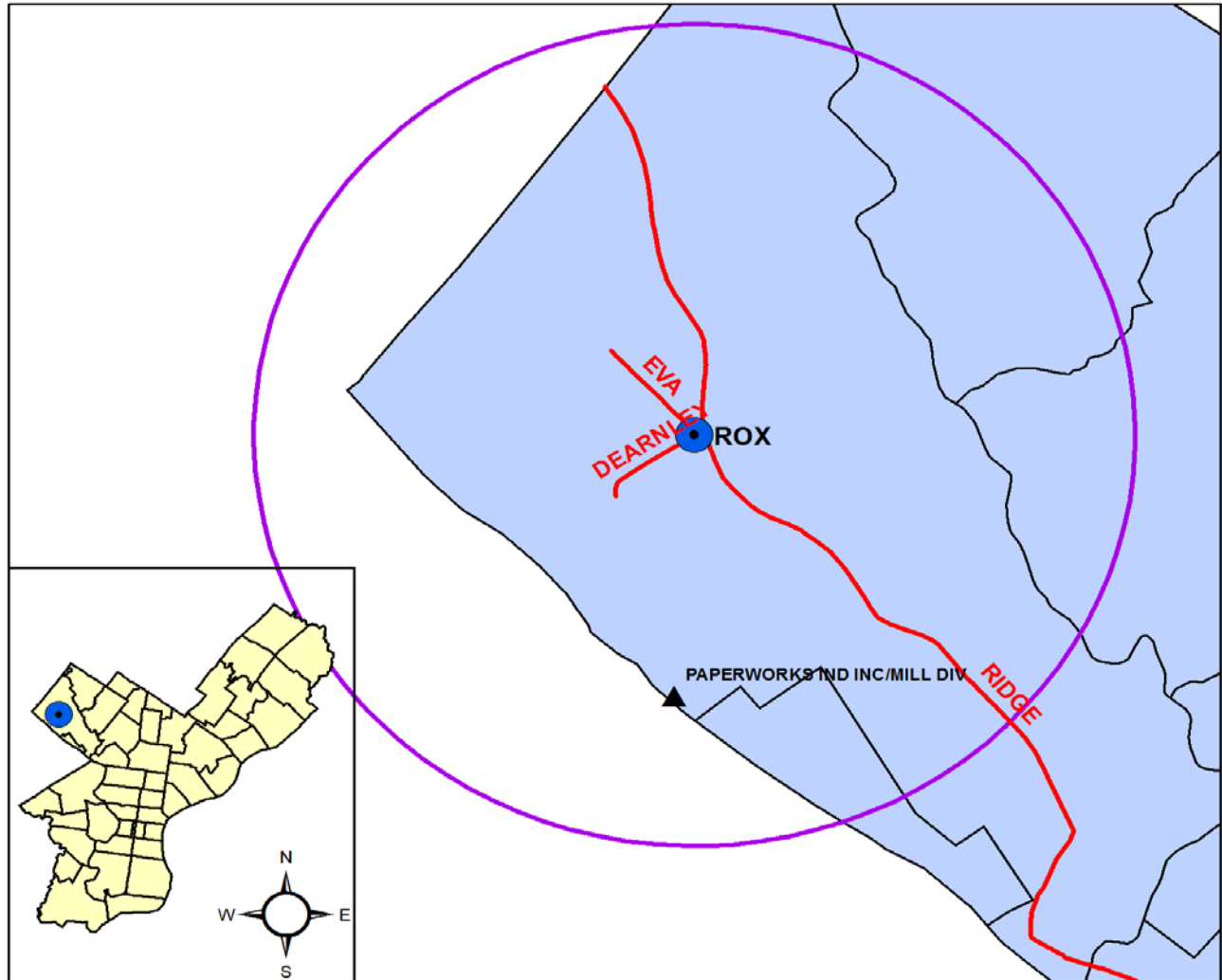
| |
|--|
| AMS SITE ID: ROX |
| AQS Site ID: 421010014 |
| Street Address: EVA & Dearnley Streets |
| Geographical Coordinates |
| Latitude: 40.049604 |
| Longitude: -75.241209 |



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------|-----------------|-----------------------------|--------------------|------------------------------|-------------------|----------|----------------|-----|------------|---------------|-----------------------|------------------|------------|
| Carbonyls | Other | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | HPLC | | Vary | 2 | 102 | Neighborhood | Highest Concentration | 7 | 5/7/2003 |
| Toxics | Other | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | Vary | 4 | 150 | Neighborhood | Highest Concentration | 7 | 1/1/2004 |

Figure 4 – ROX Monitoring Site Map with Major Streets and Major Emission Sources

ROXBOROUGH - EVA & DEARNLEY STS. EPA AIRS CODE: 421010014



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|-----------------------------|-------------------|-----------------------|-------|--------|------|-------|------|-------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101566 | PAPERWORKS IND INC/MILL DIV | 5000 FLAT ROCK RD | 0.0004 | 47.34 | 100.56 | 4.29 | 4.29 | 0.34 | 15.65 |

Figure 5 – ROX North Aerial View

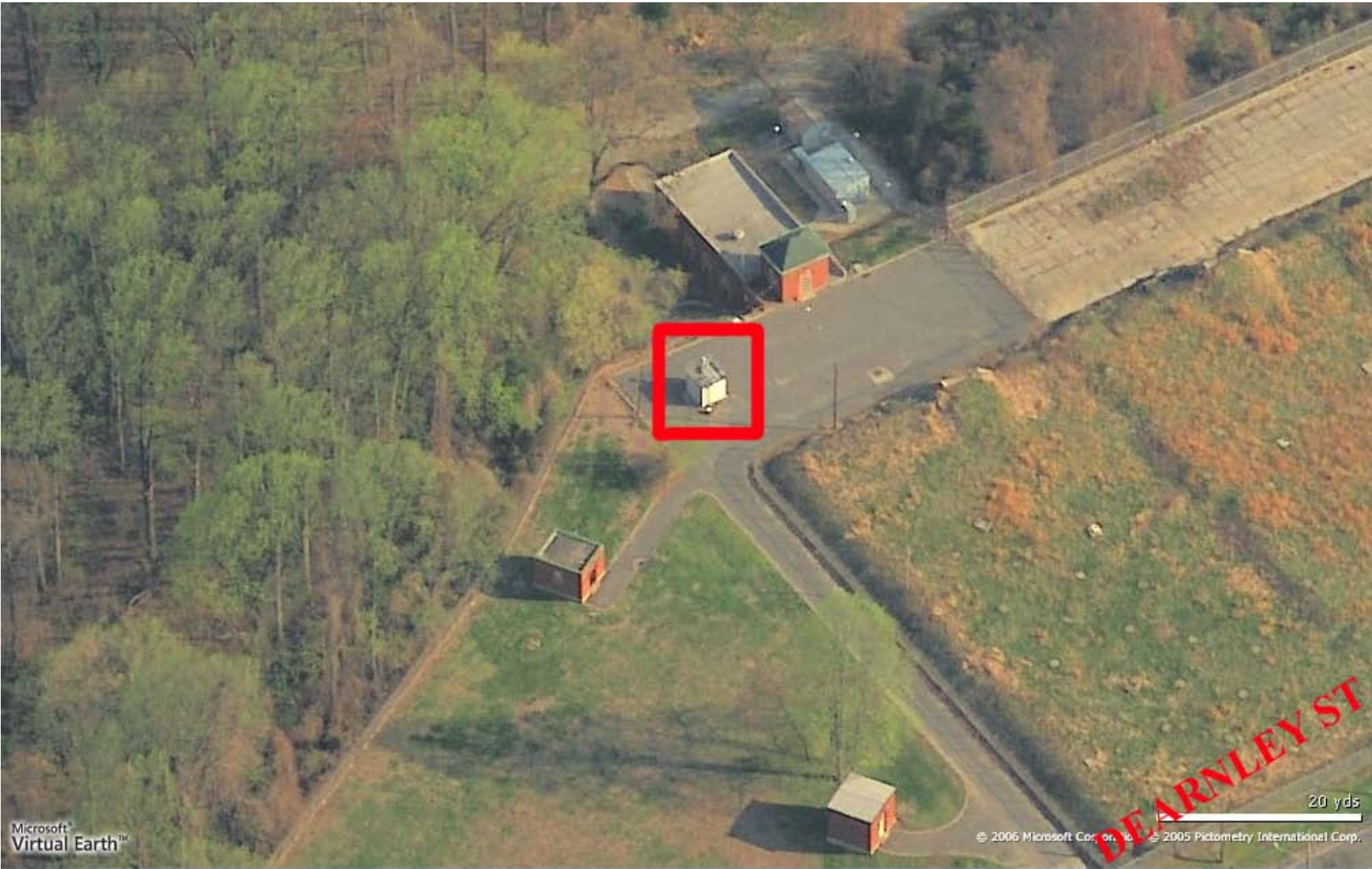


Table 4 Detailed NEA Information with Monitoring Station Picture

AMS SITE ID: NEA
 AQS Site ID: 421010024
 Street Address: Grant Ave & Ashton Rd
 Geographical Coordinates
 Latitude: 40.076389
 Longitude: -75.011944



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------|-----------------|-----------------------------|--------------------|-------------------|------------------------|----------------------|----------------|-----|------------|---------------|-----------------------|------------------|------------|
| Ozone | SLAMS | | Continuous | Instrumental | Ultraviolet Absorption | Year-round operation | 44201 | 1 | 087 | Neighborhood | Highest concentration | 6 | 1/1/1974 |

Figure 6 – NEA Monitoring Site Map with Major Streets and Major Emission Sources

NORTHEAST AIRPORT - GRANT AVE & ASHTON RD. EPA AIRS CODE: 421010024



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|------------------------------------|----------------------|-----------------------|------|------|------|-------|------|-------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101591 | PERFECSEAL/BUSTLETON FAC | 9800 BUSTLETON AVE | 0.0000 | 1.61 | 1.92 | 0.11 | 0.04 | 0.01 | 7.85 |
| 4210102030 | RYDER TRUCK RENTAL INC/BUEGRASS RD | 9751 BLUE GRASS RD | 0.0000 | 0.06 | 0.28 | 0.05 | 0.01 | 0.00 | 0.26 |
| 4210103363 | ALLIED TUBE & CONDUIT CORP/NORCOM | 11350 NORCOM RD | 0.0204 | 0.73 | 0.87 | 1.69 | 1.69 | 0.01 | 28.84 |
| 4210103846 | NATL PUB CO/ROOSEVELT BLVD | 11311 ROOSEVELT BLVD | 0.0000 | 0.51 | 0.72 | 0.02 | 0.02 | 0.00 | 3.46 |
| 4210108008 | NAZARETH HOSP/PHILA | 2601 HOLME AVE | 0.0000 | 2.06 | 2.82 | 0.21 | 0.21 | 0.04 | 0.15 |

Figure 7 – NEA North Aerial View



Table 5 Detailed NEW information with Monitoring Station Picture

AMS SITE ID: NEW

Street Address: 2861 Lewis Street

Geographical Coordinates

Latitude: 39.991389

Longitude: -75.080833

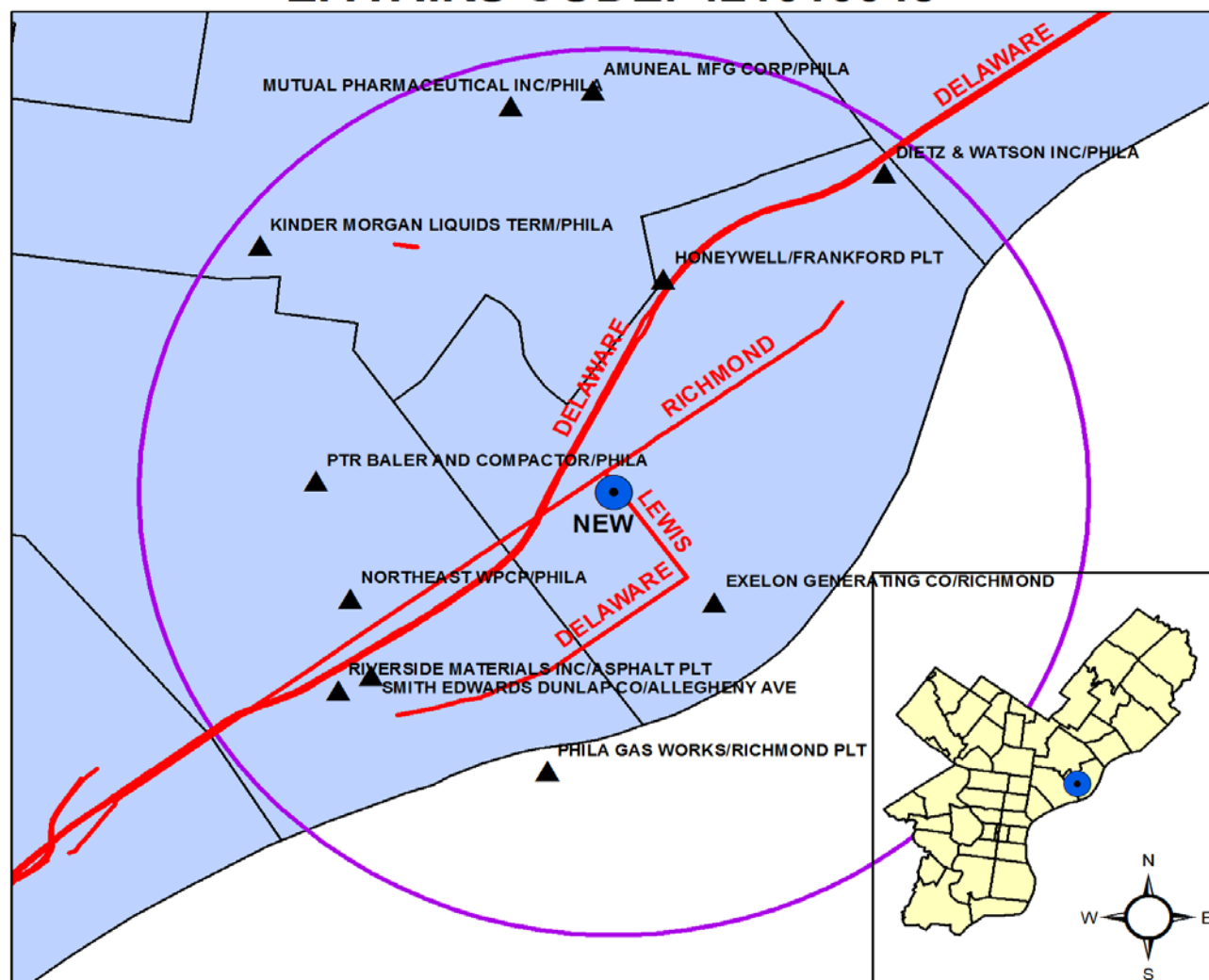


| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|------------------|-----------------|-----------------------------|--------------------|----------------------|--|--|----------------|-----|------------|---------------|----------------------|------------------|-------------------------|
| CO (trace) | SLAMS | NCORE/PAMS | Continuous | Instrumental | Gas Filter Correlation CO Analyzer | High sensitivity | 42101 | 1 | 093 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| SO2 (trace) | SLAMS | NCORE | Continuous | Instrumental | Ultraviolet Fluorescence | High sensitivity | 42401 | 2 | 100 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| Ozone | SLAMS | NCORE/PAMS | Continuous | Instrumental | Ultraviolet Absorption | Year-round operation | 44201 | 1 | 087 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| NO | SLAMS | NCORE/PAMS | Continuous | Instrumental | Chemiluminescence Teledyne | High sensitivity external converter mounted at 10m | 42601 | 1 | 099 | Neighborhood | Population Exposure | 10 | 1/1/2011, moved 10/2/13 |
| NOy | SLAMS | NCORE | Continuous | Instrumental | Chemiluminescence Teledyne | High sensitivity external converter mounted at 10m | 42600 | 1 | 699 | Neighborhood | Population Exposure | 10 | 1/1/2011, moved 10/2/13 |
| PM10 Continuous | SLAMS | NCORE | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | 81102 | 1 | 122 | Neighborhood | Population Exposure | 2 | 2/20/2007 |
| PM2.5 Continuous | SLAMS | NCORE | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | 88101 | 3 | 170 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| PM2.5 Speciated | SLAMS | NCORE, CSN | 1/3 days | URG and Met One SASS | Energy Dispersive XRF | Analysis by EPA | Vary | 5 | 811 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |

| | | | | | | | | | | | | | |
|---------------------------|-------|------------------|--|--|---|--|-------|---|------|--------------|---------------------|------|-------------------------|
| PM2.5 FRM | SLAMS | NCORE | 1/3 days | R&P PM2.5 | Gravimetric | NEW-D | 88101 | 1 | 145 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| *PM10 - PM2.5 (PM Coarse) | SLAMS | NCORE | 1/3 days | Thermo Scientific Partisol-Plus Model 2025 Sequential Sampler Pair | Paired Gravimetric | NEW-S minus NEW-D is PM Coarse | 86101 | 1 | 176 | Neighborhood | Population Exposure | 2 | 1/1/2011, moved 10/2/13 |
| Carbonyls | Other | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | HPLC | Sampled for four 3-hour periods every 3rd day during PAMS season | Vary | 2 | 102 | Neighborhood | Population Exposure | 7 | 10/14/2016 |
| Toxics | Other | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | Vary | 3 | 150 | Neighborhood | Population Exposure | 7 | 10/14/2016 |
| Meteorological | SLAMS | NCORE | Continuous | | Air quality measurements approved instrumentation for wind speed, wind direction, humidity, barometric pressure, rainfall and solar radiation | | Vary | 1 | Vary | Neighborhood | Population Exposure | Vary | 6/1/1993 |
| PAMS VOC | SLAMS | PAMS | 1/6 days (April, May, Sept, and Oct) - 24-Hr Real Time | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | Vary | 2 | 101 | Neighborhood | Source-Oriented | 7 | Vary |
| | | | 1/6 days (April-Oct) - 24-Hr Collocated | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | Vary | 5 | 101 | Neighborhood | Source-Oriented | 7 | Vary |
| | | | Daily from June-Aug, with sample every 3 hrs - 3-Hr Real Time (Continuous) | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | Vary | 1 | 101 | Neighborhood | Source-Oriented | 7 | Vary |
| | | | 1/6 days (Jun -Aug) - 3-Hr Collocated | SS Canister Pressurized | Cryogenic Preconcentration GC/FID | | Vary | 4 | 101 | Neighborhood | Source-Oriented | 7 | Vary |

Figure 8 – NEW Monitoring Site Map with Major Streets and Major Emission Sources

NORTHEAST WASTE - 2861 LEWIS ST. EPA AIRS CODE: 421010048



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|---------------------------------------|----------------------|-----------------------|-------|--------|-------|-------|-------|--------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101421 | RIVERSIDE MATERIALS INC/ASPHALT PLT | 2870 E ALLEGHENY AVE | 0.0000 | 23.92 | 4.95 | 6.28 | 4.82 | 0.61 | 8.65 |
| 4210101551 | HONEYWELL/FRANKFORD PLT | 4700 BERMUDA ST | 0.0000 | 67.37 | 282.93 | 67.69 | 53.91 | 40.90 | 107.92 |
| 4210102094 | DIETZ & WATSON INC/PHILA | 5701 TACONY ST | 0.0000 | 5.65 | 3.49 | 0.52 | 0.51 | 0.11 | 0.38 |
| 4210102255 | SMITH EDWARDS DUNLAP CO/ALLEGHENY AVE | 2867 E ALLEGHENY AVE | 0.0000 | 0.12 | 0.15 | 0.01 | 0.01 | 0.02 | 3.84 |
| 4210102258 | MUTUAL PHARMACEUTICAL INC/PHILA | 1100 ORTHODOX ST | 0.0000 | 1.18 | 1.40 | 0.11 | 0.00 | 0.01 | 1.71 |
| 4210103506 | PTR BALER AND COMPACTOR/PHILA | 2207 E ONTARIO ST | 0.0000 | 0.08 | 0.10 | 0.01 | 0.01 | 0.00 | 15.16 |
| 4210104903 | EXELON GENERATING CO/RICHMOND | 3901 N DELAWARE AVE | 0.0011 | 0.27 | 51.23 | 1.50 | 0.31 | 7.97 | 0.03 |
| 4210104922 | PHILA GAS WORKS/RICHMOND PLT | 3100 E VENANGO ST | 0.0000 | 10.07 | 5.95 | 0.24 | 0.20 | 0.03 | 0.20 |
| 4210105003 | KINDER MORGAN LIQUIDS TERM/PHILA | 3300 N DELAWARE AVE | 0.0000 | 4.58 | 4.97 | 0.35 | 0.27 | 0.04 | 39.52 |
| 4210109513 | NORTHEAST WPCP/PHILA | 3899 RICHMOND ST | 0.0000 | 3.75 | 7.67 | 1.48 | 1.48 | 2.13 | 13.25 |
| 42101T0034 | AMUNEAL MFG CORP/PHILA | 4737 DARRAH ST | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 |

Figure 9 – NEW North Aerial View



Table 6 Detailed RIT Information with Monitoring Station Picture

AMS SITE ID: RIT

Street Address: 24th & Ritner Streets

Geographical Coordinates

Latitude: 39.922867

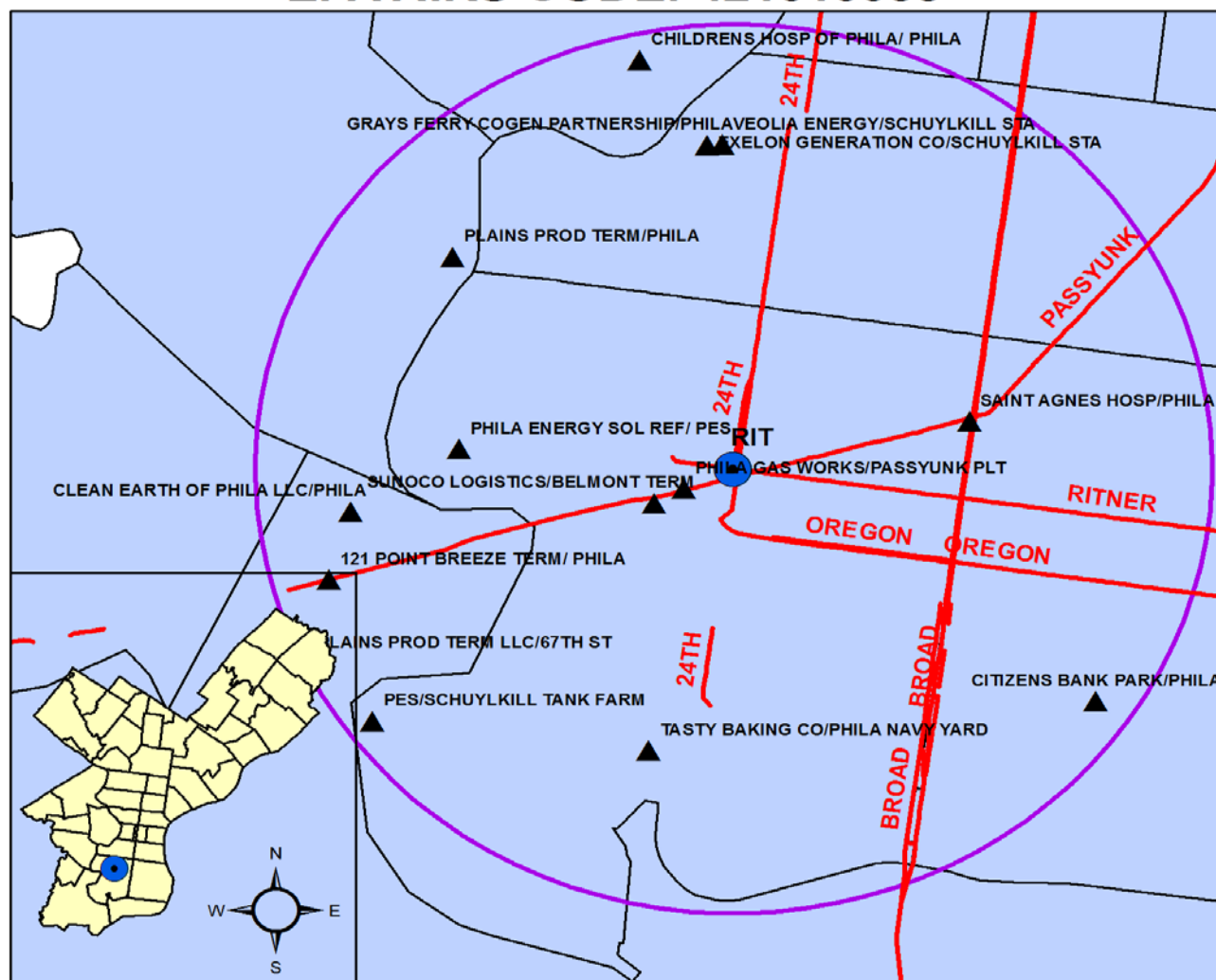
Longitude: -75.186921



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|------------------|-----------------|-----------------------------|--------------------|------------------------------|--|--|----------------|-----|------------|---------------|-----------------------|------------------|------------|
| SO2 | SLAMS | | Continuous | Instrumental | Ultraviolet Fluorescence | | 42401 | 1 | 100 | Neighborhood | Population Exposure | 4 | 11/9/2004 |
| PM2.5 Speciated | SLAMS | CSN | 1/3 days | URG and Met One SASS Teflon | Energy Dispersive XRF | Analysis by EPA | 88502 | 5 | 811 | Neighborhood | Population Exposure | N/A | 9/1/2005 |
| Metals | Other | | 1/6 days | Hi-Vol | ICP-MS | Analysis by WV (TSP sampler with quartz) | Vary | 1 | 089 | Neighborhood | Population Exposure | 7 | 8/31/2004 |
| Carbonyls | Other | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | HPLC | | Vary | 2 | 102 | Neighborhood | Highest Concentration | 7 | Vary |
| Toxics | Other | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | Vary | 4 | 150 | Neighborhood | Highest Concentration | 7 | 11/1/2004 |
| PM2.5 Continuous | SLAMS | | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | 88101 | 3 | 170 | Neighborhood | Population Exposure | 4 | 6/1/2011 |

Figure 10 – RIT Monitoring Site Map with Major Streets and Major Emission Sources

RITNER - 24TH & RITNER STS. EPA AIRS CODE: 421010055



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|-------------------------------------|--------------------------|-----------------------|---------|---------|--------|--------|--------|--------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101501 | PHILA ENERGY SOL REF/ PES | 3144 W PASSYUNK AVE | 0.0137 | 1326.28 | 1372.55 | 482.93 | 477.58 | 363.02 | 780.36 |
| 4210101507 | SUNOCO LOGISTICS/BELMONT TERM | 2700 W PASSYUNK AVE | 0.0000 | 24.31 | 9.74 | 0.30 | 0.00 | 0.10 | 32.33 |
| 4210101517 | PES/SCHUYLKILL TANK FARM | 3144 W PASSYUNK AVE | 0.0000 | 0.86 | 0.23 | 0.00 | 0.00 | 0.00 | 80.80 |
| 4210102148 | CLEAN EARTH OF PHILA LLC/PHILA | 3201 S 61ST ST | 0.0000 | 0.01 | 0.04 | 0.45 | 0.08 | 0.04 | 5.63 |
| 4210104904 | EXELON GENERATION CO/SCHUYLKILL STA | 2800 CHRISTIAN ST | 0.0000 | 0.46 | 3.46 | 0.18 | 0.02 | 0.12 | 0.02 |
| 4210104921 | PHILA GAS WORKS/PASSYUNK PLT | 3100 W PASSYUNK AVE | 0.0000 | 2.36 | 3.90 | 0.29 | 0.22 | 0.11 | 0.21 |
| 4210104942 | VEOLIA ENERGY/SCHUYLKILL STA | 2600 CHRISTIAN ST | 0.0004 | 3.27 | 53.30 | 2.58 | 2.58 | 9.73 | 0.25 |
| 4210104944 | GRAYS FERRY COGEN PARTNERSHIP/PHILA | 2600 CHRISTIAN ST | 0.0011 | 5.41 | 254.70 | 24.23 | 24.23 | 5.15 | 11.42 |
| 4210105009 | PLAINS PROD TERM/PHILA | 1630 S 51ST ST | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 1.52 |
| 4210105013 | PLAINS PROD TERM LLC/67TH ST | 6850 ESSINGTON AVE | 0.0000 | 1.71 | 2.03 | 0.12 | 0.12 | 0.01 | 49.56 |
| 4210108016 | SAINT AGNES HOSP/PHILA | 1930 S BROAD ST | 0.0000 | 1.45 | 1.93 | 0.15 | 0.15 | 0.03 | 0.11 |
| 4210108069 | CHILDRENS HOSP OF PHILA/ PHILA | 34TH & CIVIC CENTER BLVD | 0.0000 | 14.33 | 31.12 | 2.80 | 2.80 | 1.20 | 2.56 |
| 4210110029 | 121 POINT BREEZE TERM/ PHILA | 6310 PASSYUNK AVE | 0.0000 | 1.75 | 0.73 | 0.03 | 0.03 | 0.01 | 12.23 |
| 4210110236 | TASTY BAKING CO/PHILA NAVY YARD | 4300 S 26TH ST | 0.0000 | 2.75 | 3.27 | 0.31 | 0.28 | 0.00 | 0.32 |
| 4210110147 | CITIZENS BANK PARK/PHILA | 1001 PATTISON AVE | 0.0000 | 5.20 | 3.67 | 0.22 | 0.00 | 0.02 | 1.01 |

Figure 11 – RIT North Aerial View



Table 7 Detailed FAB Information with Monitoring Station Picture

AMS SITE ID: FAB

Street Address: 3rd and Spring Garden Sts.

Geographical Coordinates

Latitude: 39.960048

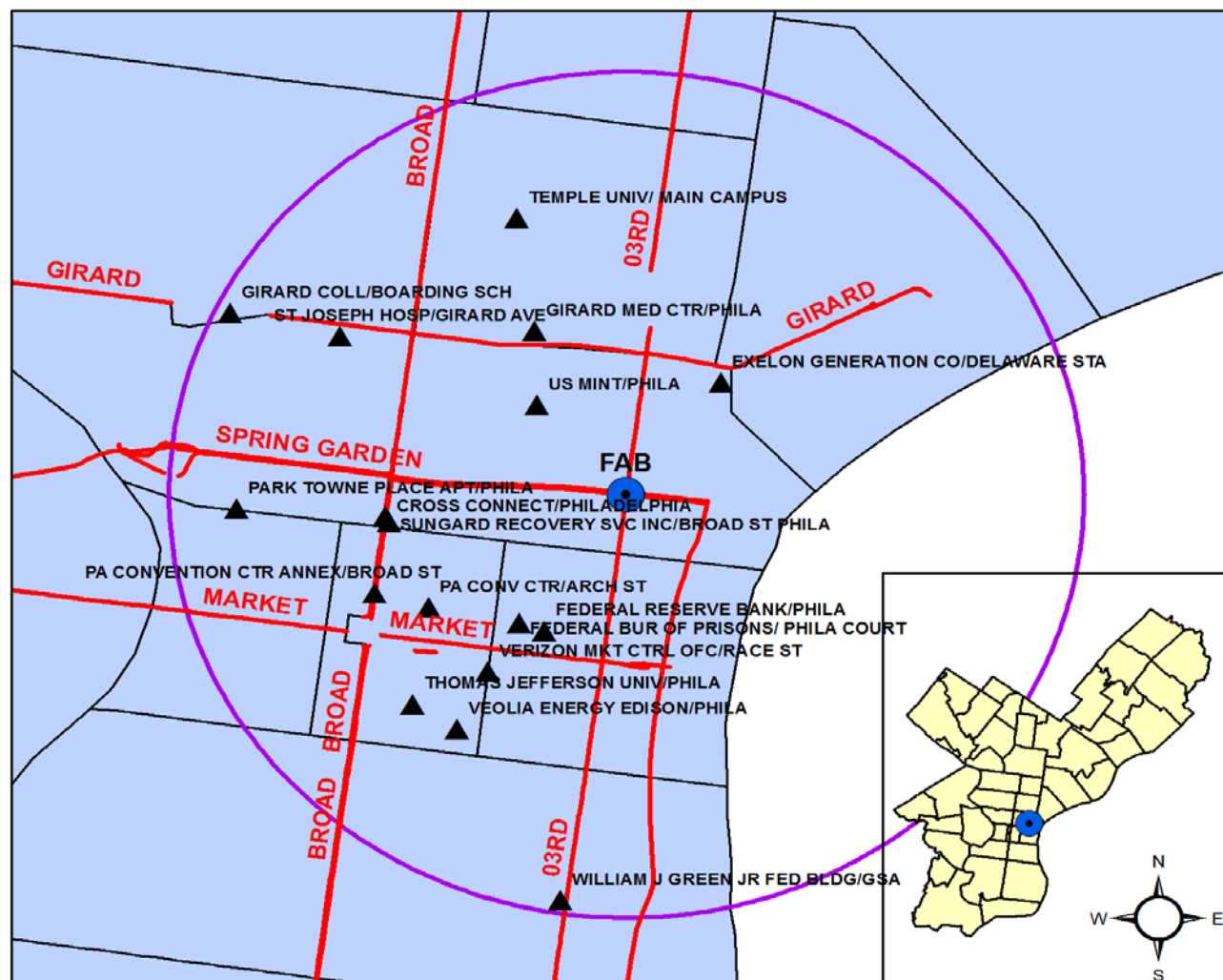
Longitude: -75.142614



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|------------------|-----------------|-----------------------------|--------------------|-------------------|---|----------|----------------|-----|------------|---------------|-----------------------|------------------|------------|
| PM2.5 Continuous | SLAMS | | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM -1020 | | 88101 | 3 | 170 | Neighborhood | Highest Concentration | 2 | 10/1/2012 |

Figure 12 – FAB Monitoring Site Map with Major Streets and Major Emission Sources

FIRE ADMINISTRATION BUILDING - 3RD & SPRING GARDEN STS. EPA AIRS CODE: 421010057



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|---|-----------------------------|-----------------------|-------|-------|------|-------|-------|------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101014 | VERIZON MKT CTRL OFC/RACE ST | 900 RACE ST | 0.0000 | 0.27 | 2.30 | 0.20 | 0.20 | 0.19 | 0.15 |
| 4210103321 | SUNGARD RECOVERY SVC INC/BROAD ST PHILA | 401 N BROAD ST STE 600 | 0.0000 | 0.16 | 0.31 | 0.02 | 0.00 | 0.10 | 0.03 |
| 421010354 | CROSS CONNECT/PHILADELPHIA | 401 N BROAD ST | 0.0000 | 0.14 | 0.67 | 0.03 | 0.00 | 0.01 | 0.04 |
| 4210104901 | EXELON GENERATION CO/DELAWARE STA | 1325 N BEACH ST | 0.0001 | 1.22 | 8.42 | 0.57 | 0.05 | 0.71 | 0.04 |
| 4210104902 | VEOLIA ENERGY EDISON/PHILA | 908 SANSOM ST | 0.0000 | 2.56 | 24.24 | 4.17 | 2.25 | 41.02 | 1.48 |
| 4210106020 | FEDERAL RESERVE BANK/PHILA | 100 N 6TH ST | 0.0000 | 4.39 | 6.78 | 0.51 | 0.00 | 0.16 | 0.36 |
| 4210106526 | PARK TOWNE PLACE APT/PHILA | 2200 BENJAMIN FRANKLIN PKWY | 0.0000 | 1.17 | 1.39 | 0.11 | 0.11 | 0.01 | 0.08 |
| 4210108027 | ST JOSEPH HOSP/GIRARD AVE | 16TH & GIRARD | 0.0000 | 0.84 | 1.30 | 0.10 | 0.10 | 0.03 | 0.07 |
| 4210108044 | GIRARD MED CTR/PHILA | 8TH & GIRARD | 0.0000 | 0.50 | 1.04 | 0.09 | 0.09 | 0.63 | 0.05 |
| 4210108901 | THOMAS JEFFERSON UNIV/PHILA | 11 & WALNUT ST | 0.0000 | 0.36 | 1.68 | 0.12 | 0.11 | 0.11 | 0.09 |
| 4210108905 | TEMPLE UNIV/ MAIN CAMPUS | 1009 W MONTGOMERY AVE | 0.0000 | 18.97 | 27.19 | 1.14 | 1.14 | 0.36 | 2.98 |
| 4210108918 | GIRARD COLL/BOARDING SCH | GIRARD & CORINTHIAN AVE | 0.0000 | 2.18 | 2.63 | 0.20 | 0.20 | 0.11 | 0.14 |
| 4210109703 | US MINT/PHILA | 151 N INDEPENDENCE MALLE | 0.0000 | 3.32 | 2.31 | 0.18 | 0.00 | 0.02 | 1.68 |
| 4210109723 | WILLIAM J GREEN JR FED BLDG/GSA | 600 ARCH ST | 0.0000 | 1.95 | 3.11 | 0.22 | 0.22 | 0.12 | 0.19 |
| 4210109726 | FEDERAL BUR OF PRISONS/ PHILA COURT | 700 ARCH ST | 0.0000 | 1.72 | 2.13 | 0.07 | 0.00 | 0.04 | 0.12 |
| 4210110092 | PA CONV CTR/ARCH ST | 1101 ARCH ST | 0.0000 | 2.06 | 3.03 | 0.12 | 0.12 | 0.07 | 0.17 |
| 4210110353 | PA CONVENTION CTR ANNEX/BROAD ST | 111 N BROAD ST | 0.0020 | 1.46 | 2.47 | 0.11 | 0.11 | 0.07 | 0.13 |

Figure 13 – FAB North Aerial View

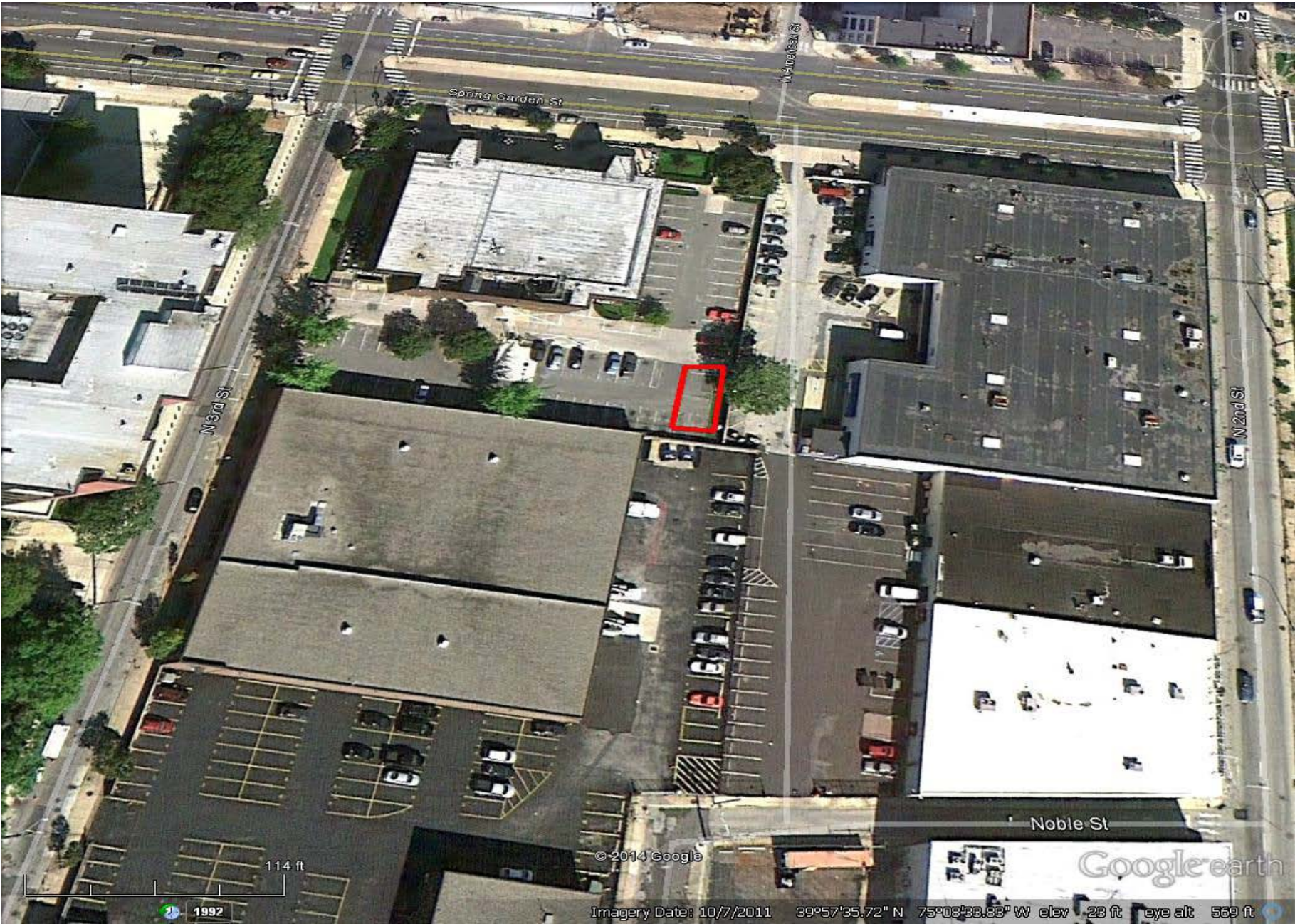


Table 8 Detailed SWA Information with Monitoring Station Picture

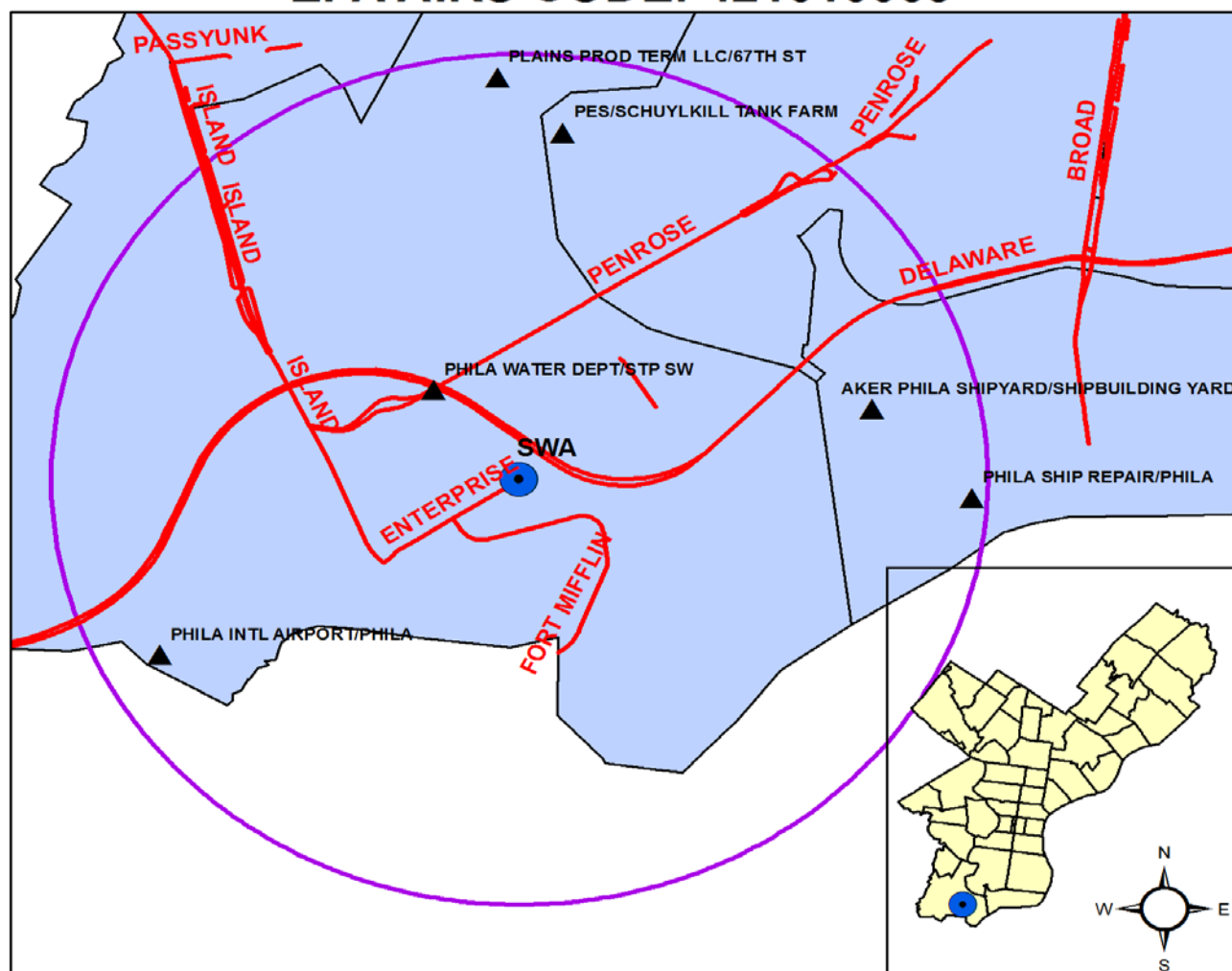
AMS SITE ID: SWA
 Street Address: 8200 Enterprise Avenue, 19153
 Geographical Coordinates
 Latitude: 39.88294
 Longitude: -75.21965



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------|-----------------|-----------------------------|--------------------|------------------------------|-------------------|----------|----------------|-----|------------|---------------|----------------------|------------------|------------|
| Carbonyls | Other | Urban Air Toxics | 1/6 days | DNPH-Coated Cartridges | HPLC | | Vary | 2 | 102 | N/A | Source-Oriented | N/A | 9/10/2009 |
| Toxics | Other | Urban Air Toxics | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | Vary | 3 | 150 | N/A | Source-Oriented | N/A | 9/10/2009 |

Figure 14 – SWA Monitoring Site Map with Major Streets and Major Emission Sources

PHILADELPHIA AIRPORT - 8200 ENTERPRISE AVE. **EPA AIRS CODE: 421010063**



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|---------------------------------------|---------------------|-----------------------|------|-------|-------|-------|------|--------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101517 | PES/SCHUYLKILL TANK FARM | 3144 W PASSYUNK AVE | 0.0000 | 0.86 | 0.23 | 0.00 | 0.00 | 0.00 | 80.80 |
| 4210101569 | AKER PHILA SHIPYARD/SHIPBUILDING YARD | PHILA NAVAL BUS CTR | 0.0000 | 2.67 | 1.59 | 20.13 | 20.06 | 0.02 | 108.98 |
| 4210105013 | PLAINS PROD TERM LLC/67TH ST | 6850 ESSINGTON AVE | 0.0000 | 1.71 | 2.03 | 0.12 | 0.12 | 0.01 | 49.56 |
| 4210109502 | PHILA INTL AIRPORT/PHILA | INDUSTRIAL HWY | 0.0000 | 6.11 | 13.45 | 1.34 | 1.34 | 0.11 | 0.83 |
| 4210109515 | PHILA WATER DEPT/STP SW | 8200 ENTERPRISE AVE | 0.0000 | 8.20 | 3.63 | 0.74 | 0.74 | 2.42 | 4.74 |
| 4213302182 | PHILA SHIP REPAIR/PHILA | 5195 S 19TH ST | 0.0000 | 0.63 | 2.85 | 0.21 | 0.00 | 0.00 | 0.84 |

Figure 15 – SWA North Aerial View



Table 9 Detailed TOR Information with Station Monitoring Picture

AMS SITE ID: TOR

Street Address: 4901 Grant Ave. & James St., 19114

Geographical Coordinates

Latitude: 40.054171

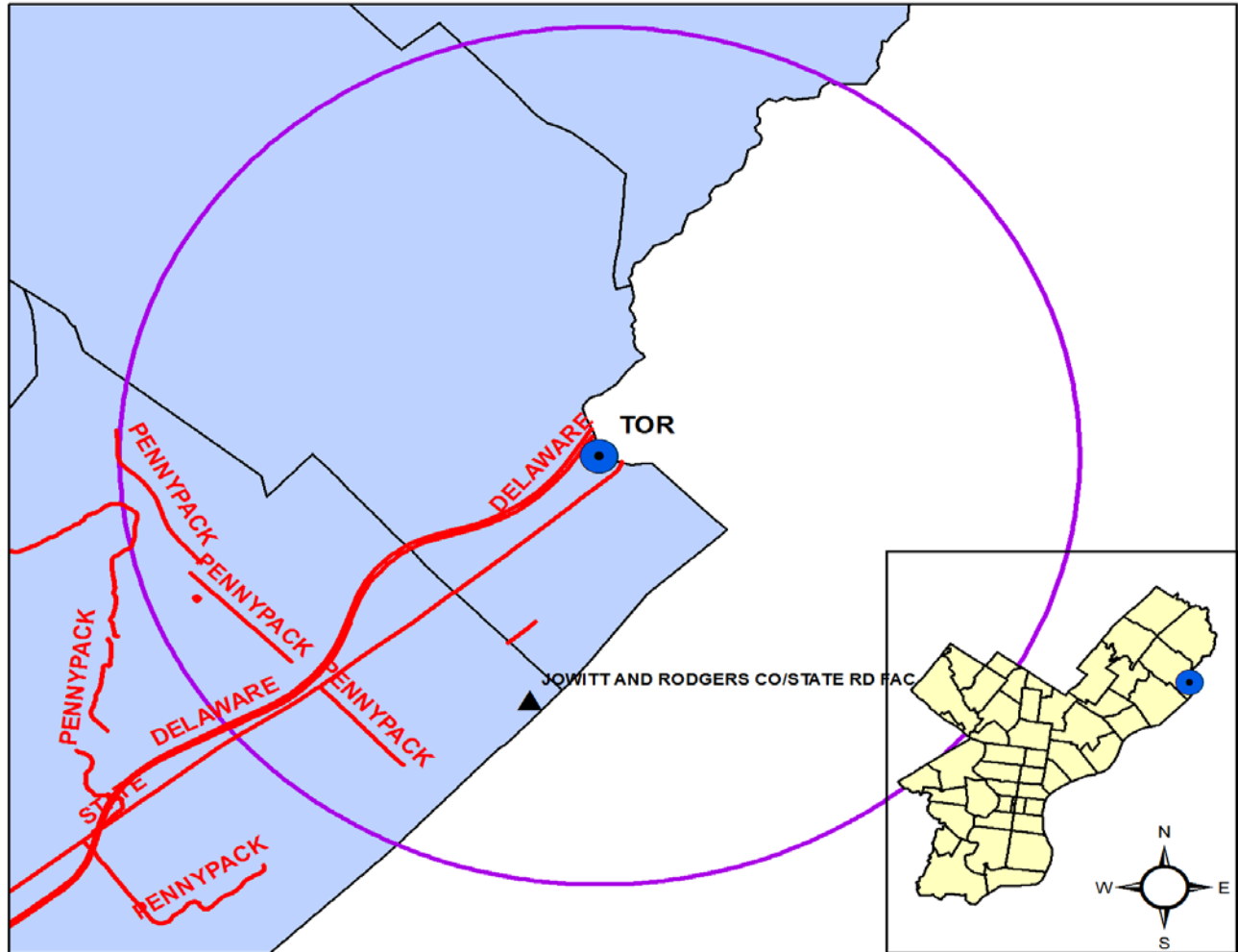
Longitude: -74.985166



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|------------------|-----------------|-----------------------------|--------------------|-------------------|--|----------|----------------|-----|------------|---------------|--|------------------|------------|
| CO | SLAMS | Near Road | Continuous | Instrumental | Gas Filter Correlation CO Analyzer | | 42101 | 1 | 093 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| NO2 | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42602 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| NO | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42601 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| NOx | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42603 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| PM2.5 Continuous | SLAMS | Near Road | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | 88101 | 1 | 170 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| Meteorological | SLAMS | Near Road | Continuous | | Vaisala 435C RH/AT Sensor | | Vary | 1 | Vary | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |

Figure 16 – TOR Monitoring Site Map with Major Streets and Major Emission Sources

TORRESDALE - 4901 GRANT AVE. & JAMES ST. EPA AIRS CODE: 421010075



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|------------------------------------|---------------|-----------------------|------|------|------|-------|------|------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210103154 | JOWITT AND RODGERS CO/STATE RD FAC | 9400 STATE RD | 0.0000 | 0.03 | 0.17 | 0.02 | 0.01 | 0.00 | 7.55 |

Figure 17 – TOR North Aerial View

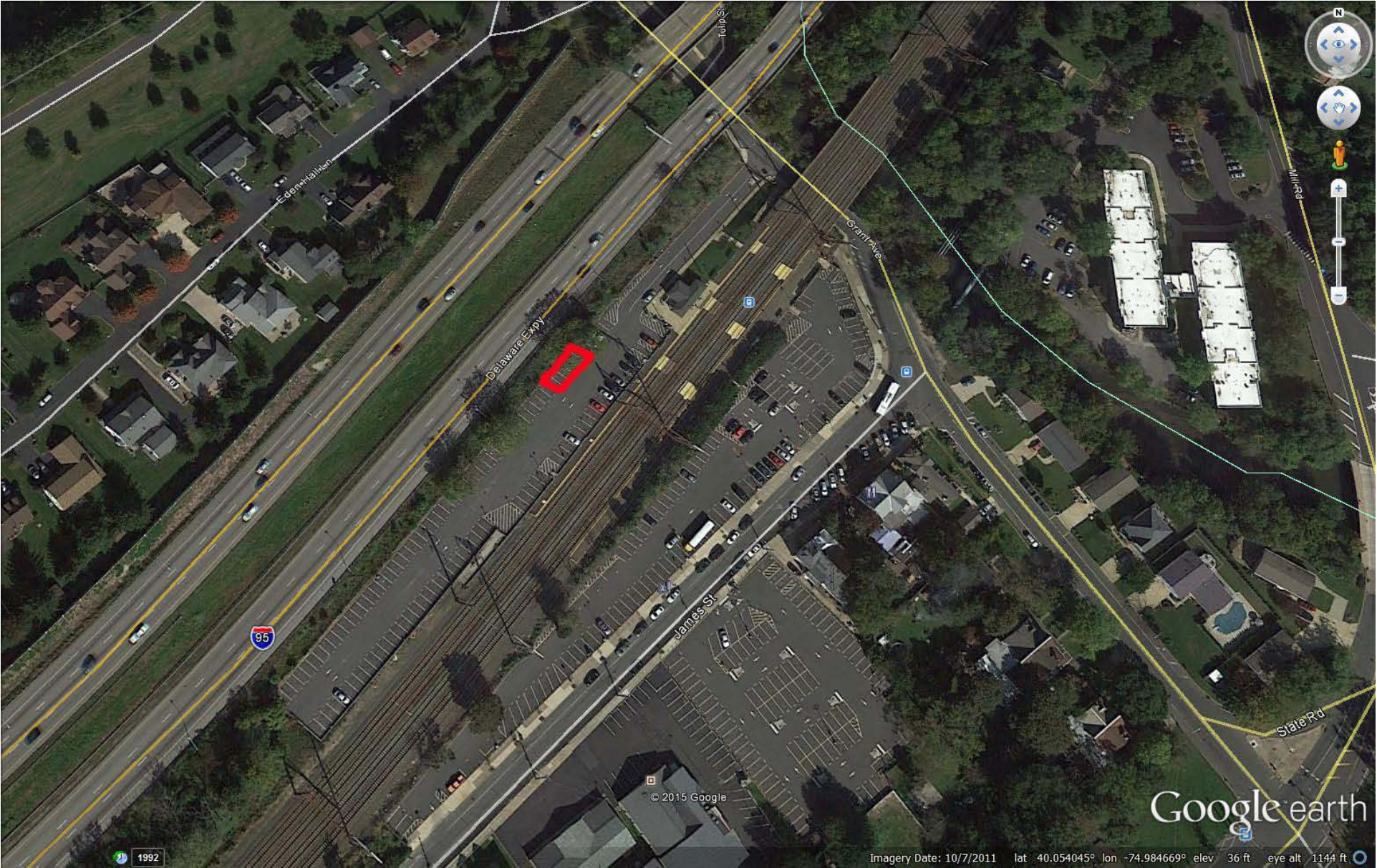


Table 10 Detailed MON Information with Monitoring Station Picture

AMS SITE ID: MON

Street Address: I-76 & Montgomery Drive, Car Barn OFM Shop 282

Geographical Coordinates

Latitude: 39.988829

Longitude: -75.207205



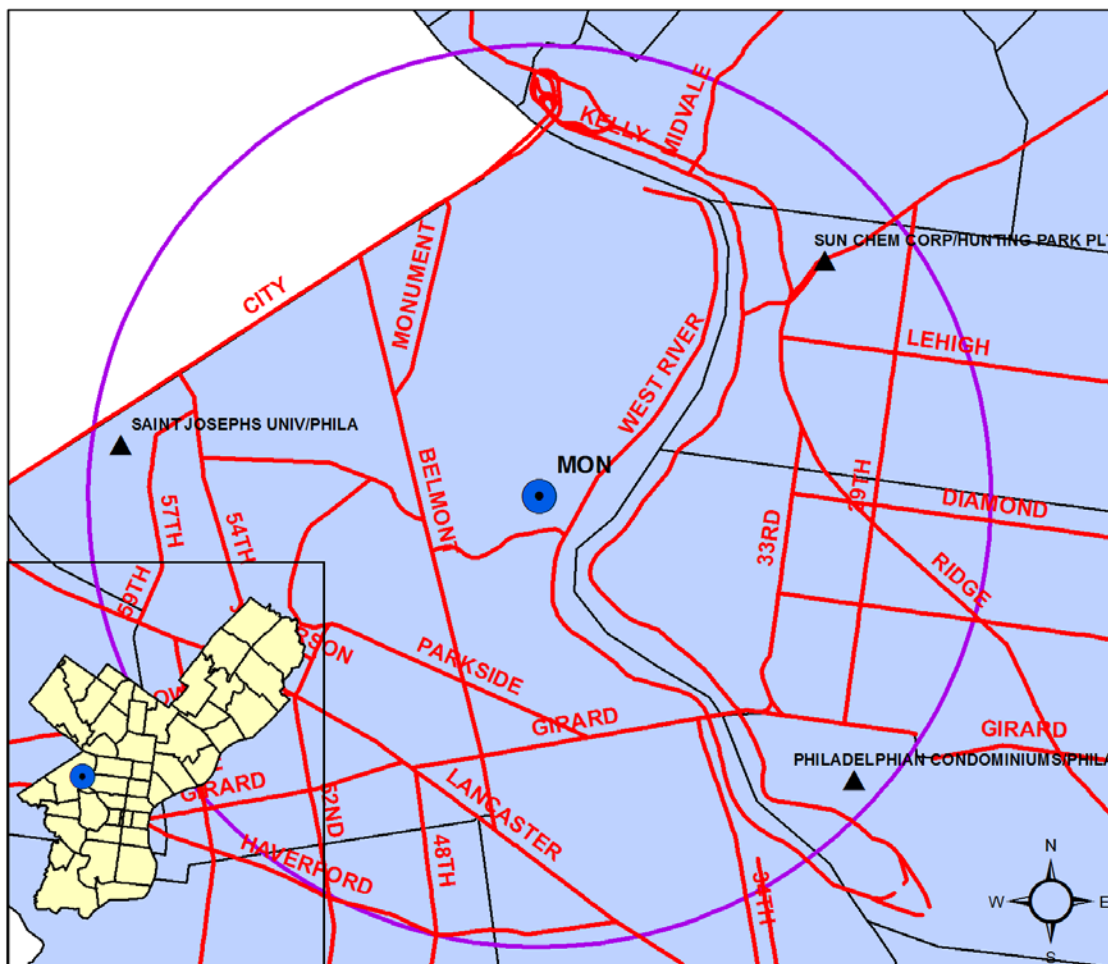
| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------------------|-----------------|-----------------------------|--------------------|-------------------|--|----------|----------------|-----|------------|---------------|--|------------------|------------|
| CO | SLAMS | Near Road | Continuous | Instrumental | Gas Filter Correlation CO Analyzer | | 42101 | 1 | 093 | Microscale | Highest Concentration, Source Oriented | 5 | 1/1/2014 |
| NO2 | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42602 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| NO | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42601 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| NOx | SLAMS | Near Road | Continuous | Instrumental | Gas Phase Chemiluminescence | | 42603 | 1 | 099 | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| PM2.5 Continuous | SLAMS | Near Road | Continuous | Instrumental | BAM =Beta Attenuation Monitor Met One BAM - 1020 | | 88101 | 1 | 170 | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| Black Carbon | SLAMS | Near Road | Continuous | Instrumental | Teledyne Model 633 | | | 1 | | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| Ultrafine Particulate | SLAMS | Near Road | Continuous | Instrumental | Teledyne Model 651 | | | 1 | | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |

| | | | | | | | | | | | | | |
|--------|-------|-----------|----------|---------------------|-------------|---|-------|---|-----|--------------|--|---|----------|
| BaP | SLAMS | Near Road | 1/6 days | Hi-Vol-SA/GMW-321-B | Gravimetric | Integrated samplers. Weighed by AMS. Analysis by Allegheny County, PA | 11101 | 1 | 091 | Microscale | Highest Concentration, Source Oriented | 5 | 7/1/2015 |
| Metals | Other | Near Road | 1/6 days | Hi-Vol | ICP-MS | Analysis by WV (TSP sampler with quartz) | Vary | 1 | 089 | Neighborhood | Population Exposure | 7 | 7/1/2015 |

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Figure 18 – MON Monitoring Site Map with Major Streets and Major Emission Sources

MONTGOMERY - INTERSTATE 76 & MONTGOMERY DR EPA AIRS CODE: 421010076



| | | | 2015 Emissions (tons) | | | | | | |
|------------|----------------------------------|-------------------------|-----------------------|------|------|------|-------|------|-------|
| Site | Facility Site | Address | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210102052 | SUN CHEM CORP/HUNTING PARK PLT | 3301 W HUNTING PARK AVE | 0.0000 | 0.25 | 0.30 | 0.63 | 0.61 | 0.00 | 11.19 |
| 4210106512 | PHILADELPHIAN CONDOMINIUMS/PHILA | 2401 PENNSYLVANIA AVE | 0.0000 | 1.98 | 2.38 | 0.18 | 0.18 | 0.07 | 0.13 |
| 4210108904 | SAINT JOSEPHS UNIV/PHILA | 54TH & CITY AVE | 0.0000 | 3.70 | 5.30 | 0.46 | 0.30 | 0.20 | 0.20 |

Figure 19 – MON North Aerial View



Table 11 Detailed PHA Information with Monitoring Station Picture



AMS SITE ID: PHA

Street Address: 3100 Penrose Ferry Road, 19145

Geographical Coordinates

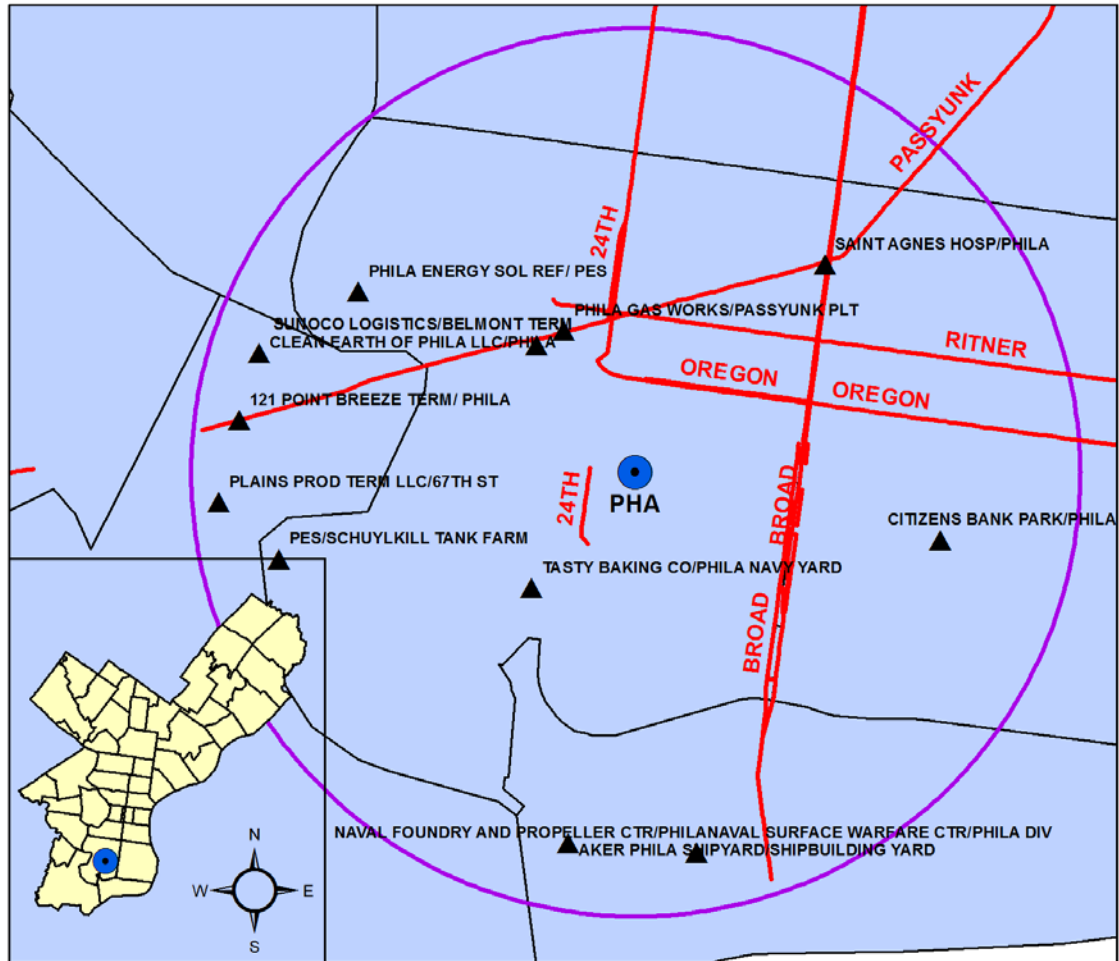
Latitude: 39.913176

Longitude: -75.185409

| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|-----------|----------------------|-----------------------------|--------------------|------------------------------|-------------------|----------|----------------|-----|------------|---------------|----------------------|------------------|------------|
| Toxics | Continuous Open Path | | Continuous | UV-DOAS | Infrared | | | | Vary | Neighborhood | Population Exposure | 2 | 2/1/2014 |
| Toxics | Other | | 1/6 days | Canister Subambient Pressure | Multi-Detector GC | | | | Vary | N/A | Source-Oriented | N/A | 1/1/2015 |

Figure 20 – PHA Monitoring Site Map with Major Streets and Major Emission Sources

PHILADELPHIA HOUSING AUTHORITY 3100 PENROSE FERRY RD.



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|---------------------------------------|---------------------|-----------------------|---------|---------|--------|--------|--------|--------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101501 | PHILA ENERGY SOL REF/ PES | 3144 W PASSYUNK AVE | 0.0137 | 1326.28 | 1372.55 | 482.93 | 477.58 | 363.02 | 780.36 |
| 4210101507 | SUNOCO LOGISTICS/BELMONT TERM | 2700 W PASSYUNK AVE | 0.0000 | 24.31 | 9.74 | 0.30 | 0.00 | 0.10 | 32.33 |
| 4210101517 | PES/SCHUYLKILL TANK FARM | 3144 W PASSYUNK AVE | 0.0000 | 0.86 | 0.23 | 0.00 | 0.00 | 0.00 | 80.80 |
| 4210101569 | AKER PHILA SHIPYARD/SHIPBUILDING YARD | PHILA NAVAL BUS CTR | 0.0000 | 2.67 | 1.59 | 20.13 | 20.06 | 0.02 | 108.98 |
| 4210102148 | CLEAN EARTH OF PHILA LLC/PHILA | 3201 S 61ST ST | 0.0000 | 0.01 | 0.04 | 0.45 | 0.08 | 0.04 | 5.63 |
| 4210104921 | PHILA GAS WORKS/PASSYUNK PLT | 3100 W PASSYUNK AVE | 0.0000 | 2.36 | 3.90 | 0.29 | 0.22 | 0.11 | 0.21 |
| 4210105013 | PLAINS PROD TERM LLC/67TH ST | 6850 ESSINGTON AVE | 0.0000 | 1.71 | 2.03 | 0.12 | 0.12 | 0.01 | 49.56 |
| 4210108016 | SAINT AGNES HOSP/PHILA | 1930 S BROAD ST | 0.0000 | 1.45 | 1.93 | 0.15 | 0.15 | 0.03 | 0.11 |
| 4210109702 | NAVAL FOUNDRY AND PROPELLER CTR/PHILA | 1701 KITTY HAWK AVE | 0.0284 | 1.98 | 2.39 | 13.07 | 0.00 | 0.08 | 2.00 |
| 4210109724 | NAVAL SURFACE WARFARE CTR/PHILA DIV | 5001 S BROAD ST | 0.0001 | 1.78 | 13.75 | 0.35 | 0.32 | 2.52 | 0.46 |
| 4210110029 | 121 POINT BREEZE TERM/ PHILA | 6310 PASSYUNK AVE | 0.0000 | 1.75 | 0.73 | 0.03 | 0.03 | 0.01 | 12.23 |
| 4210110236 | TASTY BAKING CO/PHILA NAVY YARD | 4300 S 26TH ST | 0.0000 | 2.75 | 3.27 | 0.31 | 0.28 | 0.00 | 0.32 |
| 4210110147 | CITIZENS BANK PARK/PHILA | 1001 PATTISON AVE | 0.0000 | 5.20 | 3.67 | 0.22 | 0.00 | 0.02 | 1.01 |

Figure 21 – PHA North Aerial View

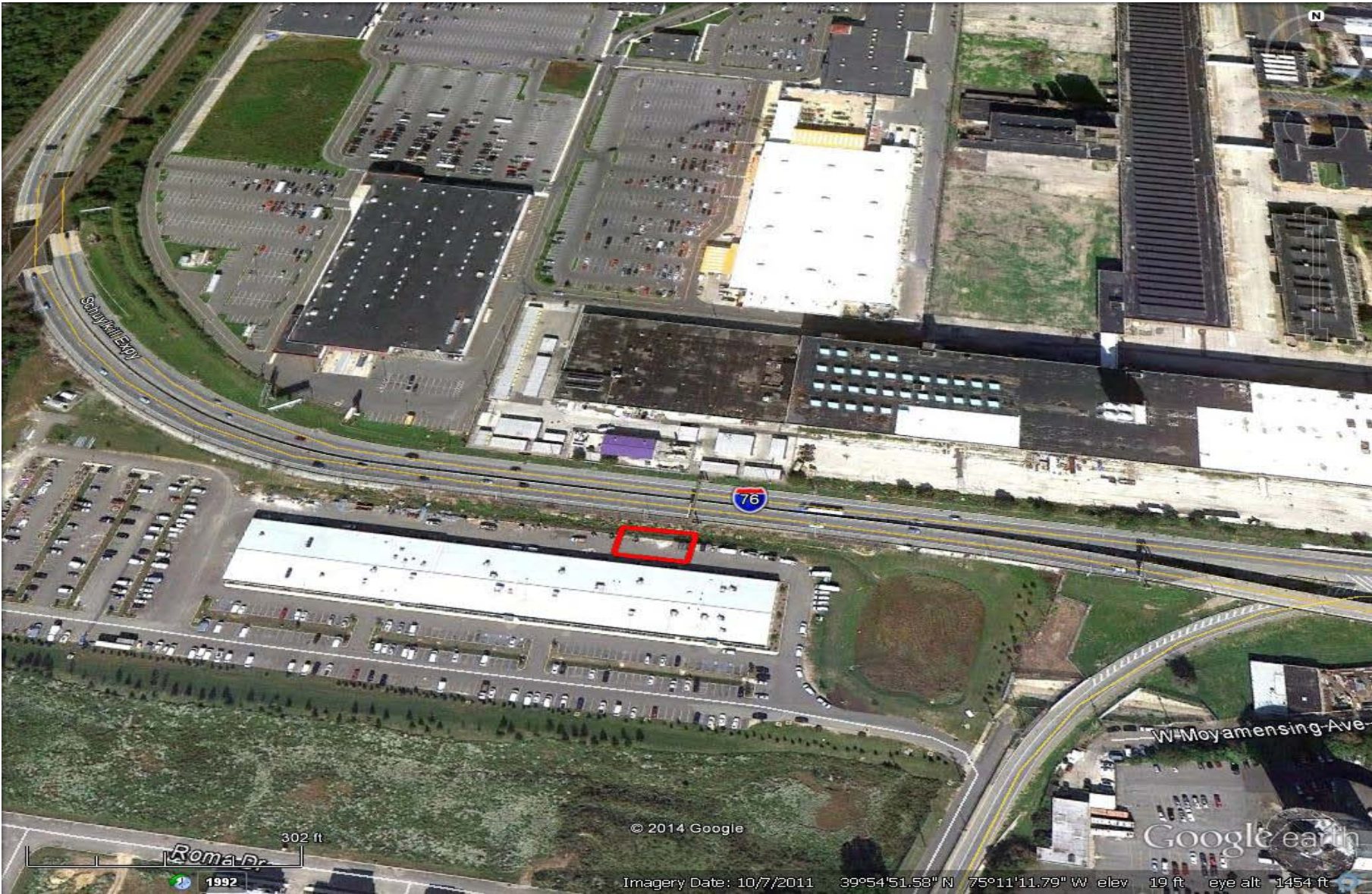


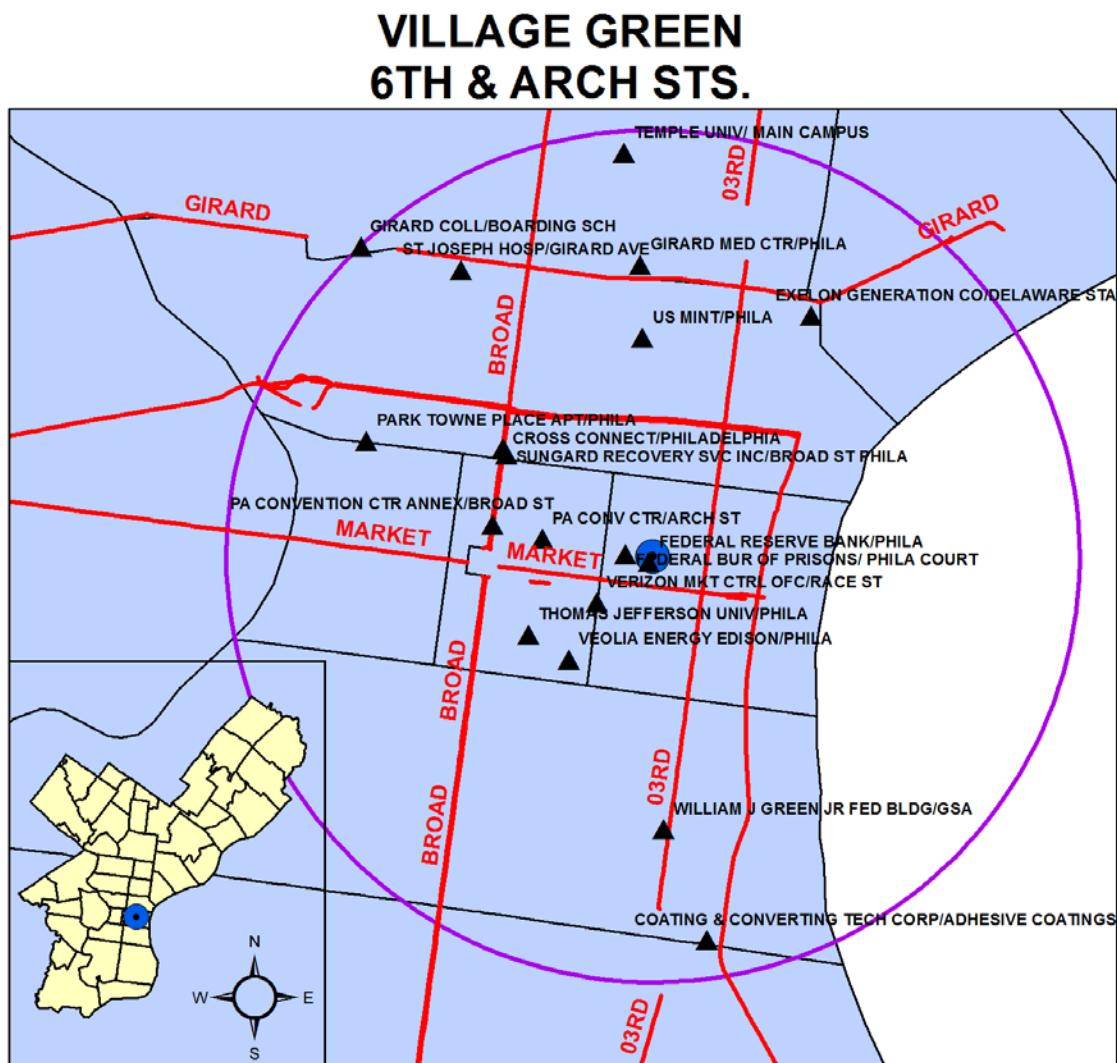
Table 12 Detailed VGR Information with Monitoring Station Picture

AMS SITE ID: VGR
 Street Address: 6th & Arch Streets
 Geographical Coordinates
 Latitude: 39.952608
 Longitude: -75.149704



| PARAMETER | MONITORING TYPE | MONITOR NETWORK AFFILIATION | OPERATING SCHEDULE | COLLECTION METHOD | ANALYSIS METHOD | COMMENTS | PARAMETER CODE | POC | AQS METHOD | SPATIAL SCALE | MONITORING OBJECTIVE | PROBE HEIGHT (m) | BEGIN DATE |
|------------------|-----------------|-----------------------------|--------------------|-------------------|---|------------|----------------|-----|------------|---------------|----------------------|------------------|------------|
| Ozone | | | Continuous | 2B Technologies | | Not in AQS | | | | | | | 3/15/2015 |
| PM2.5 Continuous | | | Continuous | Thermo | | Not in AQS | | | | | | | 3/15/2015 |
| Meteorological | | | Continuous | | Wind speed, wind direction, humidity, temperature | Not in AQS | | | | | | | 3/15/2015 |

Figure 22 – VGR Monitoring Site Map with Major Streets and Major Emission Sources



| Site | Facility Site | Address | 2015 Emissions (tons) | | | | | | |
|------------|--|-----------------------------|-----------------------|-------|-------|------|-------|-------|-------|
| | | | PB | CO | NOX | PM10 | PM2.5 | SO2 | VOC |
| 4210101014 | VERIZON MKT CTRL OFC/RACE ST | 900 RACE ST | 0.0000 | 0.27 | 2.30 | 0.20 | 0.20 | 0.19 | 0.15 |
| 4210103321 | SUNGARD RECOVERY SVC INC/BROAD ST PHILA | 401 N BROAD ST STE 600 | 0.0000 | 0.16 | 0.31 | 0.02 | 0.00 | 0.10 | 0.03 |
| 421010354 | CROSS CONNECT/PHILADELPHIA | 401 N BROAD ST | 0.0000 | 0.14 | 0.67 | 0.03 | 0.00 | 0.01 | 0.04 |
| 4210104901 | EXELON GENERATION CO/DELAWARE STA | 1325 N BEACH ST | 0.0001 | 1.22 | 8.42 | 0.57 | 0.05 | 0.71 | 0.04 |
| 4210104902 | VEOLIA ENERGY EDISON/PHILA | 908 SANSOM ST | 0.0000 | 2.56 | 24.24 | 4.17 | 2.25 | 41.02 | 1.48 |
| 4210106020 | FEDERAL RESERVE BANK/PHILA | 100 N 6TH ST | 0.0000 | 4.39 | 6.78 | 0.51 | 0.00 | 0.16 | 0.36 |
| 4210106526 | PARK TOWNE PLACE APT/PHILA | 2200 BENJAMIN FRANKLIN PKWY | 0.0000 | 1.17 | 1.39 | 0.11 | 0.11 | 0.01 | 0.08 |
| 4210108027 | ST JOSEPH HOSP/GIRARD AVE | 16TH & GIRARD | 0.0000 | 0.84 | 1.30 | 0.10 | 0.10 | 0.03 | 0.07 |
| 4210108044 | GIRARD MED CTR/PHILA | 8TH & GIRARD | 0.0000 | 0.50 | 1.04 | 0.09 | 0.09 | 0.63 | 0.05 |
| 4210108901 | THOMAS JEFFERSON UNIV/PHILA | 11 & WALNUT ST | 0.0000 | 0.36 | 1.68 | 0.12 | 0.11 | 0.11 | 0.09 |
| 4210108905 | TEMPLE UNIV/ MAIN CAMPUS | 1009 W MONTGOMERY AVE | 0.0000 | 18.97 | 27.19 | 1.14 | 1.14 | 0.36 | 2.98 |
| 4210108918 | GIRARD COLL/BOARDING SCH | GIRARD & CORINTHIAN AVE | 0.0000 | 2.18 | 2.63 | 0.20 | 0.20 | 0.11 | 0.14 |
| 4210109703 | US MINT/PHILA | 151 N INDEPENDENCE MALL E | 0.0000 | 3.32 | 2.31 | 0.18 | 0.00 | 0.02 | 1.68 |
| 4210109723 | WILLIAM J GREEN JR FED BLDG/GSA | 600 ARCH ST | 0.0000 | 1.95 | 3.11 | 0.22 | 0.22 | 0.12 | 0.19 |
| 4210109726 | FEDERAL BUR OF PRISONS/ PHILA COURT | 700 ARCH ST | 0.0000 | 1.72 | 2.13 | 0.07 | 0.00 | 0.04 | 0.12 |
| 4210110092 | PA CONV CTR/ARCH ST | 1101 ARCH ST | 0.0000 | 2.06 | 3.03 | 0.12 | 0.12 | 0.07 | 0.17 |
| 4210110353 | PA CONVENTION CTR ANNEX/BROAD ST | 111 N BROAD ST | 0.0020 | 1.46 | 2.47 | 0.11 | 0.11 | 0.07 | 0.13 |
| 4210110114 | COATING & CONVERTING TECH CORP/ADHESIVE COATINGS | 80 E MORRIS ST | 0.0000 | 0.31 | 0.37 | 0.03 | 0.03 | 0.00 | 18.29 |

Figure 23 – VGR North Aerial View



Appendix A
PAMS Implementation Network Plan Draft

DRAFT

Appendix A

PAMS Implementation Network Plan Draft

PAMS Monitoring Implementation Network Plan Monitoring Organizations Required To Operate At NCore Sites

Philadelphia Air Management Services formerly operated one Photochemical Assessment Monitoring Stations (PAMS) site in the air monitoring network in 2016, at the LAB site. However, the recently revised monitoring rule (80 FR 65292; October 26, 2015) requires PAMS measurements June 1 through August 31 at NCore sites that are located in Core-Based Statistical Areas (CBSAs) with populations of 1,000,000 or more.

Network Decision

The NCore site located at NEW will serve as the location of the required PAMS site and will measure the following parameters described below. An Inventory of equipment used at the site(s) is provided in Attachment 2.

Auto GC Decision:

Volatile organic compounds (VOCs) – A complete list of the targeted compounds are found in Table 1.

We will measure hourly speciated VOC measurements with an auto-gas chromatograph (GC) using tentatively the Consolidated Analytical Systems (CAS). Prior to the acquisition, and operation of this system, we will analyze 24 hours canisters collected on a sixth day basis year round at the NCore site by traditional PAMS Cryo-GC.

Meteorology Measurements Decision

Will measure wind direction, wind speed, temperature, humidity, and atmospheric pressure. Mixing height will be measured when acquired. We have elected to use the following instrumentation to measure the parameters described above: tentatively Vaisala.

Other Required Measurements

- **Carbonyls** - Carbonyl sampling at a frequency of three 8-hour samples on a one-in-three day basis (~90 samples per PAMS sampling season) using ATEC Sampler and Waters HPLC equipment for analysis. A complete list of the target carbonyl compounds may be found in Table 1. The TO-11A test method, as used in the National Air Toxics Trends (NATTS) program⁴ will be used.
- **Nitrogen Oxides** - Will monitor for NO and NO_y (total oxides of nitrogen) in addition to true NO₂. The true NO₂ is required to be measured with a direct reading NO₂ analyzer, cavity attenuated phase shift (CAPS) spectroscopy or photolytic-converter NO_x analyzer. We have elected to use tentatively Teledyne for the true NO₂ measurement, when acquired. NO and NO_y will be measured using Teledyne.

⁴See NATTS Technical Assistance Document for TO-11A method.

Table 1 PAMS Target Compound List

| Priority Compounds | | | | Optional Compounds | | | |
|--------------------|-------------------------------------|----|-----------------------------|--------------------|-------------------------------|----|-----------------------------------|
| 1 | 1,2,3-trimethylbenzene ^a | 19 | n-hexane ^b | 1 | 1,3,5-trimethylbenzene | 19 | m-diethylbenzene |
| 2 | 1,2,4-trimethylbenzene ^a | 20 | n-pentane | 2 | 1-pentene | 20 | methylcyclohexane |
| 3 | 1-butene | 21 | o-ethyltoluene ^a | 3 | 2,2-dimethylbutane | 21 | methylcyclopentane |
| 4 | 2,2,4-trimethylpentane ^b | 22 | o-xylene ^{a,b} | 4 | 2,3,4-trimethylpentane | 22 | n-decane |
| 5 | acetaldehyde ^{b,c} | 23 | p-ethyltoluene ^a | 5 | 2,3-dimethylbutane | 23 | n-heptane |
| 6 | acetone ^{c,d} | 24 | Propane | 6 | 2,3-dimethylpentane | 24 | n-nonane |
| 7 | benzene ^{a,b} | 25 | propylene | 7 | 2,4-dimethylpentane | 25 | n-octane |
| 8 | c-2-butene | 26 | styrene ^{a,b} | 8 | 2-methylheptane | 26 | n-propylbenzene ^a |
| 9 | ethane ^d | 27 | toluene ^{a,b} | 9 | 2-methylhexane | 27 | n-undecane |
| 10 | ethylbenzene ^{a,b} | 28 | t-2-butene | 10 | 2-methylpentane | 28 | p-diethylbenzene |
| 11 | Ethylene | | | 11 | 3-methylheptane | 29 | t-2-pentene |
| 12 | formaldehyde ^{b,c} | | | 12 | 3-methylhexane | 30 | α/β -pinene |
| 13 | Isobutane | | | 13 | 3-methylpentane | 31 | 1,3 butadiene ^b |
| 14 | Isopentane | | | 14 | Acetylene | 32 | benzaldehyde ^c |
| 15 | Isoprene | | | 15 | c-2-pentene | 33 | carbon tetrachloride ^b |
| 16 | m&p-xylenes ^{a,b} | | | 16 | cyclohexane | 34 | Ethanol |
| 17 | m-ethyltoluene ^a | | | 17 | cyclopentane | 35 | Tetrachloroethylene ^b |
| 18 | n-butane | | | 18 | isopropylbenzene ^b | | |

Source: Revisions to the Photochemical Assessment Monitoring Stations Compound Target List.
U.S. EPA, November 20, 2013

^a Important SOAP (Secondary Organic Aerosols Precursor) Compounds

^b HAP (Hazardous Air Pollutant) Compounds

^c Carbonyl compounds

^d Non-reactive compounds, not considered to be VOC for regulatory purposes

Attachment 2 Equipment Inventory

| | |
|--------|---|
| Region | 3 |
| State | PA |
| Local | Philadelphia |
| AQS ID | 42-101-0024 |
| MSA | Philadelphia- Camden- Wilmington, PA-NJ-DE-MD |

| Parameter | Category | Detail |
|---------------|---|--------|
| Site | Is the AQS site ID listed above the expected PAMS Core site location? | Yes |
| | What is the status of the decision for the expected PAMS Core site location (not started, draft, or final)? | Final |
| | Is there an alternate PAMS Core site location selected? | No |
| | Identify type of alternative site (existing PAMS, NATTS, etc) | N/A |
| | Alternate site AQS ID (if known) | N/A |
| Mixing Height | Is there an existing functional ceilometer or other similar instrument available for use? | No |
| | current location (at future PAMS Core site, at other site, not applicable) | |
| | instrument type (ceilometer, radar profiler, etc) | |
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Comments | |
| Auto GC | Is there an existing Auto GC available for use? | No |
| | current location (at future PAMS Core site, at other site, not applicable) | |
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Does it have a service contract? | |
| | Comments | |
| True NO2 | Is there an existing true NO2 instrument available for use? | No |
| | current location (at future PAMS Core site, at other site, not applicable) | |
| | instrument type (photolytic conversion, cavity ringdown, CAPS, etc) | |

| | | |
|--|----------------|-----------------|
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Comments | NO, NOy at site |

| | | |
|----------------------------|---|---|
| Carbonyls Sampling | Is there an existing sequential carbonyls sampling unit or similar instrument available for use? | Yes |
| | current location (at future PAMS Core site, at other site, not applicable) | PAMS Core site |
| | Manufacturer | ATEC |
| | Model | 8000 |
| | date purchased | 2016 |
| | Comments | |
| Carbonyl Analysis | Does the site currently have a support laboratory for carbonyls or plans to use a support laboratory? | Yes |
| | laboratory name | Philadelphia Air Management Services Laboratory |
| | Comments | Waters HPLC |
| Barometric Pressure | instrument type (aneroid barometer, etc) | Yes - Electronic |
| | Manufacturer | Vaisala |
| | Model | WXT520 |
| | date purchased | 2013 |
| | Comments | |
| UV Radiation | instrument type (UV radiometer, etc) | No |
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Comments | |
| Solar Radiation | instrument type (pyranometer, etc) | No |
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Comments | |
| Precipitation | instrument type (tipping bucket, weighing, etc) | No |
| | Manufacturer | |
| | Model | |
| | date purchased | |
| | Comments | |

Appendix B
Philadelphia Air Quality Survey

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Appendix B

Philadelphia Air Quality Survey

Project Overview

Objectives

Although the City of Philadelphia has operated a network of EPA sponsored regulatory air monitoring stations for many years, the number of these stations is usually small, and the locations of the stations cannot reflect the neighborhood-to-neighborhood variances of air quality across the city. This project aims to fill the gap in air quality monitoring as mentioned above, and achieve the following objectives:

- 1) Set up street-level, neighborhood-oriented air sampling sites throughout the city to sample the air for about two years, and capture the seasonal changes and neighborhood-to-neighborhood spatial variances in air quality.
- 2) Measure the types of air pollution with major concerns, including PM_{2.5}, NO₂ (as vehicle emission indicator and ozone precursor), diesel vehicle emissions (using black carbon as indicator), and residual oil burning (using indicators such as SO₂, nickel, and vanadium).
- 3) Obtain quality assured and reliable data results that can serve as the basis for future work, including: provide policy recommendations for reducing pollution from congested city traffic, diesel vehicles and winter time fuel burning; analyze the relations between air quality and land use characters at neighborhood level and build a Land Use Regression model to predict air pollution levels and spatial variances in different neighborhoods; provide a basis for studying public health impact of air pollution in the city.

Outputs

The project outputs will include data from the first ever city-wide street level air monitoring, which will indicate spatial variances of pollutant (PM_{2.5}, NO₂, SO₂, O₃) concentrations across different areas of the city.

Project Time Frame

The city-wide air sampling is expected to start in Summer 2017, and will last about 24 months.

Project Design

Monitoring Sites

A grid of 300m x 300m cells are created over the city map using ArcGIS for the purposes of site selection, data processing, and air quality modeling in the future. A sampling site falls in one of these cells. About 62 monitoring sites have been selected across the city (see the attached map). The entire city is divided into four quadrants (areas): Central, Northeast, Northwest, and South/Southwest. The Central Area is given larger number of sites and higher site density, considering the high density of population, traffic and buildings, and potentially larger gradients of pollutant concentration variances. Within each area, about 70% of the sites are randomly

selected using GIS mapping techniques to make the data statistically representative. About 30% of the sites are determined as "purposeful" sites. Their locations are determined to serve one or more particular purposes. At each monitoring site, a portable sampling unit will be mounted on a utility pole about 10 - 12 feet above the ground.

Sampling Unit

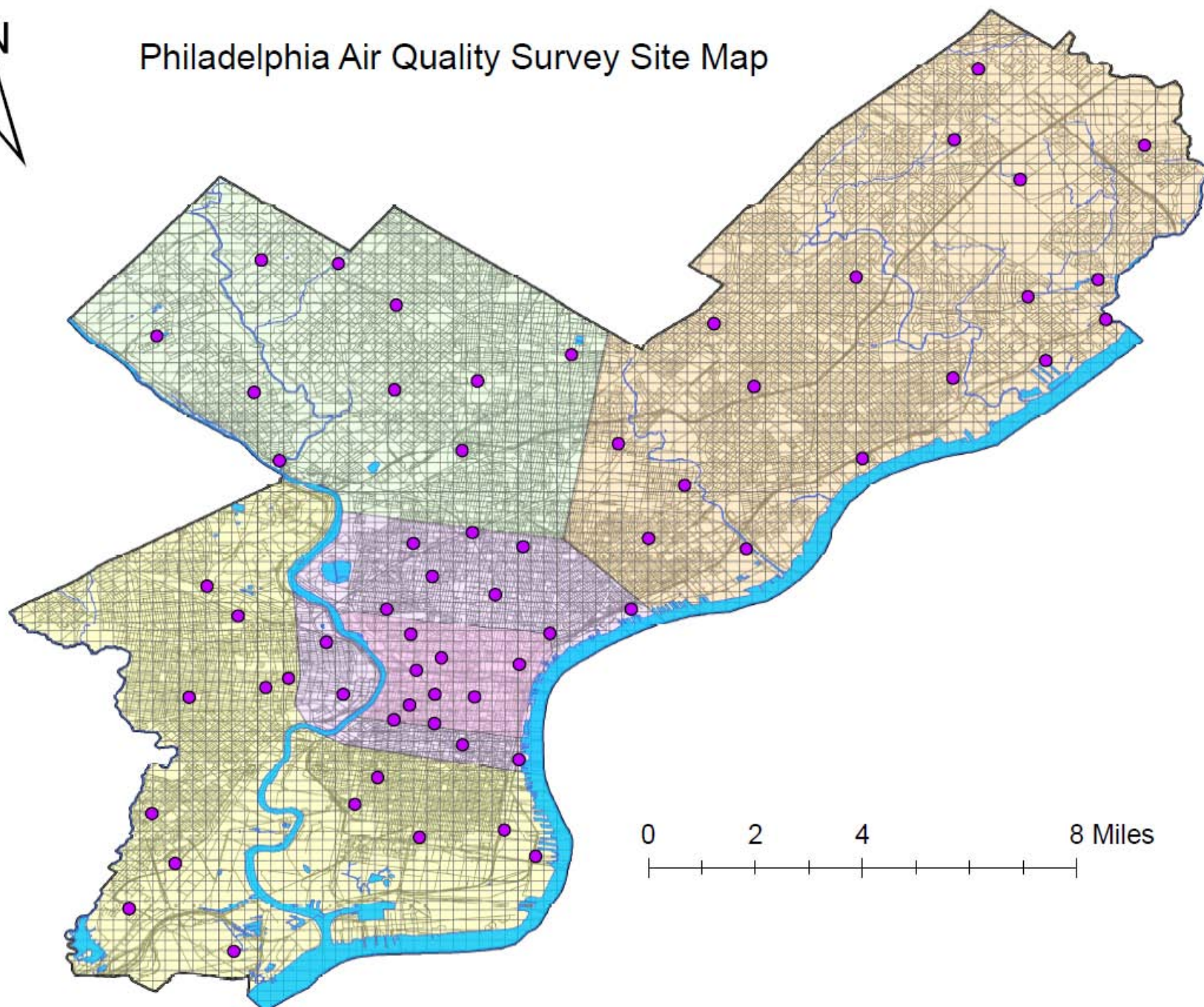
The sampling unit contains at least a PM_{2.5} sensor or sample collector. Some of the sites will also monitor NO₂, SO₂, and/or O₃. The unit contains meteorological sensors as well.

Sampling Operation

Four sites, called "reference sites", will operate continuously throughout the year. For the rest of the monitoring sites, sampling units will be rotated to cover the 58 sites in multiple operational sessions (batches). In each season (3 months), 14 to 15 sites will be monitored at a time during a two-week sampling session. Then the sampling units will be moved to the next session of 14 to 15 sites. Therefore, four sessions will cover all the sites in the city during one season. To avoid spatio-temporal confounding associated with different sites being monitored during different time windows, the sites in each operational session will be randomly selected.



Philadelphia Air Quality Survey Site Map



Appendix B
Quality Assurance Project Plan
AMS Air Quality Monitoring Survey Project

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Quality Assurance Project Plan (QAPP)

City of Philadelphia Air Management Services (AMS) Air Quality Monitoring Survey Project

Date: November 30, 2016

Revised: February 2, 2017

Prepared for:

United States Environmental Protection Agency Region III
Pennsylvania Department of Environmental Protection

Submitted by:

Kassahun Sellassie, Director

Prepared by:

Meyliana Wu, Engineering Specialist
Jason Li, Engineering Specialist

**City of Philadelphia
Department of Public Health
Air Management Services
321 S. University Ave.
Philadelphia, PA 19104**

ACRONYM AND GLOSSARY

| | |
|-------------------|---|
| 3G | Third Generation |
| AMS | Air Management Services |
| AQ | Air Quality |
| CO | Carbon Monoxide |
| EPA | Environmental Protection Agency |
| FEM | Federal Equivalent Method |
| FRM | Federal Reference Method |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| LUR | Land Use Regression |
| NAAQS | National Ambient Air Quality Standards |
| NATA | National Air Toxics Assessment |
| NO ₂ | Nitrogen Dioxide |
| O ₃ | Ozone |
| PADEP | Pennsylvania Department of Environmental Protection |
| PDPH | Philadelphia Department of Public Health |
| PM | Particulate Matter |
| PM _{2.5} | Fine Particulate Matter |
| QAPP | Quality Assurance Project Plan |
| QA/QC | Quality Assurance/ Quality Control |
| QMP | Quality Management Plans |
| SO ₂ | Sulfur Dioxide |
| SOP | Standard Operating Procedure |

1. QAPP IDENTIFICATION AND APPROVAL

***Title: QAPP for the City of Philadelphia Air Management Services (AMS)
Air Quality Monitoring Survey Project***

The attached QAPP for AMS' Air Quality Monitoring Survey Project is hereby recommended for approval and commits the City of Philadelphia, Department of Public Health, AMS to follow the elements described within.

City of Philadelphia Air Management Services (AMS)

Signature: _____ Date: _____
AMS Program Director

Signature: _____ Date: _____
AMS Research Engineer

Signature: _____ Date: _____
AMS Laboratory Administrative Engineer

Signature: _____ Date: _____
AMS Quality Assurance (QA) Engineer

EPA Region III

Signature: _____ Date: _____
EPA Region 3 QA Coordinator

Signature: _____ Date: _____

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3. DISTRIBUTION

A hard copy or an electronic copy of this QAPP has been distributed to the individuals in Table 3.1, as shown below. For Air Management Services (AMS) Laboratory personnel, this QAPP is located at I:\QA\QAPP

Table 3.1 QAPP Distribution List

| Name | Title | Division/Branch/ Unit | Contact Information Phone No. and Email |
|---|--------------------------|---|---|
| Philadelphia Air Management Services (AMS) | | | |
| Kassahun Sellassie, Ph.D., P.E. | Program Director | Administration | Phone: 215-685-7584 Kassahun.Sellassie@phila.gov |
| Edward Braun | Program Manager | Regulatory Services | Phone: 215-685-9476 Edward.Braun@phila.gov |
| Henry Kim | Administrative Engineer | Program Services | Phone: 215-685-9439 Henry.Kim@phila.gov |
| Thomas Barsley | Administrative Engineer | AMS Quality Improvement | Phone: 215-685-9417 Thomas.Barsley@phila.gov |
| Jason (Jiazheng) Li | Engineering Specialist | AMS Research | Phone: 215-685-9440 Jiazheng.Li@phila.gov |
| Dennis Sosna | Administrative Scientist | Laboratory Administration | Phone: 215-685-1051 Dennis.Sosna@phila.gov |
| Hallie Weiss | Administrative Engineer | Laboratory Administration | Phone: 215-685-1085 Hallie.Weiss@phila.gov |
| Paresh Mehta | Engineering Supervisor | Laboratory Field Operation | Phone: 215-685-1052 Paresh.Mehta@phila.gov |
| Philipose Cheriyan | Chemistry Supervisor | Laboratory Analytical Chemistry/Calibration | Phone: 215-685-1053 Philipose.Cheriyan@phila.gov |
| Meyliana Wu | Engineering Specialist | Laboratory Quality Assurance | Phone: 215-685-1050 Meyliana.Wu@phila.gov |
| Pennsylvania Department of Environmental Protection (PA DEP) | | | |
| John Krueger | Assistant Director | Bureau of Air Quality | Phone: 717-783-9264 |
| Ann Roda | Director | Office of Program Integration | Phone: 717-772-1856 |
| EPA Region III | | | |
| Alice Chow | Associate Director | Air Monitoring and Analysis | Phone: 215-814-2144 chow.alice@epa.gov |
| Kia Hence | QA Coordinator | Air Protection Division Regional Quality Council | Phone: 215-814-2111 hence.kia@epa.gov |

4. PROJECT/TASK ORGANIZATION

This section of the QAPP identifies the roles and responsibilities of those individuals involved in the project. This section also identifies lines of authority and reporting between these individuals and organizations.

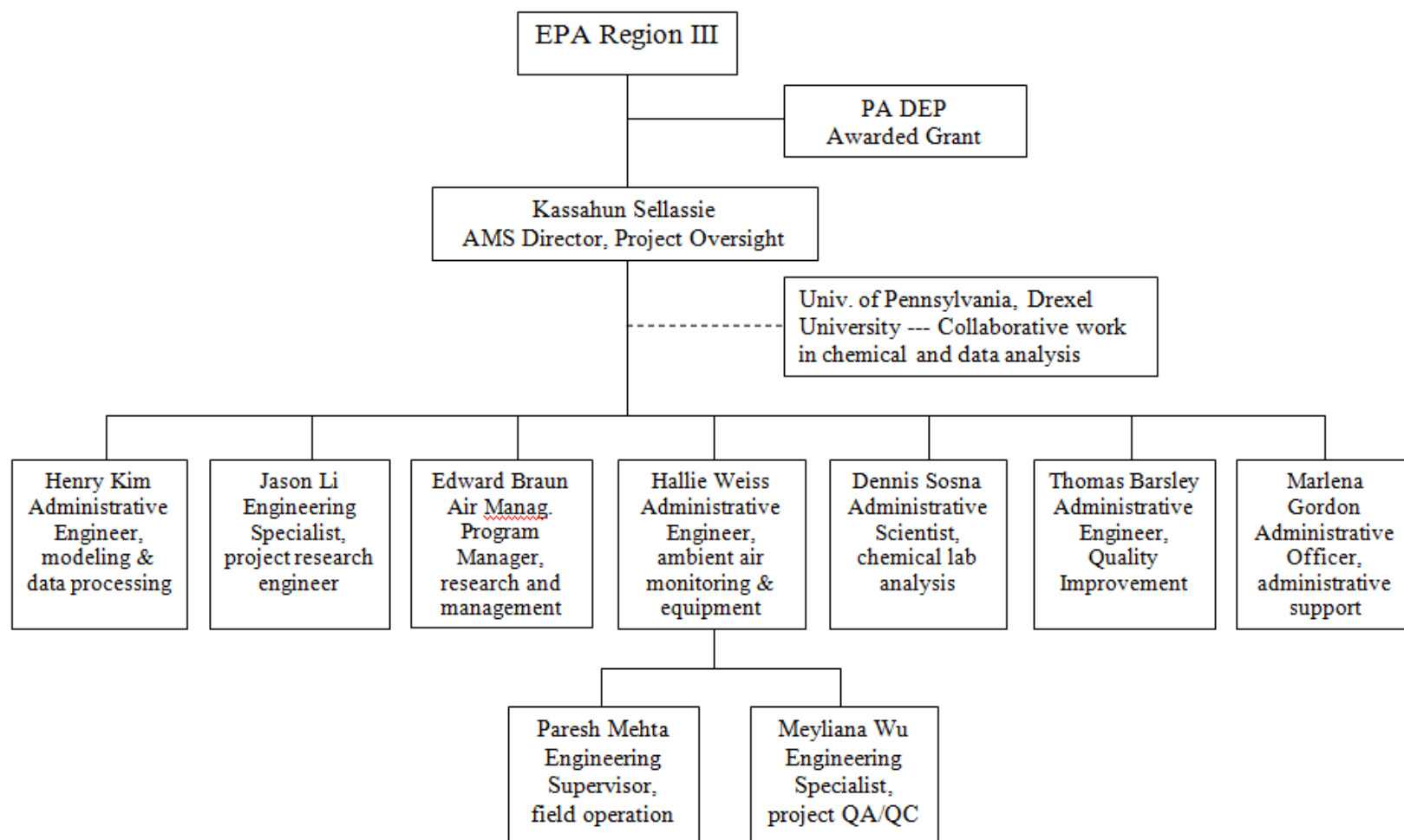
The Director of AMS has the program management responsibilities for the development, implementation and operation of the Quality Assurance (QA) Program. The AMS Quality Assurance Coordinator (QAC) who reports to the Director is responsible for development of Quality Management Plans (QMP) and ensuring that the implementation of the QA requirements is in accordance with the QMP and with state and federal guidelines regarding QA. The Project Officers (PO) who generally are the Unit Managers have overall responsibility for ensuring that appropriate requirements are implemented, consistent with EPA grants and quality assurance protocols. A Project Officer for an extramural agreement has the overall responsibility of ensuring the appropriate implementation of the QA requirements as outlined in their grants. QA Staff report to QAC and are responsible for identification of performance and quality variations from approved quality assurance/control documents and for data validation. The responsible personnel at AMS are listed below.

| Name | Title | Role |
|--------------------------------|--------------------------|------------------------------|
| Kassahun Sellassie Ph.D., P.E. | Director of AMS | Project oversight |
| Edward Braun | Air Manag. Prog. Manager | Research & management |
| Henry Kim | Administrative Engineer | Modeling and data processing |
| Jason Li | Engineering Specialist | Project research engineer |
| Hallie Weiss | Administrative Engineer | Ambient air monitoring |
| Dennis Sosna | Administrative Scientist | AMS Laboratory |
| Thomas Barsley | Administrative Engineer | Quality improvement |
| Marlena Gordon | Administrative Office | Administrative support |
| Meyliana Wu | Engineering Specialist | Project QA/QC engineer |
| Paresh Mehta | Engineering Supervisor | Field operation |

See the project organizational chart in Figure 4.1, which also shows the PA DEP and EPA Region III involvement in the project.

Staff members involved in this project have extensive experience in installing and maintaining sophisticated air pollution monitoring equipment as well as quality assuring the data produced. Hallie Weiss is responsible for the installation and maintenance of the equipment, as well as data collection activities. Henry Kim coordinates modeling and data analysis. AMS Director, Kassahun Sellassie, oversees all activities to ensure that project milestones are achieved satisfying quality requirements. Dr. Sellassie has successfully managed several projects related to air programs for a number of years and frequently communicates with community members regarding the quality of Philadelphia's air.

Figure 4.1 Organizational Chart for the Philadelphia Air Quality Survey Project |



For staff supervised by persons in this chart, see the full AMS organizational chart, Appendix A

5. BACKGROUND AND PURPOSE

This section of the QAPP gives an overview of the problem to be solved, along with any pertinent background information for the project. This section describes why the project will be done and what needs to be done. The QAPP is the critical document for any environmental data collection operation because it documents how quality assurance (QA) and quality control (QC) activities will be implemented during the project's life cycle.

5.1 Background

In order to protect air quality, active environmental data collection operations must be established and operated in a manner that assures the most applicable and highest quality data are collected. Ambient air quality monitoring programs monitor criteria pollutants (particulate matter [particles with an average aerodynamic diameter of 10 micrometers or less (PM₁₀) or 2.5 micrometers or less (PM_{2.5})], sulfur dioxide (SO₂), carbon monoxide (CO), nitrogen dioxide (NO₂), ozone (O₃), and lead (Pb). Philadelphia is the largest city in the Commonwealth of Pennsylvania and the fifth-most populous in the United States with an estimated population of 1.5 million and an area of approximately 365 square kilometers. As an urban area, Philadelphia faces many of the same pollution challenges as other densely populated areas, such as emissions from vehicles and industries. Currently, Philadelphia is considered to be in attainment for all pollutants, with the exception of ozone. However, city-wide neighborhood scale air sampling is still needed to help us better understand the air quality in various areas in the City and strategize air pollution reduction. Philadelphia Air Management Services (AMS), a division of the Philadelphia Department of Public Health and the local air pollution control agency for the City of Philadelphia, is proposing a plan to collect integrated samples of fine particulate matter (PM_{2.5}) and other pollutants (see 5.3) using portable ambient air sampling units at about 62 locations in Philadelphia.

On December 17, 2015, the EPA released the fifth version of the National Air Toxics Assessment (NATA), the 2011 NATA – a state-of-the-science screening tool that provides information on the potential risks (cancer and non-cancer) from air toxics, including non-cancer risk estimates for diesel PM. The 2011 national-scale risk assessment is based on a 2011 inventory of air toxics emissions, the most complete and up-to-date available. The NATA findings have placed Philadelphia county on the 6th rank for the highest total onroad sources cancer risk. From this project, the air sampling results will include indicators for diesel PM emissions (e.g. black carbon) and onroad vehicle emissions (e.g. NO₂). These data, in conjunction with the NATA findings, will help us better understand the spatial patterns of pollution from diesel and onroad sources in Philadelphia, therefore formulate emission reduction strategies.

5.2 Purpose

The main purpose of the project is to have a screening tool to understand air pollution that we may be missing with our current ambient air monitoring network. We will examine spatial and temporal variations of pollutant concentrations in Philadelphia. The data will be used to assess

impact on health and well-being of Philadelphia residents and the environment. To summarize, the project plans to:

- Find how pollution levels vary across City of Philadelphia
- Better understand hot spots and sources of air pollution
- Establish seasonal pollution level profiles at different locations
- Plan effective measures to reduce pollution
- Provide data for studies of health impacts of the pollutants across the City

5.3 Pollutants of Interest

Below is the list of pollutants of interest for the AMS' Air Quality Monitoring Survey:

- Particulate Matter (PM_{2.5})
- Nitrogen Dioxide (NO₂)
- Sulfur Dioxide (SO₂)
- Ozone (O₃)
- Chemical speciation of PM_{2.5}

5.4 Locations of Interest

Figure 5.4 shows proposed sampling locations in this project. Sampling locations will cover neighborhoods of the entire city of Philadelphia. There are 62 sites in total.

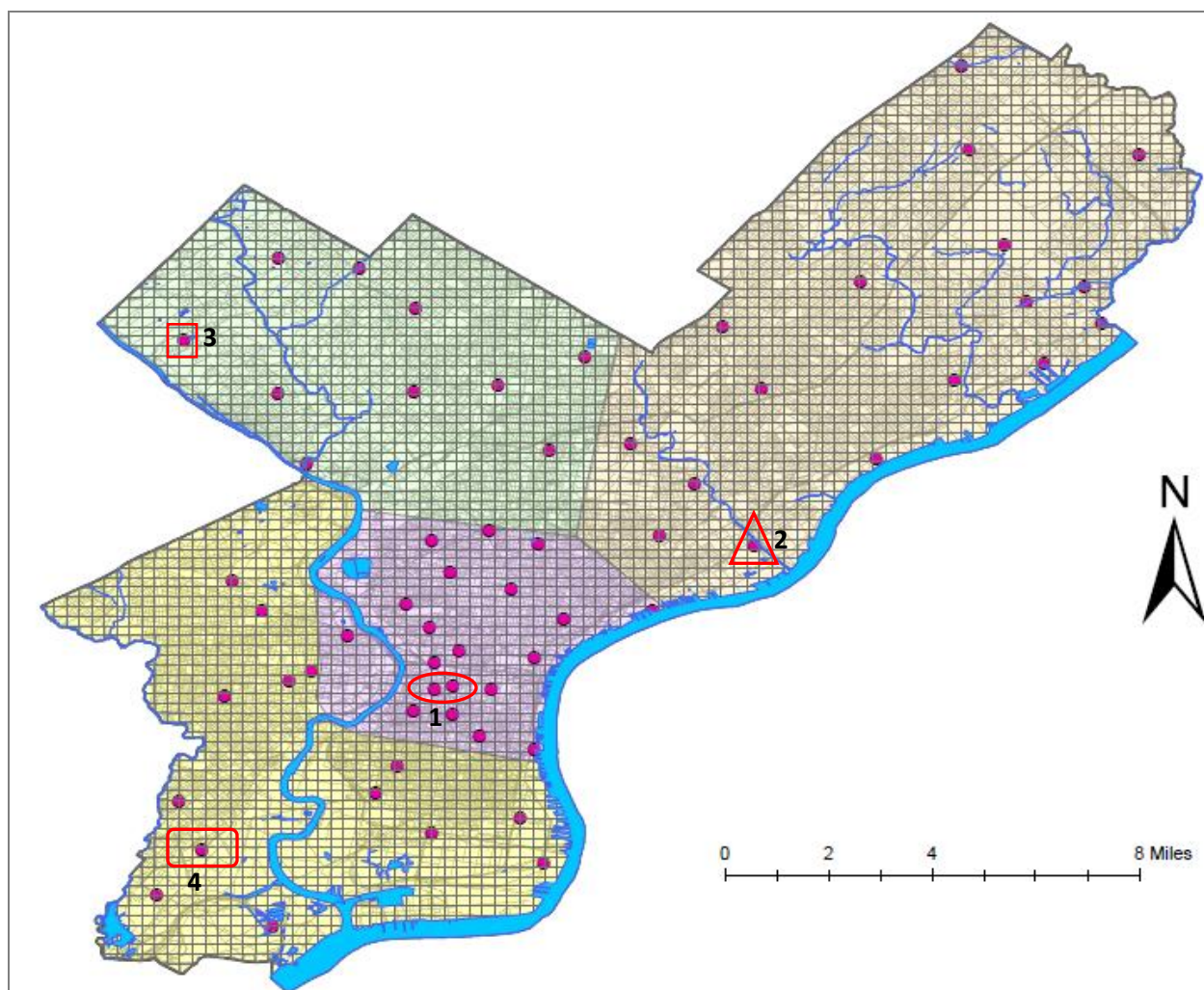


Figure 5.4 Philadelphia Map with Locations of Sampling Sites

The majority of the sampling locations were selected randomly for the purpose of data representativeness. A smaller number of locations are determined as "purposeful sites". Some of the purposeful sites are located to fill the gap of a large area not covered by random sites. Other purposeful sites are selected to monitor the impact of certain emission sources on nearby neighborhoods (see Section 10 for more details of site selection).

As examples, some of the purposeful sites are shown in Figure 5.4. and described below.

- 1) Per suggestions from the October 2016 Air Pollution Control Board meeting, the two sites in downtown (red circle) were moved to be closer to Rittenhouse Square and they represent the Center City section.
- 2) A location (red triangle) near NEW site is chosen to represent a Northeast section of the City.
- 3) A location at ROX (red square) is chosen as a reference site in Northwest section of the City.
- 4) A location near the Philadelphia Postal Processing and Distribution Center (red rectangular) represents a Southwest section of the City.

6. PROJECT/TASK DESCRIPTION AND SCHEDULE

This section of the QAPP summarizes the work to be detailed in the remaining sections of this QAPP. It describes the approach taken to address the project's objective, connecting what is needed and how it will be obtained.

6.1 Description of Work to Be Performed

A total of 62 monitoring sites are selected to sample the ambient air in various neighborhoods across the City. Samples are collected in all seasons. The monitoring sites are selected to ensure that traffic and roads conditions, density of buildings, population density, and land use in Philadelphia are adequately taken into considerations while providing a balance in spatial coverage throughout the city. See Figure 5.4 for site locations. Section 10 of this QAPP describes the methodology of selecting the sampling locations in more detail. Contractual and/or part time employees may be employed for field operation if necessary. The sampling operation and sample data collection will generally follow the sampler/sensor manufacturers' manuals and instructions. Notice that the project may use monitors not approved for Federal Reference Method (FRM) or Federal Equivalent Method (FEM) since this is not an EPA required regulatory monitoring project. There will be collocated samplers for QA/QC purpose.

The goal, tasks and deliverables of the City of Philadelphia Air Quality Survey can be organized into two main phases:

1) **Phase One**

- Design the Air Quality Monitoring Survey network, perform site survey and document detail information of each sampling site.
- Deploy 2 (or 4) calibrated multi-pollutant air quality samplers, and conduct testing and evaluation for 2 to 3 months.

2) **Phase Two**

- During this phase, full scale city-wide sampling operation is conducted. The sampling operation will last about 24 months at all 62 locations in the City. See Section 10 for more details of the sampling process design.
- Data quality assurance and data analysis.

Two types of samplers will be used. Multi-pollutant continuous samplers are used to measure PM_{2.5}, NO₂, SO₂, and O₃. Filter-based samplers will collect samples for PM_{2.5} speciation.

Sampling instruments are mounted on utility poles or similar structures, about 10 - 12 feet above the ground. Most of them will be near the street curbside. These instruments are powered by solar panels and batteries.

6.2 Field Activities

AMS laboratory field personnel will perform most of the field activities. Contractual and/or part time workers may be employed if necessary. Major field operation activities include: site survey (select a suitable utility pole and document site information for each site); in Phase I, install two sampling units for testing [one at the AMS Lab location, the other at the Spring Garden (existing

FAB site) location]; in Phase II, install and rotate sampling units periodically to monitor all sampling sites, and collect samples for filter-based PM_{2.5} speciation monitoring.

6.3 Project Assessment Techniques

An assessment is an evaluation process used to measure the performance or effectiveness of a system and its elements. As used here “assessment” is an all-inclusive term used to denote any of the following: audit, performance evaluation, management systems review (MSR), peer review, inspection, or surveillance.

The sampler testing process in Phase I serves to assess the effectiveness of sampling equipment. At least two different models of equipment will be tested, and the satisfactory model is chosen to be used in Phase II. After Phase II starts and considerable amount of data have been collected (e.g. 3 months into the city-wide sampling operation), a comprehensive data analysis will be performed to see if the data produced meet the project purpose (see 5.2) and data quality objectives (Section 7) and if any adjustments in project design and operation are needed. Section 20 discusses the project assessments in more details.

6.4 Schedule of Critical Activities

Table 6.4 is a list of the critical activities required to plan, implement and assess the Project.

Table 6.4 Critical Activities of the Air Quality Monitoring Survey

| Activity | Responsible Unit(s) | Comments |
|-------------------------------------|----------------------------------|---|
| ArcGIS (Mapping) | AMS Research | Mapping is done for all 62 locations. |
| Site Survey | AMS Research and AMS Laboratory | On 10/28/16, Jason Li and Paresh Mehta of AMS Research and AMSL started the site survey. It is on-going. |
| Equipment Purchase | AMS and/or a selected contractor | Equipment Purchasing; equipment to be purchased are calibrated PM _{2.5+1+10} , calibrated NO ₂ and SO ₂ of AlphaSense. |
| Installation of Equipment (Phase 1) | AMS and/or a selected contractor | Phase 1 - two instruments for 2-3 months testing; AMS vehicle and equipment. |
| Moving Equipment and Installation | AMS and/or a selected contractor | 15 - 16 samplers at a time every 14 days (15 eqs. x 4 times/season x 4 seasons = 240 moves per 12-month period) |
| Installation of Equipment (Phase 2) | AMS and/or a selected contractor | 6 filter base samplers per batch, 2 batches per season (2/season move x 6 x 4 seasons = 48 moves per 12 months) |
| Sample Collection | AMS Laboratory | Samples are collected by Field Techs. |
| Analyzing Samples | UPenn | Speciation samples analyzed by UPenn |
| Real Time Data Processing | AMS Research | |
| Wind Rose and Weather | AMS Program Services | |
| Mapping of Pollutants | AMS | |
| SAS/LUR | AMS/ UPenn | |
| Publication/Report | AMS/ UPenn | |
| Dust Collection | UPenn | |
| Comparison of Ambient Air and Dust | AMS/ UPenn | To see if there is any correlation between PM _{2.5} spec. and road dust |
| Flow Checks | AMS Laboratory | |
| Filter Loading/Unloading | AMS Laboratory/UPenn | Filter weighing, mass of PM _{2.5} |
| Downloading data from cloud | AMS Laboratory | |
| QA/QC | AMS Laboratory | Field data sheet & Observation sheet; Temperature and RH sheets; Flow Rate Determination sheet |
| Data Analysis | AMS/ UPenn | |

7. DATA QUALITY OBJECTIVES AND CRITERIA

7.1 Intended Use of Data

The data results from this project will be used to:

- Evaluate street level, neighborhood-to-neighborhood concentrations of the measured pollutants and their spatial variances across the City.
- Identify the areas, at neighborhood scale, with relatively high concentrations of pollutants that may indicate impact of certain types of pollution, such as diesel exhaust, vehicle emissions, emissions from major facilities and from residual fuel oil burning, etc.
- Evaluate the seasonal (temporal) changes of pollutant concentrations, which will help us better understand winter time particle and SO₂ pollution and summer time ozone precursor emissions.
- Serve as a basis upon which policy recommendations will be made to reduce emissions.
- Serve as a basis for future public health impact studies, such as evaluating public exposure in different parts of the City, building a Land Use Regression (LUR) model for air quality modeling and epidemiological studies.

7.2 Type of Data to be Produced

For continuous multi-pollutant samplers which will measure PM_{2.5}, NO₂, SO₂, O₃, and meteorological parameters, the sampling sensors can be programmed to take a reading once in a while. In the raw data, one "reading" can be an instantaneous value of the pollutant concentration or an average value of a short period of time (e.g. 2 minutes). Depending on the equipment model we use and its power supply capacity, we will program the sampling units to take readings several times (6 - 12 times) per hour. An hourly average concentration value will be calculated from these several readings. For PM_{2.5}, a daily 24-hour average value will be calculated from the hourly averages.

For filter-based samplers which collect samples for PM_{2.5} speciation analysis, the sampler will be operating 14 days to produce one sample for each sampling session. Therefore, the sample is a 14-day average for PM_{2.5} speciation data.

7.3 General Data Quality Objectives

Although the project may not use FRM or FEM samplers, sensors and samplers used in this project will be carefully tested and chosen, and QA/QC procedures will be implemented to produce as high data quality as possible. The sensors used in the samplers are AlphasenseTM sensors, which are calibrated by the manufacturer and maintain ISO 9001:2015 certification.

- All data shall be of a known and documented quality.
- Ideally, a 95% confidence of both precision and bias should be maintained with a $\pm 15\%$ difference or better between the actual amount of an introduced parameter and the indicated response of the measurement system.
- All data shall be produced in a consistent and scientific manner, so that data from different sampling locations and sampling seasons will be comparable.

- All data shall be representative of the parameters being measured with respect to time, location, and the conditions from which the data are obtained. The use of sensors for meteorological measurements will help maintain the data representativeness.
- The sampling data, by each sampling season, are expected to have at least 75% of data completeness.

It is the policy of AMS that the QA Program assures that all environmental data generated, processed and used is scientifically valid, of acceptable completeness, representativeness, and comparability, of a known and documented quality, and in conformance with EPA requirements when applicable. It is also the policy that, when appropriate, reported data includes or incorporates by reference documented precision and accuracy of the data. The QMP approved on June 15, 2016 by EPA has been prepared in accordance with the US EPA Order 5360.1, Policy and Program Requirements to Implement the Mandatory Quality Assurance Program; and US EPA QA/R-2, EPA Requirements for Quality Management Plans. The procedures outlined in the QMP will be used as a benchmark and reference for this project.

8. SPECIAL TRAINING REQUIREMENTS/CERTIFICATION

AMS engineers have participated in GIS technology training. Arrangements will be made for staff to participate in training of statistical data analysis. Field operation personnel will be trained to operate the continuous multi-pollutant samplers and filter-based samplers, handle the filter samples, as well as mount samplers on utility poles. The training includes reading this QAPP and instrument/equipment manuals and instructions provided by the manufacturers, as well as practicing installation and tuning of the instruments. Training certificates are not required.

9. DOCUMENTATION AND RECORDS

AMS maintains records in appropriate files that allow for the efficient archival and retrieval of records. Documents and records will be backed up for data safety. For this project, the documents and records to be maintained include:

- This QAPP
- Project Work Plan
- Sampling site survey procedures and survey records
- Instrument SOPs and manufacturers' manuals and instructions
- Records for instrument testing results
- Logbooks for field and laboratory operations
- Electronic data records -- all data from the multi-pollutant continuous samplers will be stored electronically
- Data records from all chemical analysis results
- Records for data quality assurance process
- Records for data processing and analysis
- Records for response/corrective actions
- Quarterly reports to PA DEP
- Final report of the project

10. SAMPLING PROCESS DESIGN

This section describes the general technical design of the sampling process of the project.

10.1 Sampling Sites

To achieve the purpose of this project, city-wide sampling locations are selected using GIS techniques. Initially, it was decided that the total number of sampling locations would be about 60 - 65. This determination was based on the purposes of the project, the estimated statistical power of data produced from such number of sites, the land size and population of the city of Philadelphia, logistic and budgetary considerations, etc. A digital map is created to cover the City with a grid of 300x300 meter squares (cells). A sampling site falls in one of these cells. Also, the City is divided into four quadrants (Central, Northeast, Northwest, and South/Southwest areas), as shown in Figure 5.4. In each quadrant, the land size, population, and air pollution related sources are examined during the process of determining the number of sampling sites in the quadrant. The quadrant containing the central part of the City is given higher site density, due to the higher densities of population, buildings, traffic, and other air pollution related contributors in this area.

For each quadrant, a random selection of the cells is conducted using ArcGIS system. This random site selection process is used to locate about 70 - 75% of the sampling sites in each quadrant. The remaining 25 - 30% of sites are determined as "purposeful" sites. The location of a purposeful site is determined to serve one or more of the purposes: a) to fill gaps where a large area is not covered by a random site; b) to locate a sampling unit near an existing regulatory monitor for evaluating the sensor performance; c) to capture the potential impact of sources with particular concerns (e.g. congested streets in downtown area, near a large emission source/facility, etc). At the end of the site selection process, 62 sites have been determined.

10.2 Site Survey

At each monitoring site, the sampling unit will be mounted on a utility pole about 10 - 12 feet above the ground. The task of site survey is to visit each proposed site, document the land use characteristics in the immediate surrounding area, and identify one or two particular utility poles that are suitable for mounting the sampling unit. Detailed utility pole information can be obtained from the City GIS system. Site surveyors will follow an SOP and fill out survey forms. The utility pole needs to meet certain criteria specified in the SOP, such as certain distance away from tree branches and air vents on buildings, easy and safe access for field operation.

10.3 Sampling Operation

A 12-month period is divided into four sampling seasons: spring (March - May), summer (June - August), fall (September - November), and winter (December - February). City-wide sampling will start in Spring 2017. For each sampling site in each season, one (1) sampling session will be conducted, which lasts two weeks (14 days). Since there are about 62 sites but we may only have

20 or fewer continuous sampling units, the 62 sites will be sampled in four operational batches in each season. That is, 15 - 16 sites will be monitored at a time. Then the samplers will be rotated to the next batch of 15 - 16 sites. To avoid spatio-temporal confounding associated with different sites being monitored during different time windows, the 15 - 16 sites in each operational batch will be randomly selected from all of sites.

In order to obtain a year-round temporal profile of the pollutant concentrations, four locations (one in each quadrant, known as reference sites), will be monitored all year around. The entire sampling operation is expected to last 24 months.

About 12 of the 62 sampling locations will be monitored with filter-based samplers for PM_{2.5} speciation, along with the multi-pollutant continuous samplers. Six such samplers will run at a time for a 2-week sampling session during an operational batch, two batches per season.

11. SAMPLING METHODS

11.1 Methods for Multi-pollutant Continuous Sampling

The integrated sampling unit includes Alphasense™ sensors within a weatherproof enclosure, real-time data monitoring via cellular communication, solar power/battery for remote operations. Besides PM_{2.5}, NO₂, SO₂, and O₃ (at select sites), meteorological data such as temperature, humidity and barometric pressure are also measured and recorded. This type of sampling units are known as higher performance/sensitivity equipment to record more detailed measurements than non-calibrated instruments. Manufacturer calibrated air sensors can be easily installed in the sampling unit enclosure.

Core features include:

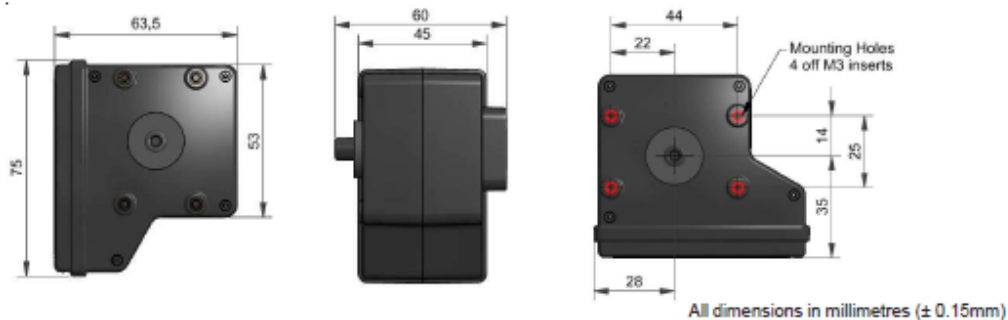
- Modular system for rapid configuration and updates
- Robust waterproof of IP65 enclosure
- Field tested
- Adding or changing sensors can be easily done
- Solar powered with external panel
- Special brackets ready for street pole mounting
- Economical and cost effective for large network deployment

The following figures are sample layouts for the calibrated sensor station (integrated sampling unit) for particle monitor, nitrogen dioxide sensor and sulfur dioxide sensor.

OPC-N2 Particle Monitor



Figure 1 OPC-N2 Schematic Diagram



- * Micro USB socket allows on-site firmware updates
- * Onboard data logging via 16GB SD card: 12 months' capture
- * SPI control of fan and laser for lowest power
- * Factory set:
 - particle size
 - particle density/Total RI
 - bin weighting for respirable profiling

MEASUREMENT

| | | |
|-----------------------------|--|------------|
| Particle range | Spherical equivalent size (based on RI of 1.5) | 0.38 to 17 |
| Size categorisation | Number of software bins | 16 |
| Sampling interval | Histogram period (seconds) | 1.4 to 10 |
| Total flow rate (typical) | L/min | 1.2 |
| Sample flow rate (typical) | mL/min | 220 |
| Max particle count rate | Particles/second | 10,000 |
| Max coincidence probability | %concentration at 10^5 particles/L | 0.84 |
| | %concentration at 500 particles/L | 0.24 |

POWER

| | | |
|---------------------|--------------|------------|
| Measurement mode | mA (typical) | 175 |
| Laser on, fan off | mA (typical) | 95 |
| Voltage range | VDC | 4.8 to 5.2 |
| Switch-on transient | mW for 1ms | < 5000 |

DATA

| | | |
|-------------------------------|-------------------------------------|------|
| Digital interface/connections | Micro USB (programming), SPI (data) | |
| Data storage | micro-SD (.CSV format) | 16GB |

KEY SPECIFICATIONS

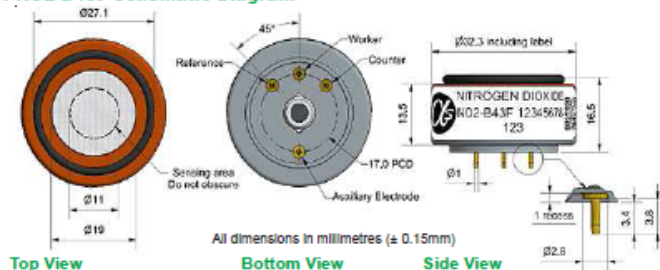
| | | |
|----------------------|---------------------|--------------------------|
| Digital interface | SPI (Mode 1), USB | |
| Laser classification | as enclosed housing | Class 1 |
| Temperature range | $^{\circ}\text{C}$ | -10 to 50 |
| Humidity range | % rh (continuous) | 0 to 99 (non-condensing) |
| Weight | g | < 105 |

Figure 11.1.1 - Technical Specification for the Calibrated Station of Particle Monitor

NO2-B43F Nitrogen Dioxide Sensor 4-Electrode



Figure 1 NO2-B43F Schematic Diagram



PERFORMANCE

| | | |
|---------------|--|--------------|
| Sensitivity | nA/ppm at 2ppm NO ₂ | -175 to -450 |
| Response time | t ₉₀ (s) from zero to 2ppm NO ₂ | < 60 |
| Zero current | nA in zero air at 20°C | -50 to +70 |
| Noise* | ±2 standard deviations (ppb equivalent) | 15 |
| Range | ppm NO ₂ limit of performance warranty | 20 |
| Linearity | ppb error at full scale, linear at zero and 5ppm NO ₂ | < ±0.5 |
| Overgas limit | maximum ppm for stable response to gas pulse | 50 |

* Tested with Alphasense ISB low noise circuit

LIFETIME

| | | |
|-------------------|---|------------|
| Zero drift | ppb equivalent change/year in lab air | 0 to 20 |
| Sensitivity drift | % change/year in lab air, monthly test | -20 to -40 |
| Operating life | months until 50% original signal (24 month warranted) | > 24 |

ENVIRONMENTAL

| | | |
|---------------------|---|-----------|
| Sensitivity @ -20°C | (% output @ -20°C/output @ 20°C) @ 2ppm NO ₂ | 60 to 80 |
| Sensitivity @ 40°C | (% output @ 40°C/output @ 20°C) @ 2ppm NO ₂ | 95 to 115 |
| Zero @ -20°C | nA | 0 to 25 |
| Zero @ 40°C | nA | -10 to 50 |

CROSS SENSITIVITY

| | | | | |
|-------------------------------|----------------------------|----------|-------------------------------|-------|
| O ₃ | Filter capacity (ppm.hr) | @ 2ppm | O ₃ | > 500 |
| H ₂ S | sensitivity % measured gas | @ 5ppm | H ₂ S | < -80 |
| NO | sensitivity % measured gas | @ 5ppm | NO | < 5 |
| Cl ₂ | sensitivity % measured gas | @ 5ppm | Cl ₂ | < 80 |
| SO ₂ | sensitivity % measured gas | @ 5ppm | SO ₂ | < 5 |
| CO | sensitivity % measured gas | @ 5ppm | CO | < 3 |
| H ₂ | sensitivity % measured gas | @ 100ppm | H ₂ | < 0.1 |
| C ₂ H ₄ | sensitivity % measured gas | @ 100ppm | C ₂ H ₄ | < 0.5 |
| NH ₃ | sensitivity % measured gas | @ 20ppm | NH ₃ | < 0.2 |
| CO ₂ | sensitivity % measured gas | @ 5% Vol | CO ₂ | < 0.1 |
| Halothane | sensitivity % measured gas | @ 100ppm | Halothane | nd |

KEY SPECIFICATIONS

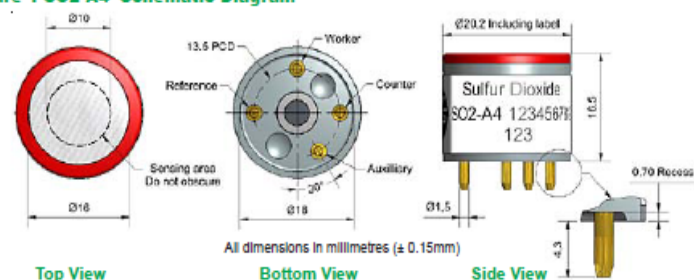
| | | |
|-------------------|---|-----------|
| Temperature range | °C | -30 to 40 |
| Pressure range | kPa | 80 to 120 |
| Humidity range | % rh continuous | 15 to 85 |
| Storage period | months @ 3 to 20°C (stored in sealed pot) | 6 |
| Load resistor | Ω (ISB circuit is recommended) | 33 to 100 |
| Weight | g | < 13 |

SO2-A4 Sulfur Dioxide Sensor 4-Electrode



Figure 1 SO2-A4 Schematic Diagram

Patented



PERFORMANCE

| | | |
|---------------|--|------------|
| Sensitivity | nA/ppm at 2ppm SO ₂ | 320 to 480 |
| Response time | t ₉₀ (s) from zero to 2ppm SO ₂ | < 20 |
| Zero current | nA in zero air at 20°C | 5 to 45 |
| Noise* | ±2 standard deviations (ppb equivalent) | 15 |
| Range | ppm limit of performance warranty | 50 |
| Linearity | ppb error at 20ppm SO ₂ , linear at zero and 2ppm SO ₂ | 0 to -5 |
| Overgas limit | maximum ppm for stable response to gas pulse | 100 |

* Tested with Alphasense AFE low noise circuit

LIFETIME

| | | |
|-------------------|---|-------|
| Zero drift | ppb equivalent change/year in lab air | < ±20 |
| Sensitivity drift | % change/year in lab air, monthly test | < ±15 |
| Operating life | months until 50% original signal (24 month warranted) | > 38 |

ENVIRONMENTAL

| | | |
|---------------------|---|------------|
| Sensitivity @ -20°C | (% output @ -20°C/output @ 20°C) @ 2ppm SO ₂ | 80 to 95 |
| Sensitivity @ 50°C | (% output @ 50°C/output @ 20°C) @ 2ppm SO ₂ | 90 to 105 |
| Zero @ -20°C | nA change from 20°C | < ±25 |
| Zero @ 50°C | nA change from 20°C | 150 to 300 |

CROSS SENSITIVITY

| | | |
|---|-------------------------|-----------------------------------|
| Filter capacity | ppm-hrs | 450 |
| H ₂ S sensitivity | % measured gas @ 5ppm | H ₂ S < 40 |
| NO ₂ sensitivity | % measured gas @ 5ppm | NO ₂ < -180 |
| Cl ₂ sensitivity | % measured gas @ 5ppm | Cl ₂ < -70 |
| NO sensitivity | % measured gas @ 5ppm | NO < -1.5 |
| CO sensitivity | % measured gas @ 5ppm | CO < 2 |
| H ₂ sensitivity | % measured gas @ 100ppm | H ₂ < 1 |
| C ₂ H ₄ sensitivity | % measured gas @ 100ppm | C ₂ H ₄ < 1 |
| NH ₃ sensitivity | % measured gas @ 20ppm | NH ₃ < 0.1 |
| CO ₂ sensitivity | % measured gas @ 5% | CO ₂ < 0.1 |

KEY SPECIFICATIONS

| | | |
|-------------------|---|-----------|
| Temperature range | °C | -30 to 50 |
| Pressure range | kPa | 80 to 120 |
| Humidity range | % rh continuous (see note below) | 15 to 90 |
| Storage period | months @ 3 to 20°C (stored in sealed pot) | 6 |
| Load Resistor | Ω (AFE circuit is recommended) | 33 to 100 |
| Weight | g | < 6 |

Figure 11.1.2 - Technical Specification for the Calibrated Station of NO₂ (Left) and SO₂ sensors (Right)

The sampling sensors can be programmed to take a reading once in a while, then be put in a "deep sleep" mode to save power. One "reading" is a raw data element, which can be an instantaneous value of the pollutant concentration or an average value of a short period of time (e.g. 2 minutes). Depending on the equipment model we use and its power supply capacity, we will program the sampling units to take readings several (6 - 12) times per hours. An hourly average concentration value can be calculated from these several readings.

11.2 Methods for Filter-based Sampling

About 12 of the 62 sampling locations will be monitored with filter-based samplers as well, along with the multi-pollutant continuous samplers. The filter based sampler is to collect samples for PM_{2.5} speciation analysis. The sampler consists of an air inlet with size selection impactor, an air pump calibrated to an actual air flow rate of 4 LPM, air filter (2 μ m pore size) and filter case. The sampling unit also contains relative humidity, temperature and barometric pressure sensors connected to a data logger. A programmable smart controller allows the air pump to start and stop by a pre-set schedule, operating 15 minutes each hour (to save power), yielding an 84-h sample with an air volume of 20.16 m³, over the 2-week sampling period. Therefore, a PM_{2.5} speciation sample is a two-week average sample. The unit is powered by batteries and has a weatherproof exterior, see in Figure 11.2.1.



Figure 11.2.1 Integrated Filter-based PM_{2.5} Sampling Unit

12. SAMPLE HANDLING AND CUSTODY

For multi-pollutant continuous samplers, the sensors produce pollutant concentration data, which are transmitted and stored electronically. There are no physical samples to be handled. The sample data management is described in Section 19.

For the filter based PM_{2.5} speciation samples, the sample handling and custody SOP will be followed when a sample filter is placed into or taken out of the sampler. The operating personnel will fill out a form with the information: operator name, sampler ID, filter case ID, filter-in date/time, filter-out date/time, where the filter is placed after taken out (e.g. filter rack number in the conditioning room), comments, etc. A filter in/out cycle is 14 days.

13. ANALYTICAL METHODS

For multi-pollutant continuous samplers, the sensors produce pollutant concentration data electronically. No lab analysis is needed.

For the filter based PM_{2.5} samples, the filter will be conditioned and weighed before and after sampling, using the same method and procedures as used in FRM PM_{2.5} filter weighing. Then the filter will be analyzed for its light Reflectance using an EEL (Incorporating Evans Electroselenium) smoke stain reflectometer (Model 43D; Diffusion Systems, London, UK). The reflectance data are used to calculate absorbance (darkness). The absorbance is used as an indicator of Black Carbon (but not directly the BC mass).

The filter will be analyzed with X-ray fluorescence method [DRI Standard Operating Procedure, X-Ray Fluorescence (XRF) Analysis of Aerosol Filter Samples (PANalytical Epsilon 5), DRI SOP #2-209r3 2007, Reno, NV.] for chemical speciation, including nickel, vanadium, and other elements that can serve as indicators of residual fuel oil burning.

14. QUALITY CONTROL

14.1 QC for Multi-pollutant Continuous Sampling

During Phase I (testing phase), the samplers will be tested. Hourly average pollutant concentrations will be calculated from the sampler raw data and used to evaluate the sampler performance.

Collocation: for at least two sampling sites, each site will have two identical, collocated continuous samplers operating under the same conditions during the city-wide operation. Data will be used for sampler precision check.

Operators must follow the manuals and instruction provided by the equipment manufacturers during equipment testing, installation, and retrieval.

14.2 QC for Filter-based Sampling

For filter-based samplers, one sampling location will have two identical, collocated samplers operating under the same conditions. Data will be used for sampler precision check. Pump flow rates before and after sample collection are compared and the temperature-corrected flow rate is compared with the expected flow rate (4 L/min). Flow rates must be within 10% of designed value, and volumes and exposure times must be within 5% of targets for data to be considered valid. For filter quality control, each season (12 samples) will have one field blank and one lab blank.

Operators must follow the manuals and instruction provided by the equipment manufacturers during equipment testing, installation, and retrieval.

15. INSTRUMENT/EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE

During Phase I, the AMS Lab personnel will inspect all sampling units received from vendors. Testing will be conducted to examine their performance and data quality before they are used in city-wide sampling operation.

During the 2-week operation of each sampling session, no routine maintenance of the equipment is needed. If a sampler is found to be malfunctioning by field personnel or through data reviews (Section 22), an investigation will be conducted and the malfunctioning part or sampler will be replaced.

16. INSTRUMENT/EQUIPMENT CALIBRATION AND FREQUENCY

For the multi-pollutant continuous samplers, sensors are calibrated by the manufacturers before they are shipped. AMS does not perform calibration on them. During the sampling operation, malfunctioning sensors will be replaced.

For PM_{2.5} speciation samplers, the pump flow rate will be set before each sampling session and checked again after the session. The flow rate data before and after sample collection are compared, and the temperature-corrected flow rate is compared with the expected flow rate (4 L/min). Cumulative pump run time and controller data are reviewed, and sample volume is computed. Flow rates must be within 10% of designed value, and volumes and exposure times must be within 5% of targets for data to be considered valid. No calibration is performed during the 2-week session of sample collection.

17. INSPECTION/ACCEPTANCE OF SUPPLIES AND CONSUMABLES

The AMS Lab personnel will inspect all supplies and consumables received from vendors. These include PM_{2.5} filters and replacement parts of the samplers. When applicable, testing will be conducted to examine their quality before they are used.

18. NON-DIRECT MEASUREMENTS

The filter absorbance (described in Section 13) is a non-direct indicator for Black Carbon. It is not the actual black carbon or elemental carbon mass or mass concentration, and should not be directly compared with the regulatory monitoring data of elemental carbon. However, the same type of absorbance data from this project can be compared with one another to evaluate the relative levels of black carbon pollution at different sampling locations. Also, statistic correlations can be established between the filter absorbance data and the regulatory monitoring data of elemental carbon.

19. DATA MANAGEMENT

Sensors in the continuous samplers will be programmed to record measurements 6 - 12 times per hour, and the data is wirelessly transmitted to a secured cloud storage. The data transmission are via 3G or 4G connections. The data transmission technology, data storage infrastructure, and data retrieval mechanisms are part of a package provided by the vendor of the sampling units. The data can be accessed via a password protected web link as needed by AMS staff and others with approved access credentials.

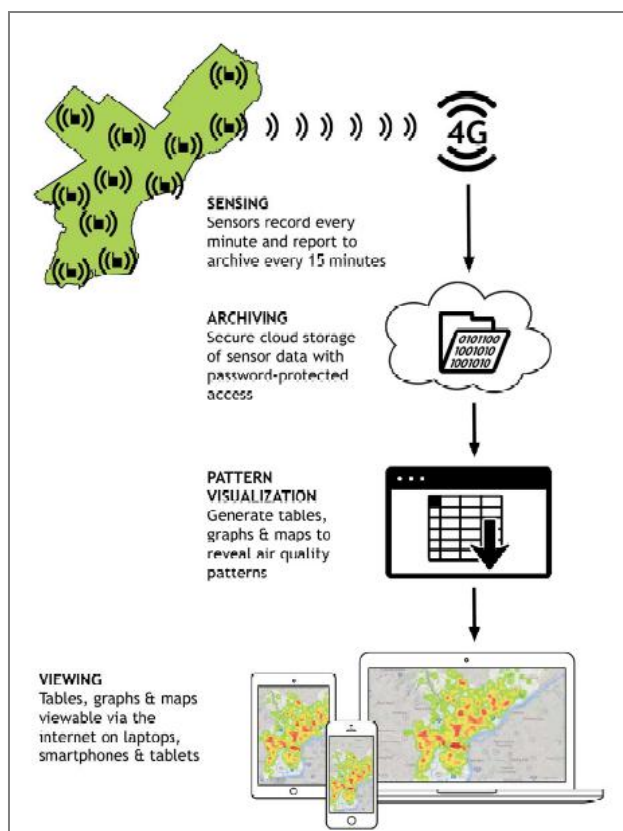


Figure 19.1 Illustration of data transmission and storage

Data in the cloud storage will be downloaded to local files periodically. Backup copied will be made and saved.

The data from the filter-based samples, including the filter weighing data and chemical analytical data, will be filled out in data sheets during operation and analysis. Then the data are entered and stored in a local database at AMS. Backup copied will be made and saved.

20. ASSESSMENT AND RESPONSE ACTIONS

For the purpose of evaluating the performance of the sampling units, about 6 continuous and 1 filter-based sampling units will be located near the existing regulatory monitoring stations. The concentrations for each pollutant monitored at each site are characterized in term of hourly averages, 24-hour averages (for $PM_{2.5}$), seasonal averages and trends, and median, mean, min and max values of a sampling session, etc. Other observations are also examined, for example, whether there are major facilities nearby which may affect the readings, vehicle idling, stack emissions, nearness of port, airport, traffic, etc. The project QA engineer, research engineer and the AMS Lab personnel will conduct the assessment.

Any participant in the collection, analysis, assessment, and report generating activities affiliated with this project is responsible for identifying the need for corrective actions. Identifying the need for corrective actions can occur during site visits, equipment installation or removal, data

analysis, or other monitoring activities. This shared responsibility, coupled with diligent attention to detail and accuracy, will assure that the project consistently collects quality data, and that this data is reviewed, analyzed, and presented in an accurate and representative manner. Any participant that perceives a need for corrective action(s) shall present the situation to their supervisor or the appropriate AMS manager within 7 days of perceiving the need. AMS supervisors will assess the need for a corrective action. If one is deemed necessary, a suitable corrective action will be selected and disseminated to the QA Staff or appropriate personnel.

The Quality Assurance Supervisor and/or Quality Engineer (QA Staff) are responsible for implementing corrective actions. An implementation notice will be supplied to the AMS manager upon completion of the corrective action. The corrective action must be implemented within 30 days notwithstanding extenuating circumstances.

21. REPORTS TO MANAGEMENT

The key AMS staff members involved in this project, as described in Section 4, will have bi-weekly meetings with AMS Director Kassahun Sellassie to report work progress and discuss any issues. Also, AMS has a bi-weekly system for reporting work task accomplishments and scheduling future work. The tasks and progress of this project will be documented in the bi-weekly reports.

AMS will submit quarterly reports to PA DEP, which include task accomplishments, scheduled activities for the next reporting period, whether the work is carried out on time, issues and proposed remedies, and expenditure. These reports will be submitted electronically within 30 days of the conclusion of a calendar quarter.

22. DATA REVIEW, VALIDATION, AND VERIFICATION

Data from the continuous samplers will be reviewed timely (e.g. every day or every other day) so that questionable data can be discovered as soon as possible. Timely corrective actions should be taken when indicated to minimize further generation of questionable data.

Data validation and verification will be performed on a batch basis. Descriptive statistics of the data will be computed for the monitored sites by session (operational batch) to identify potential outliers for further investigation. Outliers are documented/flagged and usually invalidated after investigation.

Data verification is the process for evaluating the completeness, correctness and conformance/compliance of a specific data set against the method, procedural, or contractual specification. Any deviation from the established sample collection plan (as in Sections 10 and 11) must be documented in the appropriate logbook and on the field sample data sheet. Investigations and evaluations may be necessary to determine whether the data obtained from a particular site may qualify as a baseline for nearby sites, or indicator of abnormal data. Any data

that indicates unacceptable levels of bias or precision will be flagged and investigated may be required.

The review of logbook records and QC data such as collocated sampling data, field blanks, lab blanks, and the checks described in Sections 12 and 14 of this QAPP can be used to validate sample collection procedure.

Validation of the QC procedure requires a review of the documentation of the corrective actions that were taken when QC samples failed to meet acceptable criteria and the potential effect of the corrective actions on the validity of the routine data.

23. VERIFICATION AND VALIDATION METHODS

23.1 Verification Methods

After a sample batch is compiled, a thorough review of the data will be conducted for completeness and data entry accuracy. All raw data that are hand entered from data sheets will be checked prior to entry to the appropriate database. Once the data are entered, the data will be reviewed for routine data outliers and conformance to acceptance criteria. Data from the continuous samplers will be downloaded from the cloud storage and reviewed soon after the data are available (Section 22). Unacceptable or questionable data will be flagged appropriately.

23.2 Validation Methods

Validation of measurement data requires two stages, one at the measurement value level and another at the batch level. Records of all invalid samples shall be flagged and retained in the appropriate database. Information shall include a brief summary of why the sample was invalidated along with the associated flags. Logbook notes and field data sheets shall have more detailed information regarding the reason a sample was flagged. These documents shall remain with the field operators and/or at the monitoring site. At data batch level, descriptive statistics of the data will be computed to identify potential outliers for further investigation.

24. RECONCILIATION WITH DATA QUALITY OBJECTIVES

Since this is not an EPA required regulatory monitoring project, no final Data Quality Assessment report is required. However, all AMS staff participating in this project and all contractual workers shall assure that the sampling process (Section 11) is carried out according to design, the sample handling, analysis and quality control measures (Sections 12, 13, and 14) are performed properly, and all other QA/QC measures and procedures (Sections 15, 16, 17, 22, and 23) are followed closely. Ultimately, these requirements and measures will assure that the data quality objectives (Section 7) and the project purpose (Section 5) are achieved.

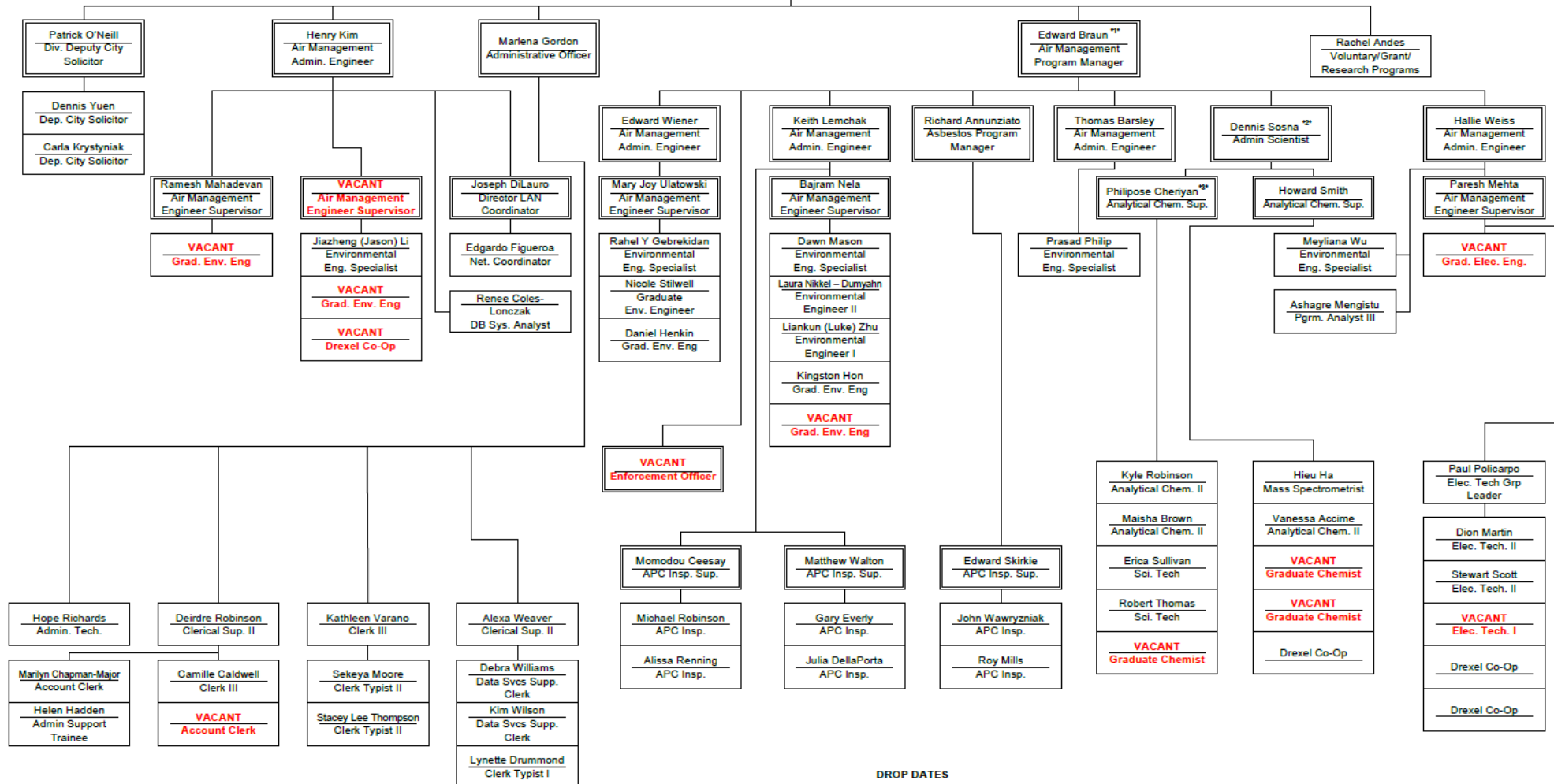
Appendix A. Philadelphia Air Management Services Organizational Chart



Department of Public Health Air Management Services

Kassahun Selassie
Air Management
Program Director

1/24/2017



DROP DATES

1. E. Braun – 12/8/2018
2. D. Sosna – 1/4/2019
3. P. Cherian – 1/3/2020

Appendix C
US EPA SO₂ Data Requirements Rule Documentation

DRAFT



pennsylvania

DEPARTMENT OF ENVIRONMENTAL
PROTECTION

January 15, 2016

Mr. Shawn Garvin
Regional Administrator
U.S. Environmental Protection Agency, Region III
1650 Arch Street (Mail Code: 3RA00)
Philadelphia, PA 19103-2029


Dear Mr. Garvin:

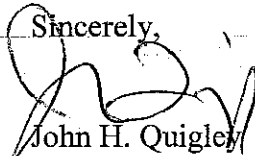
The Pennsylvania Department of Environmental Protection (DEP) is hereby submitting the list of large sulfur dioxide (SO₂) emitting sources in the Commonwealth of Pennsylvania which will undergo an "air quality characterization" as required under the final Data Requirements Rule (DRR) for the 2010 1-Hour Sulfur Dioxide Primary National Ambient Air Quality Standard (80 FR 51052, August 21, 2015). The DRR requires the permanent list of sources to, at a minimum, include sources with SO₂ emissions greater than 2,000 tons per year (tpy).

DEP based its determination of sources on the most recent inventory of actual emissions available, the 2014 SO₂ emission inventory. The list of sources, outlined below by county, adheres to the guidelines within the DRR and will undergo an additional "air quality characterization." (see enclosure)

In addition, DEP understands that the DRR is limited in its scope of emission sources that could cause or contribute to nonattainment of the 1-hour SO₂ NAAQS. Due to the short term nature of the SO₂ NAAQS, certain sources with less than 2,000 tpy of actual annual SO₂ emissions but high hourly emissions could cause or contribute to NAAQS violations. In addition, the complex topography in Pennsylvania also poses a risk to demonstrating attainment in certain areas of the commonwealth. To that end, DEP plans to further analyze the SO₂ emission inventory to determine if additional sources, less than 2,000 tpy, should be characterized for attainment purposes.

Should you have any questions or need additional information, please contact Joyce E. Epps, Director, Bureau of Air Quality, by e-mail at jeepps@pa.gov or by telephone at 717.787.9702.

Sincerely,


John H. Quigley
Secretary

Enclosure

Secretary

Pennsylvania's List of SO₂ Sources Identified Pursuant to the Data Requirements Rule

| County | Facility |
|--------------|--|
| Allegheny | NRG Midwest LP/Cheswick Generating Station |
| Blair | Team Ten/Tyrone Paper Mill |
| Cambria | Cambria Cogen/ Ebensburg |
| Cambria | Inter Power Alhcon/Colver Power Plant |
| Cambria | Ebensburg Power Co/Ebensburg Cogeneration Plant |
| Carbon | Panther Creek Power OPR LLC/Nesquehoning |
| Centre | Penn State University |
| Clearfield | NRG Rema LLC/Shawville Generating Station |
| Delaware | Kimberly Clark PA LLC |
| Delaware | Covanta Delaware Valley LP/Delaware Valley Res Rec |
| Delaware | Exelon Generation Company/Eddystone |
| Lawrence | NRG Power Midwest LP/ New Castle Power Plant |
| Lehigh | Lafarge Corp/Whitehall Plant |
| McKean | American Refuel Group/Bradford |
| Montour | Talen Energy LL/Montour Power Plant |
| Northampton | NRG Rema LLC/Portland Generating Station |
| Northampton | Hercules Cement Company LP/Stockertown |
| Northampton | Keystone Portland Cement/East Allen |
| Northampton | ESSROC/Nazareth Lower Cement Plant |
| Northampton | Northampton Generation Company/Northampton |
| Philadelphia | Philadelphia Energy Sol Ref/PES |
| Schuylkill | Schuylkill Energy Res/ St Nicholas Cogen |
| Schuylkill | Gilberton Power Co/John B. Rich Mem Power Station |
| Schuylkill | Wheelabrator Frackville/Morea Plant |
| Schuylkill | Northeastern Power Co/ Mcadoo Cogen |
| Venango | Scrubgrass Generating CO LP/Kinnerdell Plant |
| Westmoreland | ArcelorMittal Monessen LLC/Monessen Coke Plant |
| York | PH Glatfelter Co/Spring Grove |
| York | Magnesita Refractories/York |
| York | Talen Energy, LLC/Brunner Island Power Plant |

March 9, 2016

Mr. Nikos Singelis
Acting Director, Air Protection Division
U.S. Environmental Protection Agency, Region III
1650 Arch Street (Mail Code: 3AP00)
Philadelphia, PA 19103-2029

RE: Revised List of SO₂ Sources Identified Pursuant to the Data Requirements Rule

Dear Mr. Singelis

I am writing to request revisions to "Pennsylvania's List of SO₂ Sources Identified Pursuant to the Data Requirements Rule" (hereinafter "PA List of SO₂ Sources") submitted to the U.S. Environmental Protection Agency (EPA) on January 15, 2016. Pursuant to 40 CFR § 51.1203 (relating to air agency requirements) of the Data Requirements Rule for the 2010 1-hour Sulfur Dioxide (SO₂) Primary National Ambient Air Quality Standard (NAAQS), "[t]his list may be revised by the Regional Administrator after review based on available SO₂ emissions data" (80 FR 51087, August 21, 2016). To this end, the revised PA List of SO₂ Sources is enclosed for EPA's review and consideration.

Based on the Pennsylvania Department of Environmental Protection's (DEP) review of 2015 SO₂ emission data and other relevant information, the following facilities should be removed from the PA List of SO₂ Sources: American Refining Group (previously listed as American Refuel Group/Bradford); ArcelorMittal Monessen LLC/Monessen Coke Plant; Penn State University (PSU); and Scrubgrass Generating CO LP/Kinnerdell Plant. The rationale for the removal of the facilities from the list is provided as follows:

1. American Refining Group, Inc. Actual SO₂ emissions from the American Refining Group facility in Bradford (McKean County), PA declined from 1413 tons per year (tpy) in 2014 to approximately 574 tpy of SO₂ in 2015. The facility's federally enforceable Title V Operating Permit (TVOP No. 420000) also requires the permanent shutdown and replacement of coal-fired Boiler No. 5 with a new gas-fired boiler (Boiler No. 6) by no later than January 31, 2017. The gas-fired boiler, which is expected to emit no more than 2.11 tpy of SO₂, will assure compliance with the "Boiler MACT" requirements in 40 CFR Part 63, Subpart DDDDD (National Emission Standards for Hazardous Air Pollutants for Industrial, Commercial, and Institutional Boilers and Process Heaters). Operation of the gas-fired boiler should also address any potential impacts on the 1-hour SO₂ NAAQS.
2. ArcelorMittal Monessen, LLC. In 2014, the ArcelorMittal Monessen facility in Monessen (Westmoreland County), PA emitted 550 tpy of SO₂ from its coke work

operations. The preliminary review of 2015 emissions data indicates that SO₂ emissions declined to 523 tpy in 2015. However, ArcelorMittal will complete extensive source testing at the Monessen facility including testing of SO₂-emitting sources by early April 2016, at the request of EPA and DEP. Following a review of the source test results, the agencies will determine if corrective measures including the installation of control technology will be necessary to assure compliance with applicable requirements and to prevent any adverse impacts on the 2010 SO₂ NAAQS.

3. Pennsylvania State University. Pennsylvania State University (PSU) in State College (Centre County), PA emitted approximately 1,018 tpy of SO₂ in 2014 from its centralized heating facility; submission and review of 2015 emissions data is ongoing. However, PSU has commenced a natural gas conversion project at its West Campus Steam Plant (WCSP) in in order to comply with the "Boiler MACT" requirements. The WCSP Improvement Project, authorized by DEP under federally enforceable Plan Approval # 14-00003F, includes conditions for converting two coal-fired boilers to burn natural gas and the replacement of two coal-fired boilers with two new natural gas-fired boilers that will be operational by the end of 2016. Following the commencement of operation of the gas-fired boilers, the facility's actual SO₂ emissions will be less than 10 tpy; federally enforceable SO₂ emission limitations will be established by DEP. This natural gas conversion project should address any potential impacts on the 1-hour SO₂ NAAQS.
4. Scrubgrass Generating CO, LP. Actual SO₂ emissions reported to EPA's Clean Air Markets Division for the Scrubgrass facility in Kennerdell (Venango County), PA declined from 1887 tpy in 2010 to 724 tpy in 2015. Additionally, compliance with the Mercury and Air Toxics Standards (MATS) will further reduce SO₂ emissions at the facility. This approach should address any potential impacts on the 1-hour SO₂ NAAQS.

Thank you in advance for your consideration of the revised PA List of SO₂ Sources. We believe that more recent SO₂ emissions data, natural gas conversions and applicability of the Boiler MACT and MATS requirements support the removal of the previously mentioned facilities from the original list of SO₂ sources submitted to EPA on January 15, 2016.

Should you have any questions or need additional information, please contact me by e-mail at jeepps@pa.gov or by telephone at 717.787.9702.

Sincerely,



Joyce E. Epps
Director

Enclosure

ENCLOSURE**PA's Revised List of SO₂ Sources Identified Pursuant to the Data Requirements Rule**

| County | Facility |
|--------------|--|
| Allegheny | NRG Midwest LP/Cheswick Generating Station |
| Blair | Team Ten/Tyrone Paper Mill |
| Cambria | Cambria Cogen/ Ebensburg |
| Cambria | Inter Power Alhcon/Colver Power Plant |
| Cambria | Ebensburg Power Co/Ebensburg Cogeneration Plant |
| Carbon | Panther Creek Power OPR LLC/Nesquehoning |
| Clearfield | NRG Rema LLC/Shawville Generating Station |
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| Delaware | Covanta Delaware Valley LP/Delaware Valley Res Rec |
| Delaware | Exelon Generation Company/Eddystone |
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| Lehigh | Lafarge Corp/Whitehall Plant |
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| Philadelphia | Philadelphia Energy Sol Ref/PES |
| Schuylkill | Schuylkill Energy Res/ St Nicholas Cogen |
| Schuylkill | Gilberton Power Co/John B. Rich Mem Power Station |
| Schuylkill | Wheelabrator Frackville/Morea Plant |
| Schuylkill | Northeastern Power Co/ Mcadoo Cogen |
| York | PH Glatfelter Co/Spring Grove |
| York | Magnesita Refractories/York |
| York | Talen Energy, LLC/Brunner Island Power Plant |

January 28, 2016

CERTIFIED MAIL 7004 1160 0003 8197 0766

Mr. Charles D. Barksdale, Jr.
Philadelphia Energy Solutions
3144 W. Passyunk Ave.
Philadelphia, PA 19145-5208

Re: Environmental Director
Philadelphia Energy Solutions
PES Refining Complex, City of Philadelphia, Philadelphia County

Dear Mr. Barksdale,

The Pennsylvania Department of Environmental Protection (DEP) is writing to advise you that the PES Refining Complex in Philadelphia, Pennsylvania has been identified as a large source of sulfur dioxide (SO₂) emissions according to criteria outlined in the U.S. Environmental Protection Agency's (EPA) final Data Requirements Rule (DRR) for the 2010 1-Hour Sulfur Dioxide (SO₂) Primary National Ambient Air Quality Standard (NAAQS) (hereinafter SO₂ DRR; 80 FR 51052, August 21, 2015). In accordance with 40 CFR §§ 51.1202 and 51.1203, the DEP must submit to the EPA by January 15, 2016, a list of applicable sources of SO₂ emissions in Pennsylvania that have annual SO₂ emissions of 2,000 tons per year (tpy) or more. This listing, which is based on the most recently available annual SO₂ emissions data, must also include any additional SO₂ sources and their associated areas identified by the DEP or "the EPA Regional Administrator as requiring further air quality characterization."

To this end, the DEP developed the criteria below to determine which sources of SO₂ emissions in the Commonwealth warrant an "air quality characterization:"

- 1) Facilities whose 2014 SO₂ actual emissions were greater than or equal to 2,000 tpy;
- 2) Cluster of facilities with cumulative 2014 actual emissions greater than or equal to 2,000 tpy;
- 3) Facilities with 2014 SO₂ actual emissions greater than or equal to 500 tpy that are located within 5 kilometers of an environmental justice community;
- 4) Facilities that meet more than one of the criterion above.

For each facility identified in the list of applicable sources of SO₂ emissions due to EPA by January 15, 2016, the SO₂ DRR requires the DEP to indicate to EPA by July 1, 2016 whether it will complete its "air quality characterization" by air quality modeling, ambient air monitoring or a federally enforceable emission limitation that will keep the facility wide emissions below the 2,000 tpy threshold). Documentation of federally enforceable emission limitations must be provided to EPA by January 13, 2017 (40 CFR §§ 51.1203 (b) and 51.1204). The DEP believes

that the best way to decide the approach for the "air quality characterization" is to obtain feedback from the owners and operators of SO₂ DRR impacted facilities. Therefore, the DEP would like PES Refining Complex to develop a plan to achieve one of the three "air quality characterization" methods (i.e., monitoring, modeling, or federally enforceable emission limits) for the applicable SO₂ sources.

In order to facilitate the development of the plan, the DEP would like to discuss with PES Refining Complex representatives as soon as practicable the three options available to satisfy the "air quality characterization" criterion and the best pathway forward for affected sources of SO₂ emissions at your facility. To this end, within five days of receipt of this letter, please contact me to arrange a date, time and location for a meeting to discuss the options available under the DRR to satisfy your 1-hour SO₂ NAAQS obligations.

In addition to the final SO₂ DRR, EPA has developed two technical assistance documents (TADs), which include details with regards to the modeling and monitoring tracks. The modeling TADs should be used when proceeding with the modeling "air quality characterization" option. Conversely, the monitoring TADs should be used when proceeding with the monitoring "air quality characterization" option. The two TADs are available at the following hyperlinks:

Modeling: <http://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2ModelingTAD.pdf>

Monitoring: <http://www3.epa.gov/airquality/sulfurdioxide/pdfs/SO2MonitoringTAD.pdf>

We look forward to working with you to expeditiously to develop a plan for proceeding with the "air quality characterization" requirement of the SO₂ DRR. Should you have questions or need additional information, please contact me by e-mail at nlazor@pa.gov or by telephone at 717.783.9268. You may also contact Sean Nolan by e-mail at senolan@pa.gov or by telephone at 717.772.3377.

Sincerely,



Nicholas E. Lazor
Environmental Program Manager
Division of Air Quality Monitoring

cc: Henry Kim, Philadelphia Department of Public Health
Krishnan Ramamurthy
Kirit Dalal
Sean Nolan
Andrew Fleck
Randy Bordner
DEP Regional Air Program Manager

Appendix D
TSP Lead Shutdown at NEW

DRAFT



CITY OF PHILADELPHIA

DEPARTMENT OF PUBLIC HEALTH

Thomas A. Farley, MD MPH
Health Commissioner

Caroline C. Johnson, MD
Deputy Health Commissioner

Air Management Services
Kassahun Sellassie, PhD, PE
Director

321 University Avenue, 2nd floor
Philadelphia, PA 19104

Telephone (215) 685-7584
Fax (215) 685-9451

April 13, 2017

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

On December 27, 2010, EPA revised the ambient monitoring requirements for measuring airborne lead (Pb). EPA substantially strengthened the standards in a rule issued Oct. 15, 2008, revising the level of the primary (health-based) standard from 1.5 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 0.15 $\mu\text{g}/\text{m}^3$, measured as total suspended particles (TSP) and the secondary (welfare-based) standard was made to be identical in all respects to the primary standard. Appendix D of 40 CFR part 58 requires that agencies install source-oriented monitors at locations near sources that emit more than one half ton per year of Pb air emissions. Also, Pb monitoring was required in large urban areas (Core Based Statistical Areas, or CBSAs, with a population of 500,000 people or more) located along with multi-pollutant ambient monitoring sites (known as the "NCore network"). Pb monitoring at these sites were required to begin January 1, 2012.

Measuring Pb at the former Philadelphia AMS ITO site 421010449 at Castor & Delaware Avenues stopped as of January 1, 2011. That source-oriented Lead-TSP monitor was designated to measure the impact of the facilities Franklin Smelting and Refining and MDC, which are closed. To date, Philadelphia has no sources that emit 0.5 or more tons of Pb per year.

Starting January 1, 2011, the former AMS NCore site, BAX, 421011002, at 5200 Pennypack Street, monitored Pb through September 30, 2013. On October 1, 2013, AMS re-located and started operating the latest NCore site, NEW, 421010048, at 2861 Lewis Street, including monitoring for Pb. The monitor

has operated for more than three years so a regulatory accurate design value for Pb can be determined for 2014-2016. The latest 40 CFR part 58 Appendix A (Final Rule - May 27, 2016) does not require a Lead-TSP monitor at NCore.

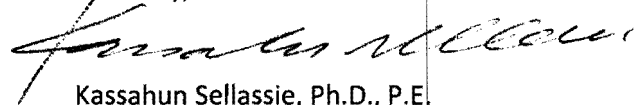
Philadelphia AMS is requesting a waiver of the requirement for a source oriented Lead-TSP monitor in Philadelphia. Paragraph 10 of §58.10 allows for a waiver request for source-oriented Lead TSP monitors according to the requirements of paragraph 4.5(a)(ii) of Appendix D to 40 CFR part 58. The basis upon which a waiver can be granted from the criteria from paragraph 4.5(a)(ii) is as follows: ...the local agency can demonstrate the Pb source will not contribute to a maximum Pb concentration in ambient air in excess of 50 percent of the NAAQS (based on historical monitoring data, modeling, or other means).

The primary and secondary ambient air quality standard for Lead TSP is specified in 40 CFR §50.16(a) and is described as "0.15 micrograms per cubic meter, arithmetic mean concentration over a 3-month period, measured in the ambient air as Pb". The method by which compliance with these standards is demonstrated is contained in paragraph (b) of the same section which states that "The national primary and secondary ambient air quality standards for Pb are met when the maximum arithmetic 3-month mean concentration for a 3-year period, as determined in accordance with appendix R of this part, is less than or equal to 0.15 micrograms per cubic meter."

The AQS AMP 480 Design Value Report for design value years 2014-2016 indicates that the design value for the Pb monitor at NEW is .04 µg/m³ which is less than 50% of the NAAQS which is the criteria for granting the waiver. The AQS AMP 480 report is attached for your review. The most recent analytical information from this site indicates that there is no concern relative to any NAAQS compliance issues, and the maximum value for this site is well below the regulatory threshold of less than 50 percent of the ambient air standard.

If you have any questions regarding this waiver request, please contact Hallie Weiss at 215-685-1085 or hallie.weiss@phila.gov. Thank you for your consideration.

Sincerely,



Kassahun Sellassie, Ph.D., P.E.
Director, Air Management Services

cc: Howard Schmidt, EPA Region III
Pauline De Vose, EPA Region III
Henry Kim, Chief of Program Services, Air Management Services
Edward Braun, Program Manager, Air Management Services
Hallie Weiss, Laboratory Administrative Engineer, Air Management Services
Nicholas Lazor, PADEP Division of Air Quality Monitoring

User ID: HTC

DESIGN VALUE REPORT

Report Request ID: 1536613

Report Code: AMP480

Mar. 28, 2017

GEOGRAPHIC SELECTIONS

| Tribal Code | State | County | Site | Parameter | POC | City | AQCR | UAR | CBSA | CSA | EPA Region |
|----------------|-------|--------|------|-----------|-----|------|------|-----|------|-----|---------------|
| | 42 | 101 | | | | | | | | | |

PROTOCOL SELECTIONS

| Parameter Classification | Parameter | Method | Duration |
|-----------------------------|-----------|--------|----------|
| DESIGN VALUE | 14129 | | |

SELECTED OPTIONS

| Option Type | Option Value |
|----------------------------|-------------------------------------|
| SINGLE EVENT PROCESSING | EXCLUDE REGIONALLY CONCURRED EVENTS |
| WORKFILE DELIMITER | , |
| USER SITE METADATA | STREET ADDRESS |
| MERGE PDF FILES | YES |
| QUARTERLY DATA IN WORKFILE | NO |
| AGENCY ROLE | PQAO |

DATE CRITERIA

| Start Date | End Date |
|------------|----------|
| 2016 | 2016 |

APPLICABLE STANDARDS

| Standard Description |
|----------------------|
| Lead 3-Month 2009 |

Report Date: Mar. 28, 2017

Design Value Year: 2016

Standard Units: Micrograms/cubic meter (LC)(105)

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

NAAQS Standard: Lead 3-Month 2009

Statistic: 3-Month Rolling Average **Level:** .15

State Name:  Pennsylvania

| | | 2016 | | | | | Total | 2015 | | | | | Total | 2014 | | | | | Total | 3-Year | | | Total |
|----------------|-------------------------|--------------|--------------|--------------|-------------|---------------|--------------|--------------|--------------|-------------|---------------|--------------|--------------|--------------|-------------|---------------|--------------|---------------|---------------|--------|--|--|-------|
| | | Max | Maximum | Cert& | Valid | | Max | Maximum | Cert& | Valid | | Max | Maximum | Cert& | Valid | | DV and Max | Valid | | | | | |
| <u>Site ID</u> | <u>STREET ADDRESS</u> | <u>Value</u> | <u>Month</u> | <u>Param</u> | <u>Eval</u> | <u>Months</u> | <u>Value</u> | <u>Month</u> | <u>Param</u> | <u>Eval</u> | <u>Months</u> | <u>Value</u> | <u>Month</u> | <u>Param</u> | <u>Eval</u> | <u>Months</u> | <u>Valid</u> | <u>Mon/Yr</u> | <u>Months</u> | | | | |
| 42-101-0048 | 3000 LEWIS ST. (NEAR BA | .04 | AUG | 14129 | | 12 | .02 | FEB | 14129 | | 12 | .02 | APR | 14129 | Y | 12 | .04 | Y AUG 2016 | 36 | | | | |

- Notes:**
1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
 2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
 3. Annual Values not meeting completeness criteria are marked with an asterisk (*).

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Mar. 28, 2017

CERTIFICATION EVALUATION AND CONCURRENCE FLAG MEANINGS

| FLAG | MEANING |
|------|---|
| M | The monitoring organization has revised data from this monitor since the most recent certification letter received from the state. |
| N | The certifying agency has submitted the certification letter and required summary reports, but the certifying agency and/or EPA has determined that issues regarding the quality of the ambient concentration data cannot be resolved due to data completeness, the lack of performed quality assurance checks or the results of uncertainty statistics shown in the AMP255 report or the certification and quality assurance report. |
| S | The certifying agency has submitted the certification letter and required summary reports. A value of "S" conveys no Regional assessment regarding data quality per se. This flag will remain until the Region provides an "N" or "Y" concurrence flag. |
| U | Uncertified. The certifying agency did not submit a required certification letter and summary reports for this monitor even though the due date has passed, or the state's certification letter specifically did not apply the certification to this monitor. |
| X | Certification is not required by 40 CFR 58.15 and no conditions apply to be the basis for assigning another flag value |
| Y | The certifying agency has submitted a certification letter, and EPA has no unresolved reservations about data quality (after reviewing the letter, the attached summary reports, the amount of quality assurance data submitted to AQS, the quality statistics, and the highest reported concentrations). |

- Notes:**
1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
 2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
 3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

Appendix E
Public Notice Proof of Publication

DRAFT

DRAFT