2010
Five Year Network Assessment of the Philadelphia Air Quality Surveillance System

City of Philadelphia
Department of Public Health
Air Management Services

July 1, 2010

EXECUTIVE SUMMARY

Starting July 1, 2010, and every five years thereafter, 40 CFR Part 58.10(d) requires the City of Philadelphia's Department of Public Health, Air Management Services (AMS) to submit to the United States Environmental Protection Agency (US EPA) an assessment of the air quality surveillance system (Assessment). This first Assessment focuses primarily on Ozone and Particulate Matter of less than 2.5 microns ($PM_{2.5}$) using network assessment tools developed by Michael Rizzo from EPA's Office of Air Quality Planning and Standards (OAQPS). This Assessment also covers the other criteria pollutants of Carbon Monoxide (CO), Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Lead (Pb) and, Particulate Matter of less than 10 microns (PM_{10}), in addition to Air Toxics, new and upcoming regulations that may affect Philadelphia County, and air monitoring equipment needs and costs for the next five years. From 2008 through 2012, EPA has and is expected to update the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants, which often include new requirements for air monitoring.

This Assessment supplements the Air Monitoring Network Plan (Plan) submitted on July 1, 2010. The Assessment and Plan provide a comprehensive review of the Philadelphia air monitoring network and the relative value of each monitor and station. In general, the Assessment determined that the AMS network still meets the monitoring objectives. The results of this Assesment are as follows:

- $PM_{2.5}$: The commitment to EPA requires five $PM_{2.5}$ monitoring sites with one co-located site and three continuous monitors. Over the next five years, AMS plans to transition to all continuous/FEM monitors as the primary monitor for $PM_{2.5}$.

- Ozone: Once the NCore station is operational (BAX), Ozone data from NEA and BAX will be compared to determine the feasibility of shutting down the NEA site.

- Other Pollutants: The trends for CO, SO_2, NO_2, and PM_{10} show large declines over the past 10 years and are well below the corresponding NAAQS. The NO_2 Primary NAAQS and Monitoring rule signed on January 25, 2010, requires two near-road and one area-wide monitor in the Philadelphia CBSA. At a minimum, one near-road monitor will be located in Philadelphia County. The proposed Lead Monitoring Rule (December 23, 2009) would require an additional Lead monitor at the NCore site (BAX) and a possible source oriented monitor at SWA for the Philadelphia International Airport.

- Monitoring Equipment: There is a need to replace many of the current air monitoring devices within the next five years. Many of the indirect air monitoring equipment will approach or exceed the expected life span and may require replacement. The cost of replacement for many of the analysis machines is significant when compared to the cost of individual monitors.

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INTRODUCTION / REGULATORY REQUIREMENT

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

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

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.

Per 40 CFR Part 58.10(d), AMS shall perform and submit to EPA Region III an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in 40 CFR Part 58 appendix D, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby States and Tribes or health effects studies. For $PM_{2.5}$, the assessment also must identify needed changes to population-oriented sites. AMS must submit a copy of this 5-year assessment (Assessment), along with a revised Plan, to EPA Region III. The first Assessment is due July 1, 2010.

This Assessment, in combination with the Plan, provides a comprehensive review of the Philadelphia air monitoring network and the relative value of each monitor and station with consideration of data users such as nearby States or health effect studies, using tools provided by EPA. It covers the National Ambient Air Quality Standards (NAAQS), Air Toxics, and meteorological monitoring networks and associated technology for which AMS has responsibility, with an emphasis on those NAAQS and toxics associated with high human health risk. This Assessment helps to optimize the network to achieve, with limited resources, the best possible scientific value and protection of public and environmental health and welfare, focusing on pollutants that are new or persistent challenges, addressing multiple, interrelated air quality issues, and deemphasizing pollutants that are steadily becoming less problematic and better understood.

NETWORK ASSESSMENT TOOLS

Michael Rizzo from EPA's Office of Air Quality Planning and Standards (OAQPS) created interactive network assessment tools to aid in the network assessment to answer two questions:

- Which sites are redundant and could possibly be either removed or relocated?
- Where is more information needed to better characterize air quality and could, therefore, use a new site?

The tools are used as a weight of evidence in deciding whether or not to keep a site or possibly establish a new site. Besides the interactive tools, the static results of these tools were also used.

The tools developed by Mike Rizzo include:

1. Population Animation
    a. This tool uses Census population estimates as inputs and uses Google Earth to output a map of population changes from 1990 – 2008. The purpose is to identify areas of stagnant, decreasing, or increasing population relative to monitoring locations.
    b. AMS used an alternative approach by taking 1990 and 2000 Census data and using ESRI's ArcMap to map Census data. Figure 1 shows population maps for 1990 and 2000. From 1990 to 2000, the population decreased by approximately 66,000 people. An estimate of the total population as of July 1, 2009, shows a slight increase of 30,000 people. For this analysis, the 2000 Census data was used. Population change and population density are shown in Figure 2.

2. Correlation Matrix Tool
    a. This tool shows the correlation, relative difference, and distance between pairs of sites within a CBSA. The shape of the ellipses represents the Pearson squared correlation between sites with circles representing zero correlation and a straight diagonal line representing a perfect correlation. This tool is used to provide a means of determining possible redundant sites that could be removed.
    b. The input consists of 2005 – 2008 monitoring data after accounting for data completeness.

3. Area Served Tool
    a. This tool allows for the input of existing sites and possible new sites to determine the populations served using a spatial analysis technique known as Voronoi or Thiessen polygons to show the area represented by a monitoring site. The shape and size of each polygon is dependent on the proximity of the nearest neighbors to a particular site. The total tract area

represented by the polygon was calculated as well as the total population and population density.

b. To represent the area served, AMS used this tool along with the monitor's spatial scale. The Area Served Tool creates Voronoi polygons based on a list of site locations. Two levels of Voronoi polygons were used: All monitoring sites and AMS monitoring sites.

4. New Sites Tool
    a. This tool determines areas where new sites could provide more information to characterize air quality using a series of criteria between neighboring sites to filter out those site pairs which meet the criteria for placing a "new" site. These criteria include the squared Pearson correlation between sites, the distance between sites, the average difference between the sites, and a final criterion related to the potential of exceeding 85% of the NAAQS.

5. Removal Bias Tool
    a. This tool determines redundant sites and acts as a means of validating a network after sites have been chosen for removal. It uses the nearest neighbors to each site to estimate the concentration at the location of the site if the site had never existed, using the Voronoi Neighborhood Averaging algorithm with inverse distance weighting.

Figure 1 - 1990 and 2000 Population for Philadelphia County

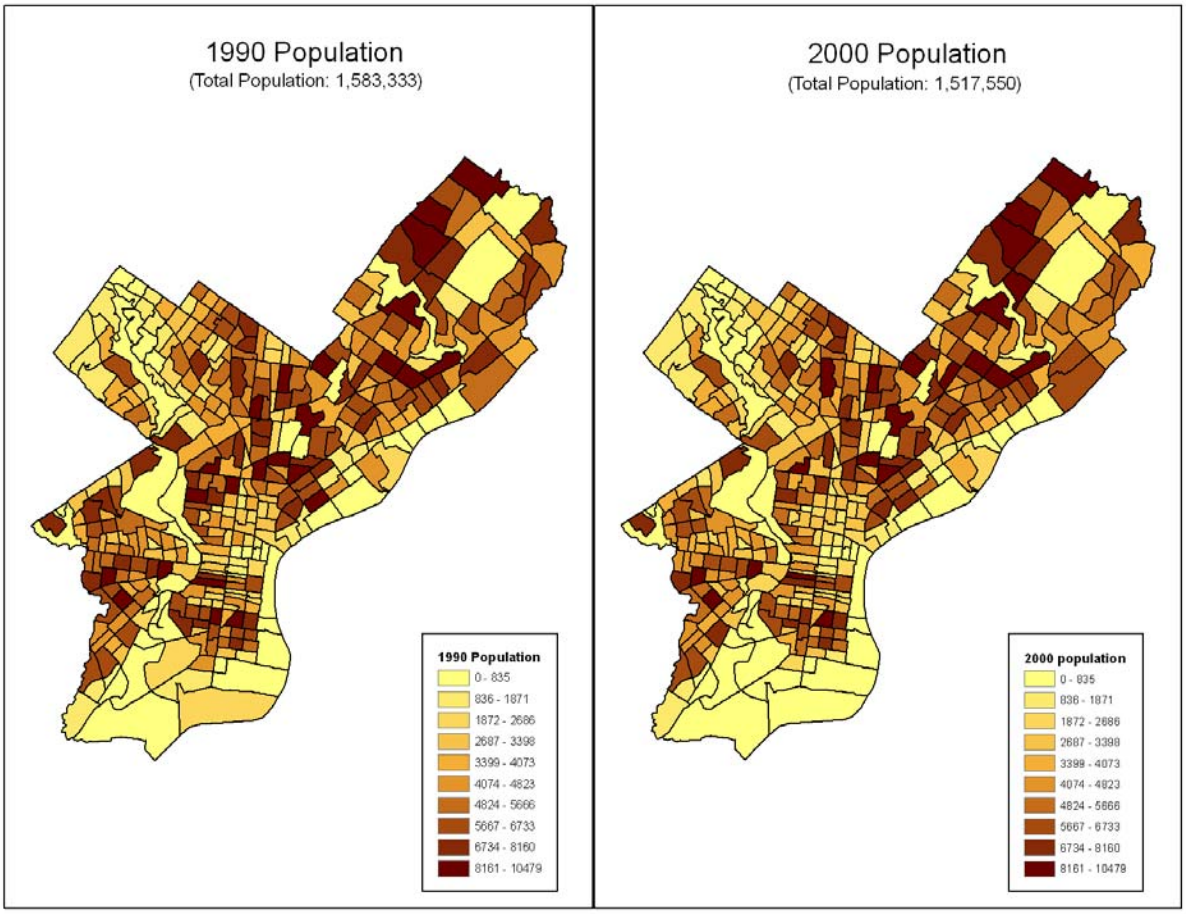
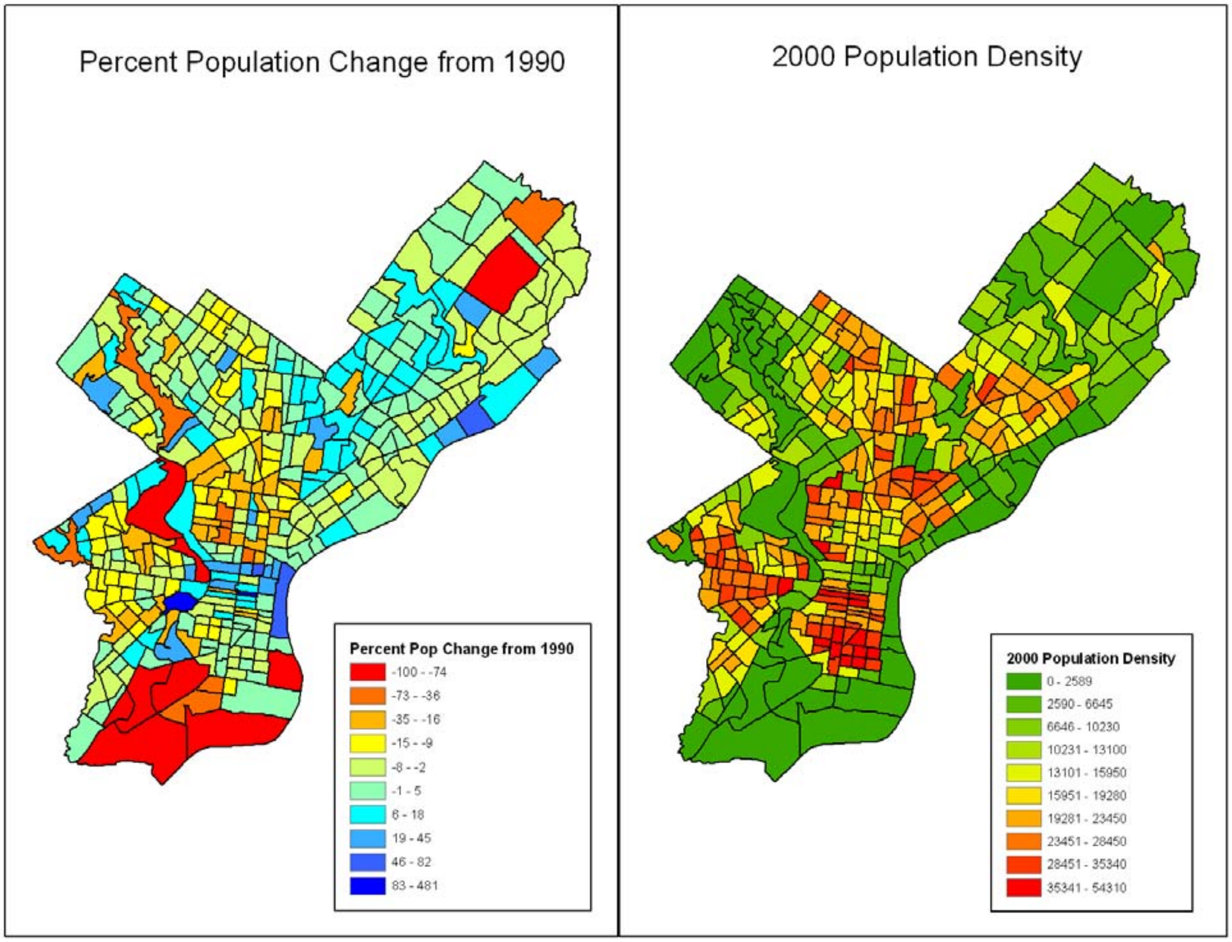


Figure 2 - 1990 Population Change & 2000 Population Density for Philadelphia County



PURPOSE/GOALS OF ASSESSMENT

The goals of the air monitoring network are to protect the health and quality of life for the citizens of Philadelphia from the adverse effects of air contaminants. To achieve this goal, air monitors are placed in areas of high concentrations or high populations. Currently, Philadelphia County is in attainment for all National Ambient Air Quality Standards (NAAQS) except for Ozone and $PM_{2.5}$.

The Philadelphia-Wilmington, PA-NJ-DE $PM_{2.5}$ Nonattainment Area is comprised of nine counties in Pennsylvania (Bucks, Montgomery, Chester, Delaware, and Philadelphia), New Jersey (Camden, Gloucester, Salem), and Delaware (New Castle). The CHS monitor is one of the highest design value monitors in the region.

The Philadelphia-Wilmington-Atlantic City, PA-NJ-MD-DE 8-hour Ozone nonattainment area consists of eighteen counties in Pennsylvania (Bucks, Montgomery, Chester, Delaware, and Philadelphia), New Jersey (Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Mercer, Ocean, and Salem), Maryland (Cecil), and Delaware (Kent, New Castle, and Sussex). This area is classified as moderate nonattainment of the 1997 8-hour Ozone standard. The NEA monitor is one of the highest design value monitors in the region.

This Assessment focuses mainly on Ozone and $PM_{2.5}$. The other criteria pollutants and toxics are briefly discussed.

NETWORK ASSESSMENT

$PM_{2.5}$ (FRM, CONTINUOUS, SPECIATED)

Monitoring Introduction

AMS currently monitors $PM_{2.5}$ (FRM, continuous, or speciated) at five monitoring sites. The focus of this discussion pertains to $PM_{2.5}$ FRM as these monitors are designated as the primary monitor at each location. Table 1 and Figure 3 show the $PM_{2.5}$ monitoring network in and around Philadelphia County. Tables 2 and 3 show the trends for annual and 24-hour averages for $PM_{2.5}$.

Table 1 - $PM_{2.5}$ Monitoring Sites

AMS Site	AQS Site ID	PM2.5 Continuous	Speciated PM2.5	PM2.5 FRM
LAB	421010004	X	X	X
NEA	421010024	X		X
CHS	421010047			X
RIT	421010055		X	X
FAB	421010057			X

Figure 3 - $PM_{2.5}$ Monitoring Sites in and around Philadelphia County for 2009

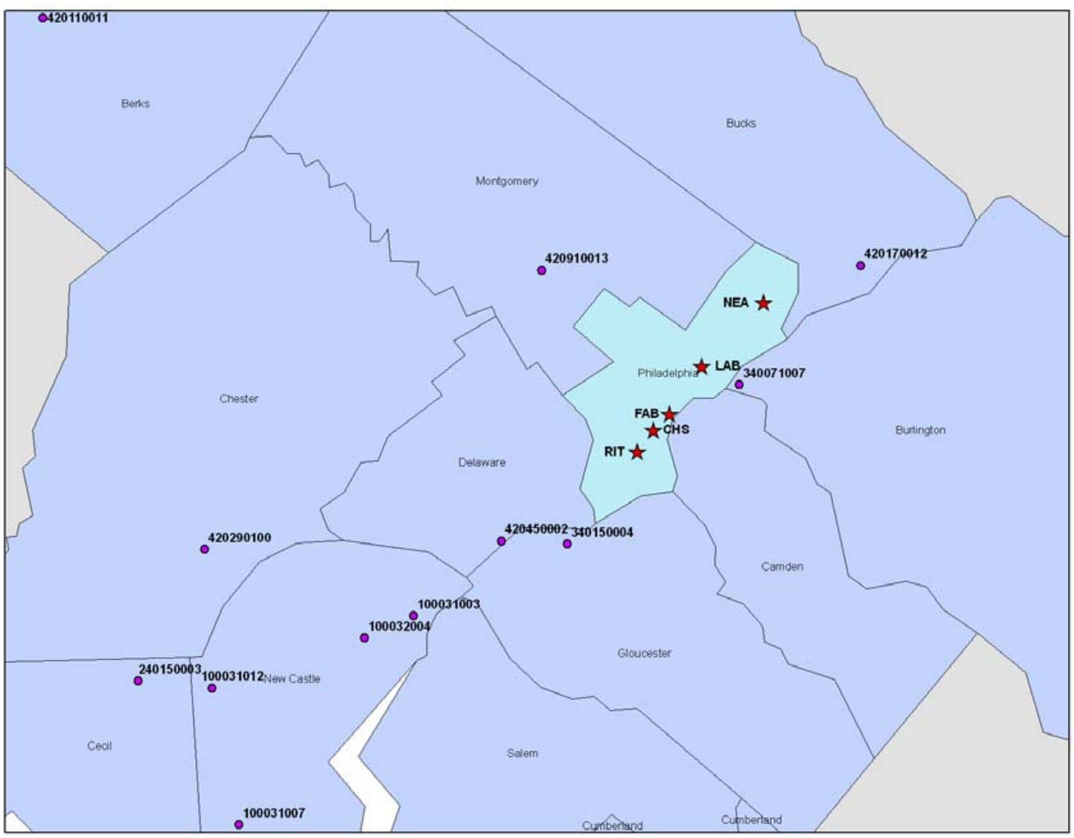


Table 2 - $PM_{2.5}$ Annual Arithmetic Mean Data (units in $\mu g/m^3$)

YEAR	LAB	NEA	CHS	RIT	FAB
1999	14.6	13.0	16.0		
2000	14.9	14.7	16.9		
2001	16.5	14.6	17.0		
2002	14.3	13.7	15.6		
2003	14.8	13.2	16.1		
2004	13.9	12.8	14.4		
2005	14.2	12.9	15.1		
2006	13.5	12.4	15.5		
2007	13.7	12.9	14.4		
2008	13.0	12.0	13.5	13.5	13.29
2009	10.9	9.9	11.1	11.3	11.06

Table 3 - $PM_{2.5}$ 24 Hour (98th Percentile) Data (units in $\mu g/m^3$)

YEAR	LAB	NEA	CHS	RIT	FAB
1999	38.9	32.5	33.3		
2000	41.2	37.5	39.0		
2001	40.2	37.1	39.6		
2002	39.7	33.7	36.2		
2003	39.9	38.7	42.3		
2004	34.3	33.4	31.5		
2005	35.9	35.8	39.4		
2006	37.9	34.7	38.5		
2007	35.4	33.5	35.2		
2008	34.5	30.5	32.8	34.5	32.80
2009	25.9	25.5	30.6	28.6	27.90

Correlation Matrix Tool

Due to new monitoring sites, closures of existing monitoring sites, and issues with data completeness, data was not available for a three year period for all sites. Static data from http://www.epa.gov/ttn/amtic/netassess/ was used for this discussion.

AMS used the following parameters:

- 3-Day FRM $PM_{2.5}$ (2008)
- Continuous $PM_{2.5}$ (2008)

3-Day FRM $PM_{2.5}$ (2008):

Tables 4-8 and Figure 4 show the correlation matrix for all monitoring sites in Philadelphia. In general the correlations and average relative differences for the Philadelphia monitors had two noticeable trends. When compared amongst one another, the Philadelphia monitors all had correlations very close to 1 with the average relative difference approximately 0.1. The Philadelphia monitors also had good correlations with neighboring monitors but the average relative difference was higher than 0.1.

Table 4 - $PM_{2.5}$ FRM (3 day) Correlation Matrix for FAB

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
FAB	100032004	0.12351	0.09587	0.11949	0.00000	0.73011	111	0.87205	43
FAB	240150003	0.23119	0.17192	0.23337	0.00000	1.49529	118	0.64402	67
FAB	340071007	0.16204	0.14888	0.12236	0.00784	0.67388	106	0.90060	8
FAB	340150004	0.19636	0.15090	0.17415	0.00000	0.84979	109	0.84997	19
FAB	420110011	0.22832	0.17725	0.20489	0.00000	0.89396	115	0.67571	84
FAB	420450002	0.17455	0.10201	0.20792	0.00000	1.00554	112	0.70548	24
FAB	CHS	0.08020	0.05863	0.06786	0.00000	0.38843	122	0.95526	3
FAB	FAB	0.00000	0.00000	0.00000	0.00000	0.00000	122	1.00000	0
FAB	LAB	0.09308	0.06706	0.08797	0.00000	0.46196	120	0.94367	7
FAB	NEA	0.11643	0.09356	0.09882	0.00000	0.49900	119	0.93633	17
FAB	RIT	0.07871	0.06641	0.06718	0.00000	0.35420	111	0.96131	6

Table 5 - $PM_{2.5}$ FRM (3 day) Correlation Matrix for RIT

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
RIT	100032004	0.12716	0.10246	0.12235	0.00000	0.74646	101	0.87373	38
RIT	240150003	0.23122	0.16724	0.24644	0.00000	1.74407	107	0.65616	62
RIT	340071007	0.18175	0.16370	0.12333	0.00000	0.59243	98	0.91167	14
RIT	340150004	0.21690	0.18974	0.17505	0.00000	0.86966	99	0.87938	13
RIT	420110011	0.22529	0.18390	0.20466	0.00000	0.79691	107	0.72219	84
RIT	420450002	0.18335	0.10841	0.20958	0.00000	1.04074	103	0.69539	18
RIT	CHS	0.07863	0.06546	0.06060	0.00000	0.28367	111	0.95925	3
RIT	FAB	0.07871	0.06641	0.06718	0.00000	0.35420	111	0.96131	6
RIT	LAB	0.09612	0.08139	0.08091	0.00000	0.42175	109	0.94878	12
RIT	NEA	0.13862	0.13187	0.11093	0.00000	0.53523	108	0.93305	23
RIT	RIT	0.00000	0.00000	0.00000	0.00000	0.00000	111	1.00000	0

Table 6 - $PM_{2.5}$ FRM (3 day) Correlation Matrix for CHS

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
CHS	100032004	0.13039	0.10904	0.11276	0.00000	0.66877	111	0.87191	40
CHS	240150003	0.23323	0.17721	0.22486	0.00000	1.41764	118	0.67457	65
CHS	340071007	0.18077	0.16971	0.11590	0.00000	0.67113	106	0.91519	11
CHS	340150004	0.20974	0.16419	0.16849	0.00000	0.87568	109	0.86273	16
CHS	420110011	0.23427	0.17464	0.19555	0.01519	0.87322	115	0.68258	83
CHS	420450002	0.16690	0.11494	0.17659	0.00718	0.98419	112	0.74922	21
CHS	CHS	0.00000	0.00000	0.00000	0.00000	0.00000	122	1.00000	0
CHS	FAB	0.08020	0.05863	0.06786	0.00000	0.38843	122	0.95526	3
CHS	LAB	0.10708	0.09551	0.07691	0.00000	0.34532	120	0.94306	9
CHS	NEA	0.13932	0.12292	0.10021	0.00000	0.44560	119	0.93016	20
CHS	RIT	0.07863	0.06546	0.06060	0.00000	0.28367	111	0.95925	3

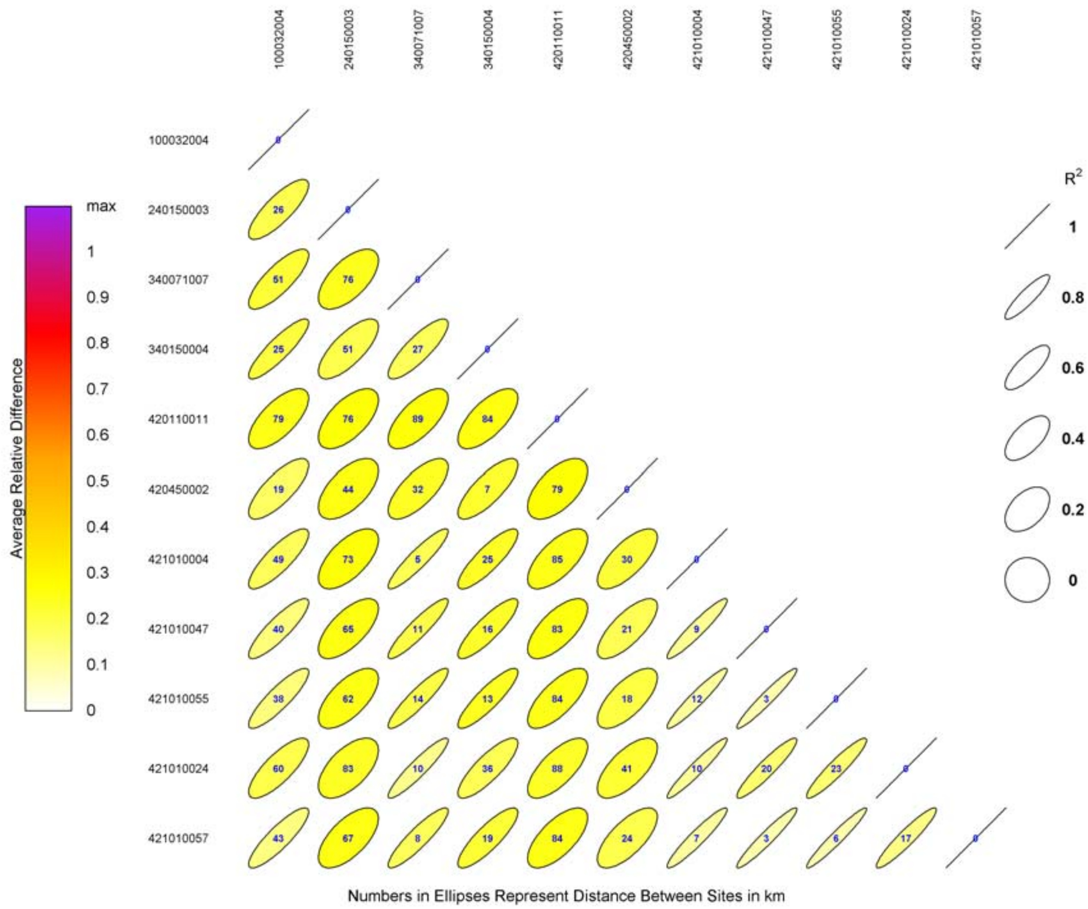
Table 7 - $PM_{2.5}$ FRM (3 day) Correlation Matrix for NEA

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
NEA	100032004	0.17528	0.12403	0.17184	0.00000	0.96124	108	0.79389	60
NEA	240150003	0.21304	0.12656	0.25755	0.00000	1.43431	115	0.59792	83
NEA	340071007	0.10925	0.08280	0.10174	0.00000	0.46370	103	0.92695	10
NEA	340150004	0.16551	0.10912	0.17423	0.00839	1.10802	106	0.83080	36
NEA	420110011	0.21024	0.14610	0.20094	0.00812	0.99837	112	0.70974	88
NEA	420450002	0.20182	0.09182	0.24541	0.00000	1.09417	109	0.67682	41
NEA	CHS	0.13932	0.12292	0.10021	0.00000	0.44560	119	0.93016	20
NEA	FAB	0.11643	0.09356	0.09882	0.00000	0.49900	119	0.93633	17
NEA	LAB	0.10068	0.08604	0.09699	0.00000	0.47714	117	0.95647	10
NEA	NEA	0.00000	0.00000	0.00000	0.00000	0.00000	119	1.00000	0
NEA	RIT	0.13862	0.13187	0.11093	0.00000	0.53523	108	0.93305	23

Table 8 - $PM_{2.5}$ FRM (3 day) Correlation Matrix for LAB

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
LAB	100032004	0.16201	0.13680	0.14101	0.00000	0.79862	110	0.83186	49
LAB	240150003	0.24258	0.16851	0.25725	0.00000	1.59688	116	0.63430	73
LAB	340071007	0.16715	0.14154	0.12609	0.00000	0.55828	105	0.91507	5
LAB	340150004	0.21252	0.15144	0.19262	0.00000	0.90066	107	0.85285	25
LAB	420110011	0.22796	0.15462	0.22415	0.00000	1.20600	113	0.67367	85
LAB	420450002	0.19498	0.11688	0.20694	0.00731	1.03731	110	0.71474	30
LAB	CHS	0.10708	0.09551	0.07691	0.00000	0.34532	120	0.94306	9
LAB	FAB	0.09308	0.06706	0.08797	0.00000	0.46196	120	0.94367	7
LAB	LAB	0.00000	0.00000	0.00000	0.00000	0.00000	120	1.00000	0
LAB	NEA	0.10068	0.08604	0.09699	0.00000	0.47714	117	0.95647	10
LAB	RIT	0.09612	0.08139	0.08091	0.00000	0.42175	109	0.94878	12

Figure 4 - $PM_{2.5}$ FRM (3 day) Correlation Matrix



Continuous $PM_{2.5}$ (2008):

Philadelphia County currently has two $PM_{2.5}$ continuous monitoring sites: NEA and LAB. At each of these sites, the primary designated monitor is a FRM $PM_{2.5}$. When compared with the $PM_{2.5}$ FRM 3-Day data, the LAB and NEA data show larger differences in correlation and average relative differences.

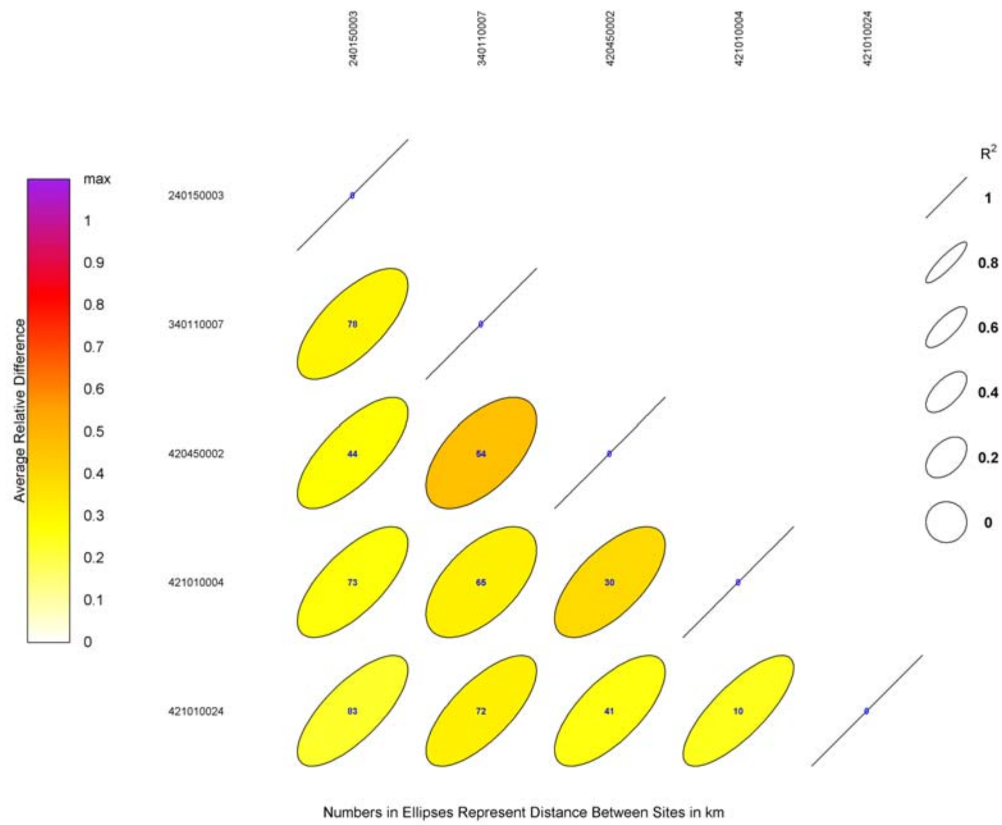
Table 9 - $PM_{2.5}$ Continuous Correlation Matrix for LAB

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	distance
LAB	240150003	0.24272	0.18093	0.24489	0.00000	1.98269	327	0.70134	73
LAB	340110007	0.28662	0.19344	0.31602	0.00000	2.22037	330	0.57885	65
LAB	420450002	0.35249	0.28920	0.28030	0.00665	1.99450	320	0.66441	30
LAB	LAB	0.00000	0.00000	0.00000	0.00000	0.00000	351	1.00000	0
LAB	NEA	0.22227	0.17448	0.22638	0.00000	2.20284	351	0.78355	10

Table 10 - $PM_{2.5}$ Continuous Correlation Matrix for NEA

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	distance
NEA	240150003	0.20890	0.15301	0.20812	0.00000	1.46060	342	0.73959	83
NEA	340110007	0.28604	0.23018	0.26441	0.00000	1.66494	341	0.72100	72
NEA	420450002	0.23599	0.18602	0.22046	0.00000	1.31453	335	0.70308	41
NEA	LAB	0.22227	0.17448	0.22638	0.00000	2.20284	351	0.78355	10
NEA	NEA	0.00000	0.00000	0.00000	0.00000	0.00000	366	1.00000	0

Figure 5 - $PM_{2.5}$ Continuous Correlation Matrix



Area Served Tool

Figure 6 shows the results for the five $PM_{2.5}$ monitoring sites in Philadelphia. The population statistics are shown in Tables 11 and 12. Using the monitoring spatial scale or the Voronoi polygons to represent the area and population served provides different methods for analysis. Either method can be used to identify sensitive populations.

Figure 6 - $PM_{2.5}$ FRM Area Served

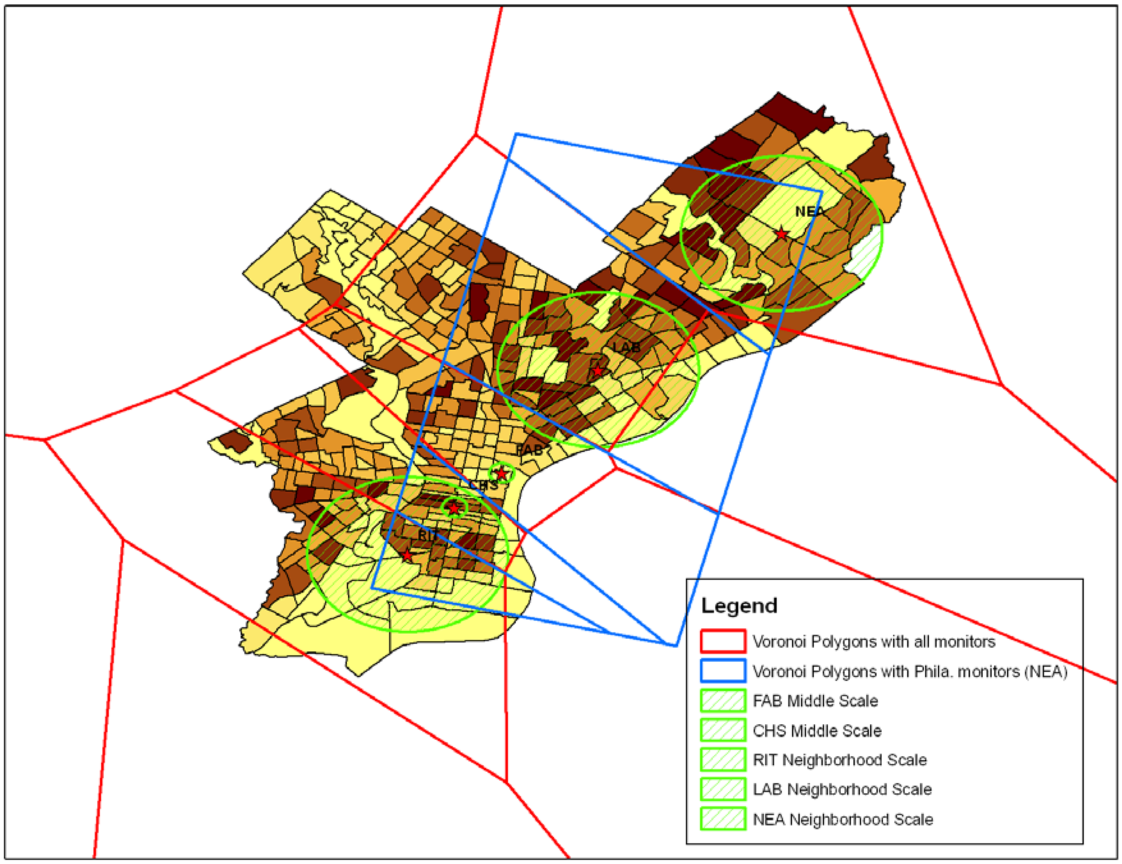


Table 11 - $PM_{2.5}$ FRM Area Served Population Statistics (Voronoi Polygon)

SITE	TOTAL POPULATION (2000)	TOTAL AGE 65 AND UP	TOTAL MINORITY	TRACT AREA (SQMI)	POPULATION DENSITY
LAB	512,343	61,542	285,269	35	14,613
NEA	181,602	38,657	27,289	24	7,430
FAB	225,528	27,557	156,734	15	14,841
CHS	179,492	24,762	75,154	12	15,520
RIT	122,448	20,190	56,695	11	10,742

Table 12 - $PM_{2.5}$ FRM Area Served Population Statistics (Monitoring Spatial Scale)

SITE	TOTAL POPULATION (2000)	TOTAL AGE 65 AND UP	TOTAL MINORITY	TRACT AREA (SQMI)	POPULATION DENSITY
LAB	335,249	34,688	170,084	23	14,525
NEA	175,845	35,642	27,769	28	6,391
FAB	7,001	645	4,145	2	3,617
CHS	38,351	4,419	11,660	1	35,418
RIT	309,598	41,230	155,803	32	9,828

New Sites Tool

Due to new monitoring sites, closures of existing monitoring sites, and issues with data completeness, data was not available for the 2006 – 2008 period.

Removal Bias Tool

This tool was not used to evaluate the removal of any sites. The commitment with EPA guarantees that five $PM_{2.5}$ FRM monitoring sites will be operational.

Future Plans: 2010 – 2015

The NAAQS review for PM is currently on-going and expected no later than November 2011. The commitment to EPA requires five $PM_{2.5}$ monitoring sites with one co-located site and three continuous monitors. Over the next five years, AMS plans to transition to all continuous/FEM monitors as the primary monitor for $PM_{2.5}$. This transition will begin at the LAB site starting in 2011 (as documented in the Plan).

OZONE

Monitoring Introduction

AMS currently monitors Ozone at two monitoring sites: LAB and NEA. Trends for the 4th maximum 8-hour values and design values are shown in Tables 13 and 14.

Table 13 - Ozone 4th Highest 8-Hour Values

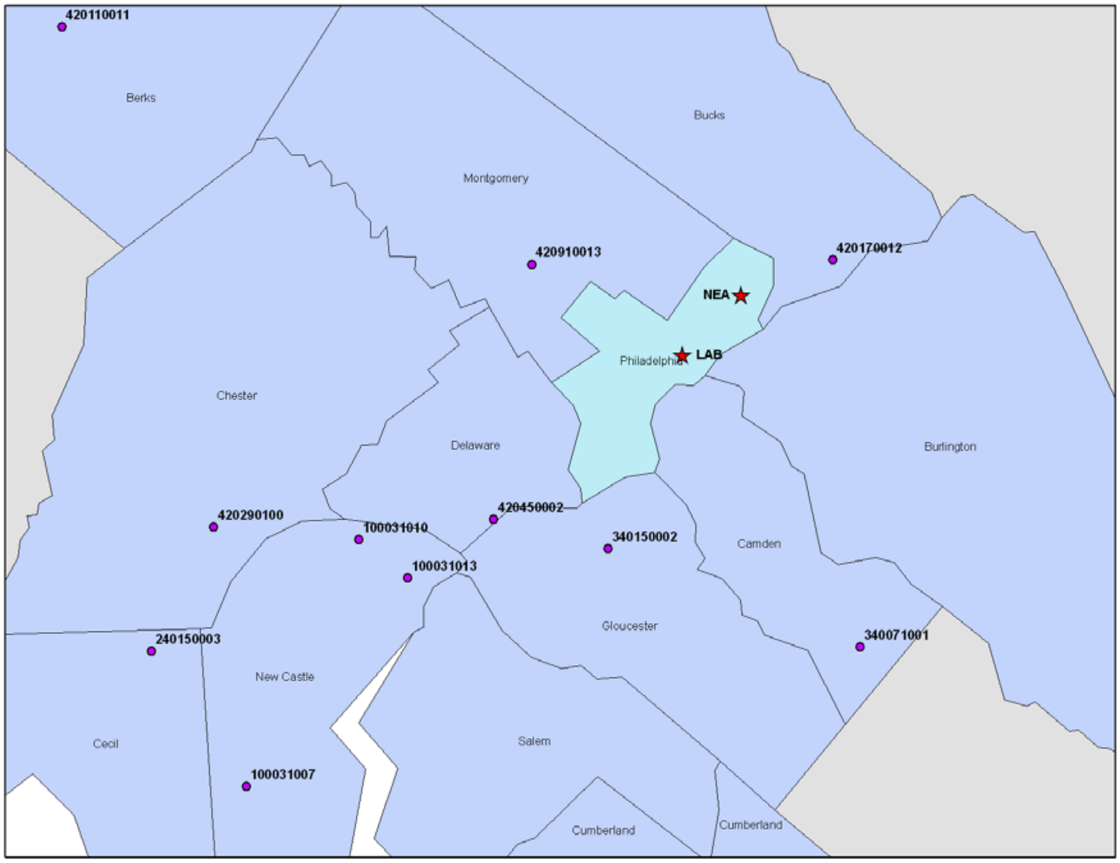
Year	LAB	NEA
1990		0.101
1991		0.112
1992		0.087
1993	0.086	0.097
1994	0.080	0.092
1995	0.091	0.113
1996	0.087	0.092
1997	0.067	0.101
1998	0.077	0.093
1999	0.073	0.060
2000	0.067	0.089
2001	0.074	0.097
2002	0.082	0.110
2003	0.069	0.086
2004	0.054	0.091
2005	0.066	0.094
2006	0.066	0.085
2007	0.073	0.095
2008	0.062	0.087
2009	0.059	0.072

Table 14 - Ozone 8-Hour Design Values

Year	LAB	NEA
1990 - 1992		0.100
1991 - 1993		0.099
1992 - 1994		0.092
1993 - 1995	0.086	0.101
1994 - 1996	0.086	0.099
1995 - 1997	0.082	0.102
1996 - 1998	0.077	0.095
1997 - 1999	0.072	0.085
1998 - 2000	0.072	0.081
1999 - 2001	0.071	0.082
2000 - 2002	0.074	0.099
2001 - 2003	0.075	0.098
2002 - 2004	0.068	0.096
2003 - 2005	0.063	0.090
2004 - 2006	0.062	0.090
2005 - 2007	0.068	0.091
2006 - 2008	0.067	0.089
2007 - 2009	0.065	0.085
2008 - 2010		
2009 - 2011		

Figure 7 shows the Ozone monitoring sites in and around Philadelphia County for 2009. The NEA monitoring site is one of the highest Ozone monitors in the region.

Figure 7 - Ozone Monitoring Sites in and around Philadelphia County for 2009



Correlation Matrix Tool

AMS used static data from http://www.epa.gov/ttn/amtic/netassess/ for 2006 – 2008 for this discussion.

Tables 15, 16 and Figure 8 show the correlation matrix for all monitoring sites. Table 15 shows that NEA is highly correlated with neighboring monitors with a low average relative difference (except for LAB). The NEA site is the highest ozone site in Philadelphia and one of the highest ozone sites in the region. Table 16 shows that LAB is highly correlated with neighboring monitors as well, but with a larger average relative difference than NEA.

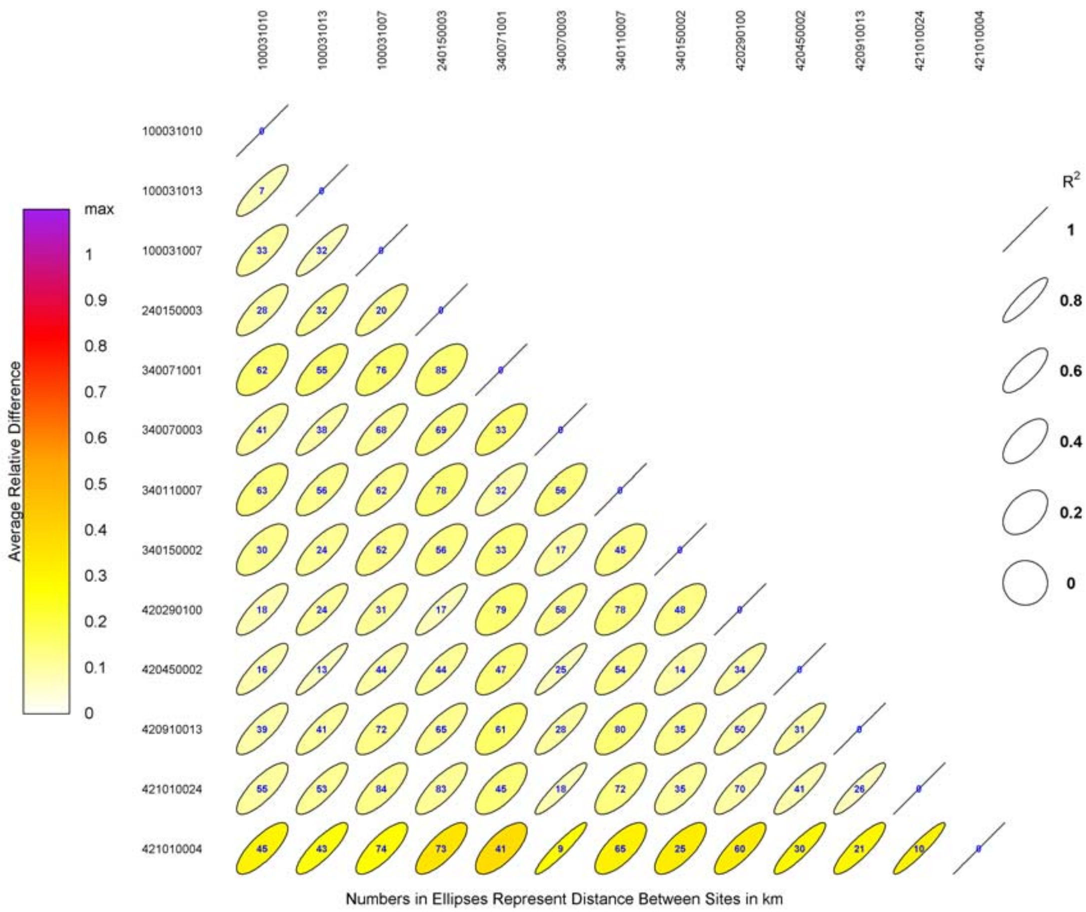
Table 15 - Ozone Correlation Matrix for NEA

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
NEA	100031007	0.11446	0.07685	0.11632	0.00000	0.90295	452	0.76785	84
NEA	100031010	0.09396	0.05723	0.11621	0.00000	1.18279	456	0.79713	55
NEA	100031013	0.10341	0.07734	0.10188	0.00000	0.77336	459	0.83016	53
NEA	240150003	0.10233	0.07420	0.10438	0.00000	0.76055	459	0.79959	83
NEA	340070003	0.07704	0.05749	0.06113	0.00000	0.34494	450	0.92458	18
NEA	340071001	0.13336	0.11062	0.12088	0.00000	1.06937	450	0.69682	45
NEA	340110007	0.12468	0.09490	0.11790	0.00000	1.04390	455	0.71889	72
NEA	340150002	0.09994	0.05705	0.13926	0.00000	1.33109	411	0.73447	35
NEA	420290100	0.09195	0.07509	0.09042	0.00000	0.80720	453	0.83589	70
NEA	420450002	0.08128	0.05713	0.07581	0.00000	0.49516	459	0.88637	41
NEA	420910013	0.06774	0.05694	0.06459	0.00000	0.45549	453	0.91970	26
NEA	LAB	0.28713	0.27986	0.11203	0.04306	0.83959	459	0.93754	10
NEA	NEA	0.00000	0.00000	0.00000	0.00000	0.00000	459	1.00000	0

Table 16 - Ozone Correlation Matrix for LAB

site1	site2	Avg rel_diff	Median rel_diff	Sd rel_diff	Min rel_diff	Max rel_diff	nobs	corr	Distance (km)
LAB	100031007	0.25359	0.24266	0.13734	0.00000	0.68385	452	0.78723	74
LAB	100031010	0.27724	0.26242	0.13649	0.00000	0.98408	456	0.78014	45
LAB	100031013	0.23922	0.24415	0.12349	0.00000	0.59929	459	0.84815	43
LAB	240150003	0.32210	0.29636	0.15787	0.00000	0.91025	459	0.77272	73
LAB	340070003	0.25112	0.24203	0.11408	0.00000	0.77010	450	0.93902	9
LAB	340071001	0.34253	0.33682	0.15349	0.02105	0.98942	450	0.70792	41
LAB	340110007	0.28712	0.28268	0.14470	0.00000	0.89152	455	0.71419	65
LAB	340150002	0.29976	0.28539	0.15195	0.00000	0.98789	411	0.74710	25
LAB	420290100	0.29752	0.30070	0.13021	0.00000	0.79471	453	0.81917	60
LAB	420450002	0.26877	0.28360	0.11223	0.00000	0.67627	459	0.89613	30
LAB	420910013	0.27031	0.26099	0.13568	0.00000	0.65248	453	0.87150	21
LAB	LAB	0.00000	0.00000	0.00000	0.00000	0.00000	459	1.00000	0
LAB	NEA	0.28713	0.27986	0.11203	0.04306	0.83959	459	0.93754	10

Figure 8 - Ozone Correlation Matrix



<u>Area Served Tool</u>

Figure 9 shows the results for the two Ozone monitoring sites in Philadelphia. The population statistics are shown in Tables 17 and 18.

Figure 9 - Ozone Area Served

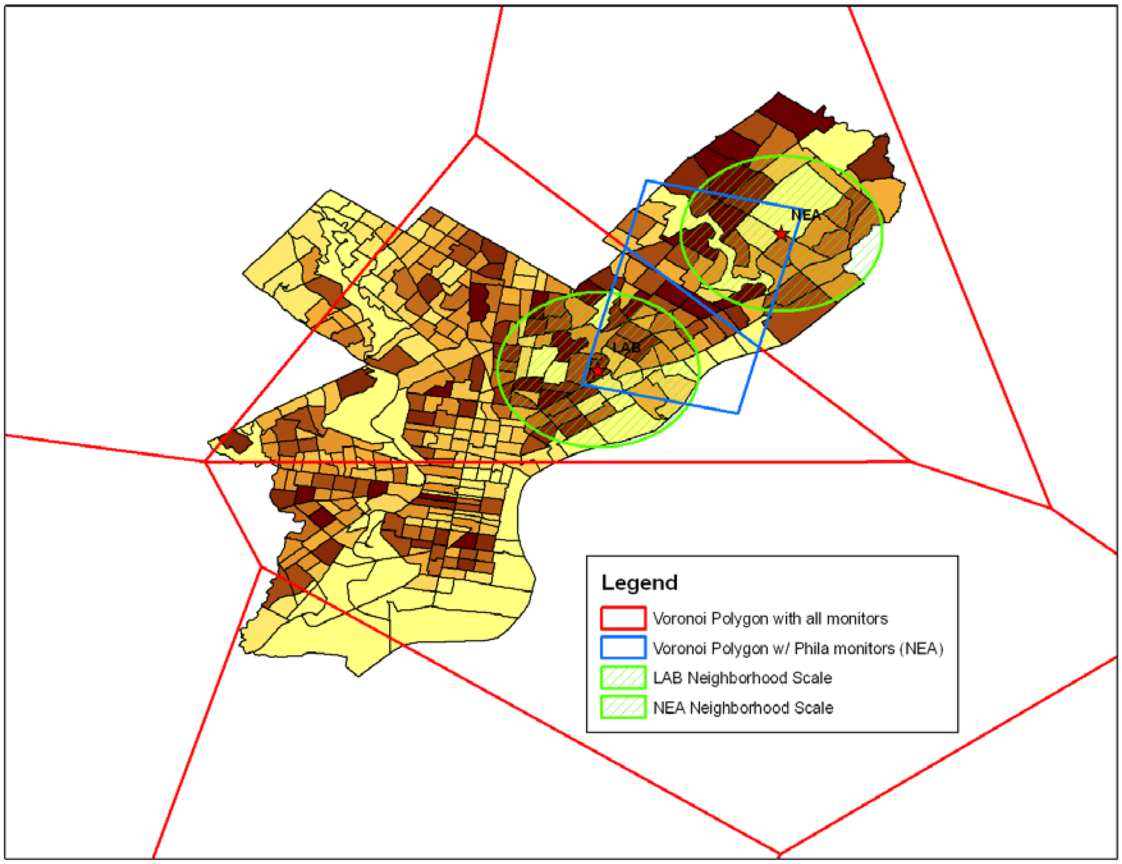


Table 17 - Ozone Area Served Population Statistics (Voronoi Polygon)

SITE	TOTAL POPULATION (2000)	TOTAL AGE 65 AND UP	TOTAL MINORITY	TRACT AREA (SQMI)	POPULATION DENSITY
LAB	196,681	30,281	48,051	16	12,109
NEA	174,176	37,017	26,244	23	7,550

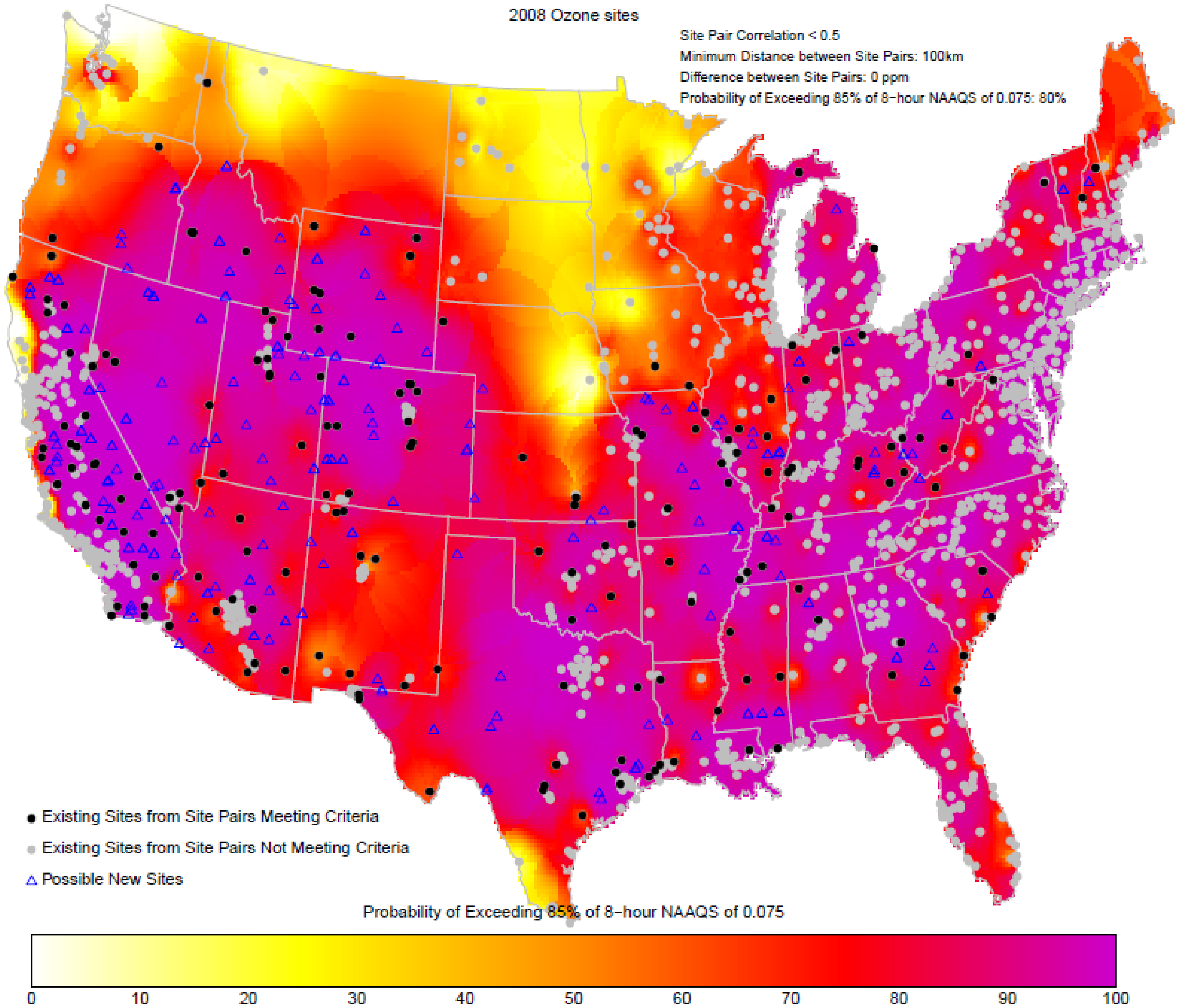
Table 18 - Ozone Area Served Population Statistics (Monitoring Spatial Scale)

SITE	TOTAL POPULATION (2000)	TOTAL AGE 65 AND UP	TOTAL MINORITY	TRACT AREA (SQMI)	POPULATION DENSITY
LAB	335,249	34,688	170,084	23	14,525
NEA	175,845	35,642	27,769	28	6,391

<u>New Sites Tool</u>

Due to the numerous number of criteria combinations that could be evaluated, AMS ran an initial case using only the default values. The result is shown in Figure 10. Figure 10 shows that the Philadelphia region has a high probability of exceeding 85% of the 8-hour NAAQS. No sites met the criteria for new sites in Philadelphia County.

Figure 10 - Ozone 8-Hour New Sites Tool Results



Removal Bias Tool

The Removal Bias Tool was not run due to the limited number of Ozone monitoring sites in Philadelphia County.

Future Plans: 2010 – 2015

The proposed Ozone monitoring rule published July 16, 2009 would lengthen the Ozone season starting in 2011 and revisions to the monitoring network would apply for the 2012 Ozone season. This proposed rule does not affect AMS as all Ozone monitors are run year long and no additional monitoring stations are needed.

As mentioned in the Plan, once the NCore station is operational (BAX), Ozone data from NEA and BAX will be compared to determine the feasibility of shutting down the NEA site. The BAX site will be located approximately 2.8 miles south of NEA.

OTHER POLLUTANTS

Discussion and Future Plans

Trends and monitoring locations for CO, SO_2, NO_2, PM_{10}, Lead, and Toxics are detailed in the Plan. Table 2 of the Plan lists a NAAQS implementation timeline and the impact on AMS.

The trends for CO, SO_2, NO_2, and PM_{10} show large declines over the past 10 years and are well below the corresponding NAAQS.

The NO_2 Primary NAAQS and Monitoring rule signed on January 25, 2010, requires two near-road and one area-wide monitor in the Philadelphia CBSA. At a minimum, one near-road monitor will be located in Philadelphia County.

The proposed Lead Monitoring Rule (December 23, 2009) would require an additional Lead monitor at the NCore site (BAX) and a possible source oriented monitor at SWA for the Philadelphia International Airport.

MONITORING EQUIPMENT ASSESSMENT

An important and often overlooked component of a network assessment is the evaluation of the condition and cost of all monitoring equipment as well as any indirect equipment needed to support the air monitoring network.

Tables 19-23 inventory the type, condition, and cost for all air monitoring and indirect equipment. These tables show that in the next five years, many of the indirect air monitoring equipment will approach or exceed expected life span and may require replacement. The cost of replacement for many of the analysis machines is significant when compared to the cost of individual monitors. The tables also show a need to replace many of the current air monitoring devices within the next five years. These tables do not include any additional monitoring or monitoring sites based on the NAAQS implementation timeline.

Table 19 - Air Monitoring Equipment Inventory

Site: 421010004 (LAB)

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
FRM - PM 2.5 - D	Thermo	Aug-05	5	5	$ 29,000	7. Poorly Performing Equipment	YES
FRM - PM 2.5 - C	Thermo	Sep-98	12	5	$ 29,000	7. Poorly Performing Equipment	YES
Continuous PM 2.5	Met One	Nov-07	3	5	$ 23,000	5. Well Performing Equipment	NO
Spec. PM 2.5 (2 ch.)	Met One	Sep-04	6	5	$ 13,500	6. Adequately Performing Equipment	YES
Spec. PM 2.5 (1 ch.)	URG	Nov-09	1	5	$ 22,000	3. Relatively New Equipment	NO
SSI - PM 10	TISCH	Feb-90	20	15	$ 4,000	7. Poorly Performing Equipment	YES
TSP	TISCH	Feb-87	23	15	$ 4,000	7. Poorly Performing Equipment	YES
NOx	T-API	Oct-05	5	7	$ 13,000	5. Well Performing Equipment	NO
NOy	T-API	Apr-07	3	7	$ 16,000	5. Well Performing Equipment	NO
CO	T-API	Oct-05	5	7	$ 12,500	5. Well Performing Equipment	NO
SO_2	T-API	Oct-04	6	7	$ 13,000	5. Well Performing Equipment	NO
Ozone	T-API	Oct-05	5	7	$ 13,000	5. Well Performing Equipment	NO
Carbonyl	REMSI	Dec-05	5	7	$ 17,000	6. Adequately Performing Equipment	YES
Canister Sampler	TISCH	Jul-08	2	7	$ 12,000	5. Well Performing Equipment	NO
MET System	N/A	Jun-95	15	10	$ 10,000	5. Well Performing Equipment	YES

Site: 421010055 (RIT)

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
FRM - PM 2.5 - D	Thermo	Aug-05	5	5	$ 29,000	6. Adequately Performing Equipment	YES
Spec. PM 2.5 (2 ch.)	Met One	Oct-00	10	5	$ 13,500	7. Poorly Performing Equipment	YES
Spec. PM 2.5 (1 ch.)	URG	Nov-06	4	5	$ 22,000	4. Relatively New Equipment Under Repair	YES
TSP	TISCH	Feb-90	20	15	$ 4,000	6. Adequately Performing Equipment	YES
SO_2	T-API	Oct-04	7	7	$ 13,000	5. Well Performing Equipment	NO
Ozone	T-API	Oct-05	5	7	$ 13,000	5. Well Performing Equipment	NO
Carbonyl	REMSI	Dec-05	5	7	$ 17,000	5. Well Performing Equipment	NO
Canister Sampler	TISCH	Jul-08	2	5	$ 12,000	5. Well Performing Equipment	NO

Site: 421010024 (NEA)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
FRM - PM 2.5	Thermo	Aug-04	6	5	$ 29,000	7. Poorly Performing Equipment	**YES**
Continuous PM 2.5	Met One	Nov-07	3	5	$ 23,000	5. Well Performing Equipment	NO
Ozone	T-API	Oct-05	5	7	$ 13,000	5. Well Performing Equipment	NO
Ozone (c)	T-API	Oct-05	5	7	$ 13,000	5. Well Performing Equipment	NO

Site: 421010047 (CHS)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
FRM - PM 2.5 - D	Thermo	Aug-05	5	5	$ 29,000	7. Poorly Performing Equipment	**YES**
FRM - PM 2.5 - C	Thermo	Sep-98	12	5	$ 29,000	7. Poorly Performing Equipment	**YES**
TSP	TISCH	Apr-87	23	5	$ 4,000	7. Poorly Performing Equipment	**YES**
NOx	T-API	Oct-05	5	5	$ 13,000	6. Adequately Performing Equipment	**YES**
Carbonyl	REMSI	Feb-03	7	7	$ 17,000	5. Well Performing Equipment	NO
Canister Sampler	TISCH	Jul-08	2	5	$ 12,000	5. Well Performing Equipment	NO

Site: 421010063 (SWA)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
TSP	TISCH	Feb-87	23	15	$ 4,000	7. Poorly Performing Equipment	**YES**
Carbonyl	REMSI	Feb-03	5	5	$ 17,000	5. Well Performing Equipment	**YES**
Canister Sampler	TISCH	Jul-08	2	5	$ 12,000	5. Well Performing Equipment	NO

Site: 421010014 (ROX)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
TSP	TISCH	Feb-87	23	15	$ 4,000	6. Adequately Performing Equipment	**YES**
Carbonyl	REMSI	Mar-09	1	5	$ 17,000	3. Relatively New Equipment	NO
Canister Sampler	TISCH	Jul-08	2	5	$ 12,000	3. Relatively New Equipment	NO

Site: 421010048 (NEW)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
Continuous PM 10	Met One	May-03	7	5	$ 22,000	5. Well Performing Equipment	**YES**

Site: 421011001 (BAX NCore)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
FRM - PM 2.5	Thermo	Jun-09	1	5	$ 29,000	3. Relatively New Equipment	NO
FRM - PM 10	Thermo	Jun-09	1	5	$ 29,000	3. Relatively New Equipment	NO
Continuous PM 2.5	Met One	Nov-07	3	5	$ 22,000	3. Relatively New Equipment	NO
Spec. PM 2.5 (2 ch.)	Met One	SEE LAB	SEE LAB	5	$ 13,500	1. New Equipment Needed 9. Spare Needed	**The LAB unit will go to BAX.**
Spec. PM 2.5 (1 ch.)	URG	Nov-09	1	5	$ 22,000	3. Relatively New Equipment	NO
NOy	T-API	Feb-08	2	5	$ 16,000	3. Relatively New Equipment	NO
CO	T-API	Feb-08	2	5	$ 13,000	3. Relatively New Equipment	NO
SO_2	T-API	Feb-08	2	5	$ 13,000	3. Relatively New Equipment	NO
Ozone	T-API	Feb-08	2	5	$ 13,000	3. Relatively New Equipment	NO
MET System	N/A	Jun-95	15	10	$ 10,000	5. Well Performing Equipment	**YES**

Site: 421010449 (ITO)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
TSP Lead - D	TISCH	Apr-87	23	15	$ 4,000	7. Poorly Performing Equipment	**YES**
TSP Lead - C	TISCH	Apr-87	23	15	$ 4,000	7. Poorly Performing Equipment	**YES**
SSI - PM 10	TISCH	Feb-90	20	15	$ 4,000	7. Poorly Performing Equipment	**YES**

Site: 421010649 (NEL)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
SSI - PM 10	TISCH	Feb-90	20	15	$ 4,000	7. Poorly Performing Equipment	**YES**
SSI - PM 10	TISCH	Feb-90	20	15	$ 4,000	7. Poorly Performing Equipment	**YES**

Site: 421010057 (FAB)							
Instrument	**Vendor**	**Year Purchased**	**Age (yrs.)**	**Avg. Life Span**	**Estimated Cost**	**Condition**	**Replacement Recommended**
FRM - PM 2.5	Thermo	Aug-04	6	5	$ 29,000	7. Poorly Performing Equipment	**YES**

Table 20 - Carbonyl (TO-11) Analysis Equipment

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
HPLC-E, Alliance 2695 Sep Module w/sample and column heater, and 2487 dual uv/vis det	Waters Corp.	2003	7	10	$ 72,500	5. Well performing equipment (2-5 years away from needing replacement)	NO
HPLC-F, Alliance 2695 Sep Module w/sample and column heater, and 2487 dual uv/vis det	Waters Corp.	2003	7	10	$ 72,500	5. Well performing equipment (2-5 years away from needing replacement)	NO
HPLC-G, Alliance 2695 Sep Module w/sample and column heater, and 2487 dual uv/vis det	Waters Corp.	2003	7	10	$ 72,500	5. Well performing equipment (2-5 years away from needing replacement)	NO
Millipore Direct-Q 3uv Reverse osmosis water purifications system w/30L Storage tank.	Millipore	2006	4	10	$ 10,000	5. Well performing equipment (2-5 years away from needing replacement)	NO

Table 21 - PAMS and TO-15 Analysis Equipment

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
Hydrogen Generator	Parker Balston	2002	8	6	$ 6,000	8. Equipment not working	**YES**
GCMS	Alilent	2003	8	5	$ 120,000	5. Well Performing Equipment	NO
GC-FID	Alilent	2001	9	5	$ 50,000	5. Well Performing Equipment	NO
Prec Concentrator	Entech	2003	7	5	$ 55,000	5. Well Performing Equipment	NO
Prec Concentrator	Entech	2008	2	5	$ 55,000	5. Well performing equipment	NO
Entech Auto Sampler	Entech	2003	7	5	$ 11,000	6. Adequately performing equipment	**YES**

Table 22 - Calibration Equipment

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
Gaseous Calibrator-LAB	Sabio	2001	9	10	$ 16,000	5. Well Performing Equipment	NO
Gaseous Calibrator-CHS	Sabio	2001	9	10	$ 16,000	5. Well Performing Equipment	NO
Gaseous Calibrator-RIT	Sabio	2001	9	10	$ 16,000	5. Well Performing Equipment	NO
Zero Air Supply-LAB	TEI	1993	17	15	$ 6,000	6. Adequately performing equipment	YES
Zero Air Supply-CHS	TEI	1993	17	15	$ 6,000	6. Adequately performing equipment	YES
Zero Air Supply-RIT	TEI	1993	17	15	$ 6,000	6. Adequately performing equipment	YES
Gaseous Calibrator	CSI	1988	25	15	$ 16,000	8. Equipment not working	YES
Gaseous Calibrator	CSI	1988	25	15	$ 16,000	7. Poorly performing equipment	YES
Ozone Calibrator-LAB	Teledyne API	2007	3	5	$ 9,000	9. No spare unit on hand. Spare unit neeeded.	YES
Flow Calibrator - Met-Lab	BIOS				$ 52,000	1. New Equipment needed	YES
Portable Zero Air Generator	Perma Pure				$ 6,000	1. New Equipment needed	YES

Table 23 - General Chemistry Equipment

Instrument	Vendor	Year Purchased	Age (yrs.)	Avg. Life Span	Estimated Cost	Condition	Replacement Recommended
XMet Xray Fluorescence LEPS	Metrorex	Before 1995	>15	10	$ 6,000	1. New Equipment Needed	**YES**
Balance S/N 1114150791	Mettler Toledo	May-95	15	10	$ 5,000	5. Well performing equipment	NO
Titrator	Metrohm	May-95	15	10	$ 12,000	5. Well performing equipment	NO
Laboratory Oven	Thelco	Jun-96	14	15	$ 4,000	5. Well performing equipment	NO
Balance S/N 1120291235	Mettler Toledo	Oct-01	9	10	$ 3,000	5. Well performing equipment	NO
Balance S/N 1126021226	Mettler Toledo	May-05	5	10	$ 9,000	5. Well performing equipment	NO
Balance CP# 452170	Mettler Toledo	Sep-91	19	10	$ 5,000	5. Well performing equipment	NO
Filter Weiging Chamber CP#452171	Mettler Toledo	Sep-91	19	10	$ 3,000	5. Well performing equipment	NO
Analyst 300 (used for Lead Analysis)	Perkin Elmer	May-99	11	10	$ 160,000	1. New Equipment Needed	**YES**
Laboratory Oven	CMS	Jan-84	26	20	$ 4,000	5. Well performing equipment	YES
Laboratory Hood C/P# 466070	Hemco Corp.	Mar-94	16	26	$ 1,500	5. Well performing equipment	NO
Balance S/N 1126021226	Mettler Toledo	May-05	5	10	$ 8,500	5. Well performing equipment	NO
Conductance Meter CP# 400161	Scientific Design	Before 1984	>26	15		7. Poorly Performing Equipment	**YES**
GC 5790A CP# 404856	Hewlett Packard	Jan-85	15	15	$ 60,000	5. Well performing equipment	NO
Zymate XP Robot CP#506447	Calipher	Feb-99	11	10	$ 55,000	5. Well performing equipment	NO
Balance - MX5 S/N 1122281049 CP#550102	Mettler Toledo	Oct-02	8	10	$ 10,000	5. Well performing equipment	NO
Balance - MT5 S/N 11155500943 CP# 487945	Mettler Toledo	Feb-97	13	10	$ 12,000	5. Well performing equipment	NO