Preliminary Assessments for SO_2, NO_2, CO, Pb, PM10 Monitoring Networks

Sulfur Dioxide (SO2)

As a criteria pollutant, sulfur dioxide (SO2) has the potential to cause health problems generally in association with large point sources. Given the recent and anticipated reductions in SO2 emissions due to implementation of the acid rain program and other current program requirements, there is appears to be little likelihood of developing new "hot spots" of SO2 concentrations. Sulfur dioxide is of primary interest today because it is a precursor to acid rain and fine particulates. Continued monitoring of SO2 recommended in order to identify broad transport gradients important to air quality planning and management and measuring background levels for stationary source permitting.

The recommended SO2 monitors to retain in Region III are:

Monitoring Site ID	Location
421230004	Overlook site near Warren in Warren County, PA
540290009	Summit Circle site in Weirton, Hancock County, WV
540511002	Moundsville, Marshall County, WV
420033003	Glassport site in Allegheny County, PA
510591004	Seven Corners site in Fairfax County, VA
540390010	Charleston in Kanawha County, WV
420958000	Easton in Northampton County, PA
420030021	Pittsburgh in Allegheny County, PA
420990301	Perry County, PA
511130003	Madison County, VA

Nitrogen Dioxide (NO_2)

Monitored levels of NO_2 have decreased in the last two decades. All nonattainment areas for NO_2 are now meeting the standard. However, according to EPA's National Air Quality and Emissions Trends Report for 2001, national emissions of NO_x have actually increased over the past 20 years by 9 percent. This increase is the result of a number of factors, the most significant being an increase in NO_x emissions from nonroad engines and diesel vehicles. This increase is of concern because NO_x emissions contribute to the formation of ground-level ozone (smog), but also to other environmental problems like acid rain and nitrogen loadings to waterbodies.[1]

While there is no credible threat to exceed the nitrogen dioxide (NO_2) NAAQS in Region III, see Figure 1 for annual average NO_2 for the past three years (using the existing monitoring network), because NO_2 is a precursor to both ozone and PM2.5 the general concentration patterns of NO_2 are of interest. We also find that a very similar concentration pattern can be derived from a lesser number of monitors. Figure 2 is a depiction of the NO_2 derived from an hypothetical reduced network (see list below). It is likely that even further reductions could be effected with minimal impact on the usefulness of the data. Note that there are no NO_2 monitoring sites now operating in WV. The single data point in WV is from data collected in 1999. In order to gain a better picture for the concentration patterns for Region 3, the potential addition of two sites in WV (perhaps Charleston and Beckley) and a site in Madison County, VA may be appropriate.

Recommended NO_2 Monitors to retain:

AIRS			
240030019 - 3	Fort Meade	Anne Arundel Co	MD
240259001 - 1		Harford Co	MD
245100040 - 1	Baltimore	Baltimore City	MD
420030008 - 1		Allegheny County	PA
420430401 - 1	Harrisburg	Dauphin Co	PA
420490003 - 1	Erie	Erie Co	PA
420692006 - 1	Scranton	Lackawanna Co	PA
420950025 - 1		Northampton Co	PA
421010047 - 1	Philadelphia	Philadelphia Co	PA
510360002 - 1		Charles City Co	VA
511611004 - 1	Vinton	Roanoke Co	VA
515100009 - 3	Alexandria	Alexandria City	VA
517100023 - 1	Norfolk	Norfolk City	VA
517600024 - 1	Richmond	Richmond City	VA
540990003 - 1		Wayne Co	WV

[1] http://www.epa.gov/air/aqtrnd01/nitrodox.html

Carbon Monoxide (CO)

Nationally, the 2001 ambient average CO concentration is almost 62 percent lower than that for 1982 and is the lowest level recorded during the past 20 years.[2] There seems to be no carbon monoxide (CO) problem in Region III. The only site to experience an exceedance of the 8-hour NAAQS (the controlling time period) in the last three years is Summit Circle in Weirton, WV. In 2000 there was one exceedance at Summit Circle and, therefore, no violation. There are only a handful of sites in the Region where the maximum 8-hour average in any of the past three years is as much as one-half of the NAAQS. Those sites, in decreasing order by the maximum 8-hr average, are:

AIRs

540290009 Summit Circle, Weirton, WV (1999, 2000, 2001)

540290011 Marland Heights, Weirton, WV (1999, 2000)

420490101 12th & Myrtle Sts., Erie, PA (1999, 2000, 2001)

421010004 AMS Lab, Philadelphia, PA (1999, 2000)

421010051 Race Street, Philadelphia, PA (1999)

421010027 Broad & Butler, Philadelphia, PA (1999, 2001)

517100019 Church Street, Norfolk, VA (1999, 2000)

110010041 34th & Dix Sts, NE, Washington, DC (1999, 2000)

540291004 Oak Street, Weirton, WV (2000, 2001)

110010023 C&P Phone Co, Washington, DC (2000)

245100040 Old Town Fire Dept, Baltimore, MD (1999)

Although not making the above list, we would add 420030038, Forbes Ave site in Pittsburgh, PA because of the recent redesignation to attainment. The italicized sites are redundant and can be removed.

[2] http://www.epa.gov/air/aqtrnd01/carbon.html

Lead (Pb)

The 2001 average air quality concentration for lead is 94 percent lower than in 1982. Emissions of lead decreased 93 percent over that same 20-year period. Today, the only violations of the lead NAAQS occur near large industrial sources such as lead smelters and battery manufacturers.[3] Only one site in the Region has violated the lead NAAQS in the past three years. That site, associated with the now nonexistent Franklin Smelting is Castor & Delaware Avenue in Philadelphia. The Franklin Smelting area and the vicinity of a battery reclamation facility in Berks County, PA are the only areas where Pb need be monitored. The site at which the maximum 24-hour concentration during any of the last three years was greater than the value of the quarterly average NAAQS (1.5 ug/m^3) are:

420110003Heffner & Deka Roads, Reading, PA
420110717Lyons Station, Berks Co. PA
420111717Spring Valley Road, Berks Co. PA
421010449Richmond St. & Wheatsheaf Lane, Philadelphia, PA

[3] http://www.epa.gov/air/aqtrnd01/lead.html

PM10

Between 1992 and 2001, average PM_{10} concentrations decreased 14 percent, while direct PM_{10} emissions decreased 13 percent.[4] Region III currently has three areas that are designated as moderate nonattainment for PM10. Two of these areas are in the Northern Panhandle of West Virginia in the City of Weirton and in the area of Follansbee in Brooke county. The third area is located in Allegheny county in PA. Recent data shows that these areas are attaining the PM10 NAAQS, and the States are working on getting the areas redesignated to attainment. However, these areas will need to maintain sufficient PM10 networks to continue to demonstrate maintenance of the current PM10 standard. In addition, some current SIP work going on in Baltimore, MD may require the use of PM10 data from that area.

The PM10 network was originally reduced in order to allow more resources to be used for PM2.5 and many PM10 monitors (about 50%) are collocated with PM2.5 FRMs. Further network reductions are possible. PM10 monitors that are not collocated with PM2.5 or other pollutant monitors should generally be eliminated unless they are tracking elevated levels of PM "coarse," or are needed for SIP or NSR purposes. If a monitoring site is monitoring multiple pollutants ie. PM10, PM2.5, SO_2, etc., and it is felt that one or more of the monitors should be eliminated, then all other pollutant monitors including PM10 should be considered for elimination. For those PM10 monitors collocated w/PM2.5 monitors, these should also be reviewed to determine if they are needed to record "elevated PM coarse" concentrations and whether they are using technology compatible with PM2.5 FRMs. Collocated PM10/PM2.5 monitors recording elevated "coarse" concentrations and using technology compatible with PM2.5 FRMS should receive the highest priority and be maintained for the next several years.

[4] http://www.epa.gov/air/aqtrnd01/pmatter.html

Preliminary Assessment for the PM2.5 Monitoring Network

Fine Particulate Matter (PM2.5)

The initial assessment of the PM2.5 monitoring network uses the same methodology as that used to assess the ozone network. Twelve decision criteria are used, which include the adequacy of the air quality estimate for Region III as a whole (using 3 statistics), personnel impact and costs. Like the ozone network assessment, the PM2.5 assessment uses 6 network scenarios to frame the discussion for stakeholders. Figure 1 shows the hierarchy of decision criteria used for this preliminary PM2.5 monitoring network assessment. The methodology used is described briefly in the ozone portion of this report and can be found in more detail in Stahl et al. [Stahl et al., 2002] Because PM 2.5 estimates are necessary for each county, the analytical procedure used for this PM2.5 monitoring assessment relies on interpolation of monitored PM2.5 data in order to generate estimates for other areas that do not have PM2.5 monitors.[5] Details for the procedure used to create the statistical metrics PM2.5 estimates are found in Appendix A of this section. The criteria definitions used in the PM2.5 assessment are the same as those used for ozone and can be found in Appendix B in the ozone section of this report.

As with the ozone assessment, the adequacy of estimating the PM2.5 air quality field in each of these areas is based on three general statistical measures: 1) "Data Fit" (This statistic answers the question: On average are the estimates across the area over or under-predicted?); 2) "Data Scatter" (This statistic answers the question: In general, what is the degree of variation in the estimates about the average ("Data Fit")?); 3) "Worst Outlier" (This statistic answers the question: At its worst, how bad is the scatter?). These four measures reside on the third level in the hierarchy. The detailed definitions for these statistical measures can be found in Appendix B of the ozone portion of this report.

Description of Initial Network Scenarios

In order to initialize the discussion of PM2.5 monitoring networks, 6 different network scenarios were constructed. These scenarios, developed by using all pollutant monitors through 2001, are intended to allow stakeholders to examine some extreme boundary scenarios as compared with the current ozone monitoring network. Some of these extreme scenarios are those that would seek the best ozone estimate possible and the least

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[5] In brief, the adequacy of interpolation techniques to estimate PM2.5 concentrations where monitors do not exist can be factored into the monitoring network assessment by generating statistical metrics such as data fit, data scatter, and worst outlier. Details for the methodology on calculating these statistical metrics can be found in Appendix B of the ozone section. Interpolation techniques have been used extensively in scientific applications that require the estimation of spatial fields from data points [Matheron, 1963]. The interpolated PM2.5 concentration fields, used in this assessment, were produced using Surfer® 8.0 software [Golden Software, 2002].

cost possible. The six initial scenarios are:

1) **the 2001 PM2.5 monitoring network, i.e. "Baseline"**

   This current network is the basis to which all other scenarios will be evaluated. It includes monitors used to construct the 2001 PM2.5 design values in Region III. In 2001, the base network contains 110 PM2.5 monitors.

2) **a network that removes redundant PM2.5 monitors in counties, leaving only one monitor in that county, "1cty"**

   As there are multiple PM2.5 monitors operating in a given county, this scenario evaluates the impact of removing "extra" monitors, while maintaining a good air quality estimate for that county. No monitors were added to this network. 46 monitors were removed from Region III, at a savings of $1,314,720 in 2002 dollars.

3) **a network that contains the current PM2.5 monitoring network and then adds an PM2.5 analyzer to all existing monitoring stations (currently monitoring for criteria pollutants other than ozone) in Region III, "All stns"**

   This scenario considers leveraging other monitoring stations currently being used to measure non-PM2.5 pollutants. This scenario would add a PM2.5 analyzer, which would be less expensive than establishing a brand new PM2.5 monitoring site, at an existing monitoring station. Analyzers are added only to stations that are in Region III. 128 new analyzers were added, at a cost of $4,039,680 in 2002 dollars.

4) **a network that starts with network scenario #2 and then adds a PM2.5 monitor to every county in Region III where one currently doesn't exist, "All ctys"**

   In this scenario, we evaluated the impact of placing a PM2.5 ozone monitor in every county in the Region. By doing so, we would assume that we would be able to get the best air quality estimate for every single county. We began with monitors identified in scenario #2, and added 139 new monitors to Region III at a cost of $26,351,400 in 2002 dollars. This scenario is intended to frame the upper end of the analysis by establishing the highest cost and best air quality estimate.

5) **a network that starts with the current PM2.5 monitoring network and removes PM2.5 monitors until the baseline PM2.5 estimate starts to degrade, "Lst cost"**

This scenario is strictly one of least cost–the removal of as many monitors as possible--while keeping a good air quality estimate. There were no consideration of factors other than using the spatial interpolation of air quality as the guide. As such, we were able to remove 66 monitors from the current Region III monitoring network, at a savings of $3,949,560 in 2002 dollars.

6) **a network that starts with network scenario #5 and adds 27 additional monitors in Region III where PM2.5 estimates are the worst, "BstKrig"**

This scenario builds upon scenario #5 (a removal of 44 monitors) in that we added 27 new ozone monitors (16 were brand new stations, 11 were new analyzers) in Region III in order to improve the air quality estimate. The net monetary effect of removing 44 existing monitors and adding 27 new monitors is a cost of $85,680, in 2002 dollars.

Figures 2 - 7 are maps showing the location of the monitors that comprise each of the 6 initial networks. For network scenarios #2 - #7 the location of existing monitors are also presented for reference. Since for each of the initial scenarios, the monitors outside the Region did not change, their locations are presented only for the existing network (Figure 2).

Using these initial network scenarios, stakeholders should discuss whether the decision criteria are appropriate, whether the criteria data are reasonable for this analysis, and whether there are additional concerns that have not been captured in the analysis. Stakeholders should use these discussions to construct and test additional network scenarios in conjunction with Region III personnel. Questions regarding data can be directed to Alice H. Chow (chow.alice@epa.gov), questions regarding spatial interpolation: Al Cimorelli (cimorelli.alan@epa.gov), and questions regarding the analytical process: Cynthia Stahl (stahl.cynthia@epa.gov).

MATERIALS ACCOMPANYING THIS DOCUMENT

1) Figure of decision criteria hierarchy used for the preliminary PM2.5 monitoring network analysis
2) Figures of 6 initial PM2.5 monitoring network scenarios
3) Figures describing the benchmark dataset (1996 CMAQ run)
4) Data spreadsheet (MS Excel) showing all data used and how they are used in the preliminary ozone monitoring network analysis. Stakeholders are encouraged to talk with Region III for a better understanding of the contents of the spreadsheet.
5) Appendix A of this section describes the use of the benchmark data set. The definition of terms used in the PM2.5 analysis is the same as it is for ozone and can be found in Appendix B of the ozone section of this report.

RECOMMENDATION AND NEXT STEPS (by about March 2003)

As with the ozone monitoring network assessment, stakeholders are encouraged to participate in discussions to identify relevant issues, establish appropriate decision criteria, obtain the needed data, and deliberate the criteria relative to different network scenarios. The kinds of questions that can be explored are contained in the ozone section of this report as these questions also apply to the assessment of the PM2.5 monitoring network.

Appendix A: Methodology for calculating PM2.5 metrics

To assess a network's adequacy for estimating spatial fields we first construct a benchmark PM 2.5 concentration field from area modeling. Then a subset of the benchmark data is assembled by sampling the data at each monitor location within the network. Each concentration in the subset is analogous to measurements taken at a particular monitoring site. The data subset, which represents data taken from the full network, is interpolated, using kriging, to produce an estimated concentration field. The adequacy of the network is then established by comparing the benchmark and estimated fields using a variety of spatial statistics.

The benchmark field used in this assessment is a field of annual PM fine concentrations that we constructed were from a nation-wide photochemical modeling analysis. The PM 2.5 concentrations were estimated using EPA's Community Multiscale Air Quality Modeling System (CMAQ) {U.S. Environmental Protection Agency 1999 353 /id}. The 1996 National Emissions Inventory (NEI - http://www.epa.gov/ttn/chief/eidocs/nei.html) and a complete year of 1996 MM5 {Grell, Dudhia, et al. 1995 354 /id} meteorological data were used with CMAQ to construct the annual average PM 2.5 concentration field. Figure 8 shows an isopleth plot of this benchmark spatial field. As an example of a network's estimated field Figure 9 presents the estimated field based on a subset of the benchmark data that was created using existing monitor locations (i.e., Network #1 - Base).

In addition to being able to provide data for estimating the complete spatial field, analysts must also be able to construct different PM 2.5 monitoring network scenarios that can show how the resources that will be needed to collect the data have been considered. Therefore, criteria have been established to consider the resource demand (both personnel and financial) that a network places on an organization.

For further information, please contact Al Cimorelli at 215-814-2189 or email at cimorelli.alan@epa.gov.

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Region III Ozone Network Reassessment

Region III Ozone Network Reassessment

SUMMARY

The goal of Region III's reassessment of its ozone monitoring network is to ensure that the new network continues to produce good air quality estimates and that where possible, costs can be reduced by the removal of monitors that do not contribute significantly to those estimates or other state and EPA goals. Our reassessment contains 6 network scenarios developed to frame the discussion for stakeholders and recommends one of those scenarios as the starting point for further examination. Region III intends to meet with stakeholders to refine the assessment and to finalize the network design.

INTRODUCTION

The purpose of this initial work is to provide an analytical framework that will allow decision makers and other stakeholders to identify and consider relevant criteria such as air quality estimate, costs, personnel demand, and air quality trends with respect to how monitoring networks should be constructed. In order to accomplish this task, a preliminary analysis was constructed that includes 40 decision criteria relevant to the design of an ozone monitoring network. The approach that is described in this document is a generic approach that is designed to integrate the assessment of the entire pollutant monitoring network. However, for demonstration purposes, we illustrate the technique using only the ozone monitoring network.

Monitoring network design must allow stakeholders to incorporate concerns such as the cost of monitors and the costs of personnel servicing these monitors and whether air quality estimates are adequate for making policy decisions. Ultimately, what is desired is a minimal ozone monitoring network that would meet the Agency's and states' needs for estimating air quality to make air quality designations, modeling, research and other decisions as well as minimizing costs to EPA and State agencies for establishing and maintaining the network.

In the approach described below, stakeholders apply a transparent analytical framework to identify and examine individual decision criteria and their impacts on different ozone monitoring network scenarios. By evaluating some extreme conditions, such as hypothetically placing a monitor in every county or removing all redundant ozone monitors in each county, stakeholders can learn about the impacts to air quality estimates (using a set of statistically based indicators) as well as to different kinds of costs (capital, operation and maintenance, personnel). Some of these boundary condition scenarios have already been run in our preliminary analysis and are described briefly in the sections below.

In order to come to a final recommendation on an appropriate ozone monitoring network, state stakeholders must be engaged. State information and participation is critical to the analysis so that additional monitoring network scenarios can be generated for debate and deliberation. Therefore, the current preliminary ozone monitoring network assessment has provided not only a framework but also a suggested starting point for decision makers to deliberate the impacts of many different network scenarios before making the final selection.

NETWORK ASSESSMENT METHODOLOGY

The details of the analytical process can be found in Stahl et al. [2002]. This document will not describe details of the analytical procedure except as pertains generally to the ozone monitoring network assessment.

The analytical process used for assessing the ozone monitoring network follows nine major steps. In general, these steps are:

1) Select the 'problem set,' which is the set of elements that are to be ranked. In this application the problem set consists of a group of optional networks;
2) Define decision criteria;
3) Gather the data needed for each criterion;
4) Index the criteria to a common decision scale;
5) Criteria Weighting - Quantify the relative importance of the decision criteria ;
6) Create initial 'decision set,' which is a problem set whose elements are ranked based on the indexed data and criteria weighting;
7) Iteration – Creating many different decision sets for the initial problem set and modifying that problem set, if appropriate, as learning occurs and additional options are discovered;
8) Stakeholder Deliberation;
9) Final Decision.

Decision Criteria

Forty decision criteria have been initially selected for use in assessing Region III's ozone monitoring network. These criteria include statistically-based metrics pertaining to a network's adequacy in characterizing a field of ozone concentrations across different parts of Region III, air quality trends, monitor capital and servicing costs, and personnel costs. The current air quality metrics allow stakeholders to examine and compare the adequacy of generated network scenarios for all of Region III, within the Region III's one hour ozone attainment and non-attainment areas separately, and within the Region III PSD Class I areas. The 40 criteria are arranged hierarchically as shown in Figure 1. This hierarchy and the criteria should be examined by stakeholders to determine whether it should be modified (i.e. other criteria added or existing criteria modified). Guiding this examination should be questions with regard to how stakeholders intend to use the ozone monitoring network, such

as air quality data for designations, inputs to air quality modeling for attainment demonstrations, human health and ecosystem exposure research, and other uses.

In the ozone monitoring network hierarchy shown in Figure 1, the four basic considerations that have been included in the analysis are shown at the primary level: Air Quality, Personnel Impact, "Costs" and "Trends Impact". While both "Costs" and "Trends Impact" are themselves each a single criterion, Personnel Impact includes two separate criteria ("Monitor Servicing Distance" and "Work Load") that appear on the secondary level. The "Costs" criterion considers both the capital costs for a new ozone monitor as well as the costs for the operation and maintenance of an ozone monitor. An important consideration regarding monitor removal is the impact that removing a monitor will have on the continuity of data for trends reporting. The "Trends Impact" criterion is designed as a measure of the degree to which a remaining monitor can act as an acceptable substitute based on a comparison of the length of the data record between two monitors. The detailed definitions for these criteria can be found in Appendix B.

The remaining 36 criteria are used to consider the adequacy of a network's data for constructing various fields of ozone air quality. This is because we are not only interested in ozone air quality in general but also whether there are differences among different geographic areas within Region III. The analysis is constructed in order to allow stakeholders to examine these potential differences via several kinds of summary statistics that are shown at the tertiary and quaternary levels in Figure 1. The four areas within Region III are considered as shown in Figure 1 at the secondary level: 1) Region III as a whole; 2) Region III's 1 hour ozone non-attainment areas; 3) Region III's 1 hour ozone attainment areas; and 4) the four Class I areas contained within the region. Other areas could also be examined.

The adequacy of estimating the air quality field in each of these areas is based on three general statistical measures: 1) "Data Fit" (This statistic answers the question: On average are the estimates across the area over or under-predicted?); 2) "Data Scatter" (This statistic answers the question: In general, what is the degree of variation in the estimates about the average ? ("Data Fit")); 3) "Worst Outlier" (This statistic answers the question: At its worst, how bad is the scatter?). These four measures reside on the third level in the hierarchy. The detailed definitions for these statistical measures can be found in Appendix B.

The "Worst Outlier" measure constitutes 4 of the 40 criteria, one for each of the four areas considered. For both the "Data Fit" and "Data Scatter" measures, 4 separate criteria are used for each area. These criteria, which appear on the quaternary level in the hierarchy, were designed to recognize that from certain perspectives it is more important to accurately estimate the air quality at certain points within an area than at others. Varying the importance of data points within an area is accomplished by numerically weighting each point base on a spatial characteristic of interest. In addition to the unweighted case ("Area

Wide"- where all points have equal importance), we have included three weighted cases: 1) "Population weighting"; 2) "Design Value weighting"; and 3) "Attainment Threshold weighting." Each of the 4 metrics (3 weighted and 1 unweighted) constitute 8 separate criteria. They each apply to the "Data Fit" and "Data Scatter" statistics for each of the 4 areas which result in the remaining 32 criteria.

Initial Set of Network Scenarios

Network scenarios are generated by using the procedure described in Stahl et al. (2002), each of the 40 criteria are populated with data, indexed to attribute significance to the monitoring network assessment decision problem, and utilized with user-derived criteria preferences in order to assess how different network scenarios are affected by those criteria data and preferences. Because ozone estimates are necessary for each county, the analytical procedure used for this ozone monitoring assessment relies on interpolation of monitored ozone data in order to generate estimates for other areas that do not have ozone monitors.[6] Details for the procedure used to create the statistical metrics for ozone estimates and the definitions of the other criteria are found in Appendix B.

In order to initialize the discussion of ozone monitoring networks, 6 different network scenarios were constructed. These scenarios, developed by using all pollutant monitors through 2001, are intended to allow stakeholders to examine some extreme boundary scenarios as compared with the current ozone monitoring network. Some of these extreme scenarios are those that would seek the best ozone estimate possible and the least cost possible. The six initial scenarios are:

1) the 2001 ozone monitoring network, i.e. "Baseline"

This current network is the basis to which all other scenarios will be evaluated. It includes monitors used to construct the 2001 ozone design values. This network includes all ozone monitors within Region III and those states that border the region. In 2001, the base network contains 318 ozone monitors of which 110 are located in Region III[7].

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[6] In brief, the adequacy of interpolation techniques to estimate ozone concentrations where monitors do not exist can be factored into the monitoring network assessment by generating statistical metrics such as data fit, data scatter, and worst outlier. Details for the methodology on calculating these statistical metrics can be found in Appendix A. Interpolation techniques have been used extensively in scientific applications that require the estimation of spatial fields from data points [Matheron, 1963, U.S.Environmental Protection Agency, Office of Air Quality Planning and Standards, 1994]. The interpolated ozone concentration fields, used in this assessment, were produced using Surfer® 8.0 software [Golden Software, 2002].

[7] There are 99 monitors in Region III with 8 hour design values as determined by U.S. EPA, OAQPS but an additional 11 ozone monitoring sites are considered in this analysis, even though these sites currently do not have the required amount of ozone data to determine design values.

2) a network that removes redundant ozone monitors in counties, leaving only one monitor in that county, "1cty"

As there are multiple ozone monitors operating in a given county, this scenario evaluates the impact of removing "extra" monitors, while maintaining a good air quality estimate for that county. No monitors were added to this network. 33 monitors were removed from Region III, at a savings of $2,319,700 in 1993 dollars.

3) a network that contains the current ozone monitoring network and then adds an ozone analyzer to all existing monitoring station (currently monitoring for criteria pollutants other than ozone) in Region III, "All stns"

This scenario considers leveraging other monitoring stations currently being used to measure non-ozone pollutants. This scenario would add an ozone analyzer, which would be less expensive than establishing a brand new ozone monitoring site, at an existing monitoring station. Analyzers are added only to stations that are in Region III. 102 new analyzers were added, at a cost of $2,682,600 in 1993 dollars.

4) a network that starts with network scenario #2 and then adds an ozone monitor to every county in Region III where one currently doesn't exist, "All ctys"

In this scenario, we evaluated the impact of placing an ozone monitor in every county in the Region. By doing so, we would assume that we would be able to get the best air quality estimate for every single county. We began with monitors identified in scenario #2, and added 165 new monitors to Region III at a cost of $26,359,100 in1993 dollars. This scenario is intended to frame the upper end of the analysis by establishing the highest cost and best air quality estimate.

5) a network that starts with the current ozone monitoring network and removes ozone monitors until the baseline ozone estimate starts to degrade, "Lst cost"

This scenario is strictly one of least cost–the removal of as many monitors as possible--while keeping a good air quality estimate. There were no consideration of factors other than using the spatial interpolation of air quality as the guide. As such, we were able to remove 62 monitors from the current Region III monitoring network, at a savings of $4,015,700 in 1993 dollars.

6) **a network that starts with network scenario #5 and adds four additional monitors in southwestern Region III where ozone estimates are the worst, "BstKrig"**

This scenario builds upon scenario #5 (a removal of 62 monitors) in that we added 4 new ozone monitors (3 were brand new stations, one was a new analyzer) in Region III in order to improve the air quality estimate. The net monetary effect of removing 62 existing monitors and adding 4 new monitors is a cost savings of $3,499,400, in 1993 dollars.

Figures 2 - 7 are maps showing the location of the monitors that comprise each of the 6 initial networks. For network scenarios #2 - #7 the location of existing monitors are also presented for reference. Since for each of the initial scenarios, the monitors outside the Region did not change, their locations are presented only for the existing network (Figure 2).

While none of these scenarios is being proposed as the definitive Region III ozone network recommendation, we do, however, recommend that stakeholders consider Scenario #6 as a starting point of their own network analysis if cost and the adequacy of the air quality estimate are equally important factors in the monitoring network decision. Scenario #6 produces significant cost savings over the current network while also improving the adequacy of the air quality estimate. Further examination and experimentation with variations of Scenario #6 will allow stakeholders to design a customized network scenario that will address other concerns such as personnel impacts.

Using these initial network scenarios, stakeholders should discuss whether the decision criteria are appropriate, whether the criteria data are reasonable for this analysis, and whether there are additional concerns that have not been captured in the analysis. Stakeholders should use these discussions to construct and test additional network scenarios in conjunction with Region III personnel. Questions regarding data can be directed to Alice H. Chow (chow.alice@epa.gov), questions regarding spatial interpolation: Al Cimorelli (cimorelli.alan@epa.gov), and questions regarding the analytical process: Cynthia Stahl (stahl.cynthia@epa.gov).

DISCUSSION OF INITIAL NETWORK SCENARIOS

In this section, a more detailed description and explanation of the 6 initial network scenarios is presented. In the discussion of network scenarios #2 through #6, each of scenarios is compared with the baseline scenario #1 in order to determine the relative change that would be produced from the new scenario (as compared to the current monitoring network) with respect to air quality estimates, costs, personnel, and trends criteria. The following table shows, in summary form, the criteria values for 3 selected decision criteria (out of 40 used in this preliminary analysis).

	Relative Cost (1993 dollars)	**Region 3 Data Fit**	**Region 3 Data Scatter**
Scenario #1 (Base)	**0**	**0.0151**	**0.8587**
Scenario #2 (1Cty)	**-$2.3 mil**	**0.0156**	**0.8589**
Scenario #3 (AllSta)	**$2.7 mil**	**0.004**	**0.8571**
Scenario #4 (AllCtys)	**$26.4 mil**	**0.0039**	**0.9862**
Scenario #5 (LstCost1)	**-$4.0 mil**	**0.0137**	**0.8502**
Scenario #6 (BstKrig1)	**-$3.5 mil**	**0.0051**	**0.9079**

Network Scenario #1 (Baseline)

Figure 10 shows selected criteria values for network scenario #1. For illustrative purposes, we discuss only 3 criteria, although 40 criteria were part of the analysis. The 3 criteria discussed are: relative costs, and two statistics that indicate the adequacy of the air quality estimate – Region 3 data fit, and Region 3 data scatter. The map of the adequacy of the air quality estimate is simply a pictorial version of the air quality statistical metrics used, which include data fit, data scatter, and worst outlier statistics. Only the Region 3 data fit and Region 3 data scatter metrics are shown in the figure. The baseline values for each of these criterion are shown on the left side of Figure 10.

The adequacy of the air quality estimates are based on using a benchmark modeled dataset that represents the best understanding of ozone air quality science today. We use this benchmark modeled dataset to determine how good the interpolated air quality estimates are by interpolating (via kriging) the monitored data. Please see Appendix A for more details. In brief, we interpolate the monitored ozone data and produce a field of ozone concentrations for Region III. In order to determine whether the interpolation is a reasonable estimate of air quality in those areas without ozone monitors, we need a benchmark. Since modeled ozone data is available from the NOx SIP call work, we use that modeled data by extracting from the modeled data field, only those ozone values at the locations of the current ozone monitors. By deleting the remainder of the modeled field and then interpolating those extracted ozone data at the monitor locations, we are able to produce a field of ozone concentrations for Region III. We compare this interpolated modeled field with actual modeled field for Region III. This comparison is the uncertainty value shown in the colored bar in Figure 10. Yellow and green contours on the map show that

the air quality estimate is within 10% of the benchmark modeled dataset. The line between the yellow and green contours represents a perfect fit between the modeled data (benchmark) and the interpolated data. Pink and red contours on the map indicate that the air quality estimate is between 10 and 30% of the benchmark modeled dataset.

The relative costs for network scenario #1 are zero because we are interested in comparing the relative costs of other possible networks to the current network, not determining the current cost of the existing network. The presumption is that we have already invested in the current network and the decision question is whether the other possible networks are more or less expensive than this current investment.

The Region 3 data fit criteria is a metric that shows the degree to which the interpolated data over or underestimates air quality when compared with the benchmark dataset. A value of zero indicates that there is no deviation from the benchmark dataset. The Region 3 data fit metric value for scenario #1 is 0.0151. This means that, on average, the interpolated estimates are within about 2% of the benchmark. However, the significance of this value is more easily determined when it is compared with the same metric for other network scenarios.

The Region 3 data scatter criteria is a metric that shows the degree to which the interpolated estimates deviate from the benchmark dataset's best fit line. A value of 1 indicates that there is a perfect fit with the benchmark dataset's best fit line. The Region 3 data scatter metric value for scenario #1 is 0.8587. In this relative analysis, the significance of this value is determined by comparing it with the same metric calculated for other network scenarios.

Network Scenario #2 (1Cty)

Figure 11 shows the values for the same 4 selected criteria for network scenario #2. The adequacy of the air quality estimate here appears to be similar in magnitude to network scenario #1 upon considering the two metrics, Region 3 data fit and Region data scatter. For network scenario #2, the Region 3 data fit value is 0.0156 and the Region 3 data scatter value is 0.8589. When compared with those metrics for the baseline scenario, we see that there is very little change, indicating that at least with respect to these two statistics, the adequacy of the air quality estimate is similar between scenario #1 and scenario #2. The relative cost of this network scenario compared with the baseline (scenario #1) represents a savings of about $2.3 million. That is, network scenario #2 represents a significant cost savings without noticeable degradation in the estimation of air quality (as can be seen by the contour plots). All 40 criteria were used to assess network scenario #2 and the details are available in the accompanying spreadsheet.

Network Scenario #3 (All Sta)

Figure 12 shows the values for the 3 selected criteria for network scenario #3. By comparing them with the baseline and with network scenario #2, we can gain better insight into the constraints of the monitoring network problem. A glance at the contour map shows that the adequacy of the air quality estimates for this scenario is slightly improved (based on less red areas) from the map representing scenario #2. Examining the Region 3 data fit and Region 3 data scatter metrics give more quantitative measures of air quality estimate adequacy. The data fit metric is 0.004, which shows an improvement with respect to estimation bias, and the data scatter metric is 0.8571, which would indicate that the adequacy of the air quality estimate with respect to this statistic is slightly poorer than that for scenarios #1 and 2. Whether this is significant is for the stakeholders to discuss and determine.

Network Scenario #4 (AllCtys)

Figure 13 shows that when a monitor is hypothetically placed in every county, the adequacy of the air quality estimate improves significantly as can be seen visually by the conversion of all areas on the contour map to yellow/green indicating that the air quality estimate anywhere in the Region deviates no more than 10% from the benchmark. Using the statistical measures, improvements are seen in the R3 data fit value over the baseline value (0.0039 vs. 0.0151) as well as in the R3 data scatter value (0.9862 vs. 0.8587). This network scenario produces the best air quality estimate of the networks so far produced, based on these statistical indices. As before, stakeholders should discuss and determine whether these differences are significant to the decision. As might be expected, the costs for implementing network scenario #4 is high, $26.4 million.

Network Scenario #5 (LstCost1)

Figure 14 shows a network possibility that provides a $4.1 million savings with air quality estimates that are similar to the baseline (network scenario #1). The R3 data fit metric is 0.0137 compared with 0.0151 for scenario #1. The R3 data scatter metric is 0.8502 compared with 0.8587 for scenario #1. Stakeholders should consider this scenario to be just the first of many other possible scenarios that can be constructed and examined where the goal is to reduce the number of monitors in the network without significantly degrading the adequacy of the air quality estimate and without adding any new ozone monitors.

Network Scenario #6 (BstKrig1)

Figure 15 shows a network scenario that attempts to address the poorer air quality estimate in the southwest areas of Region 3 by hypothetically placing 4 monitors in the area. This scenario should serve as a initial experiment that seeks to examine the effect of selective monitor placement in areas where the baseline scenario and the previously constructed scenarios indicate that the air quality estimate is not as good as other areas of the Region. Therefore, this scenario places 4 monitors in the southwest portion of the Region. Stakeholders should further experiment with the particular placement of hypothetical monitors in order to eventually determine the appropriate number and location of monitors based on the air quality estimate statistics.

In this initial scenario, the air quality estimate is shown to improve over the baseline scenario (network scenario #1). The R3 data fit value is 0.0051 compared with 0.0151 for scenario #1. The R3 data scatter value is 0.9079 compared with 0.8587 for scenario #1. Because this scenario includes some removal of redundant monitors elsewhere in the Region, even with the addition of 4 monitors, there is a cost savings of $3.5 million over the costs of scenario #1.

Summary of Network Scenario Discussion

These initial 6 scenarios are intended to seed further stakeholder discussions and experimentation with network possibilities. As can be seen, the impacts of different network scenarios can be directly compared with each other and with the current monitoring network. Stakeholders are guided through the process by an analytical framework that first organizes all the relevant criteria and criteria data, calculates the appropriate metrics, and then uses stakeholder judgments to assess which criteria are more important and by how much. Stakeholders are guided by decision analytic theory and asked to compare each of the decision criteria in a pairwise fashion. For example, stakeholders are asked whether costs are a more important consideration than the adequacy of the air quality estimate, whether the adequacy of the air quality estimate is more important than air quality trends, and whether air quality trends are more important than costs.

By combining these stakeholder derived judgments with the criteria data, it is possible to rank all the network scenarios relative to each other. Therefore, for stakeholders that indicate that cost is the most important criterion, a network scenario like that represented by scenario #5 might be the most preferred choice of the ones that have already been generated. If stakeholders are more willing to compromise cost slightly in order to accommodate improvements in the adequacy of the air quality estimate, a network scenario like that represented by either scenarios #2 or 6 might be preferred. If stakeholders prefer to consider network scenarios that do not add new ozone monitors but could remove redundant monitors in counties, they may prefer to start with scenario #5 and construct variations of that network scenario.

Consequently, depending on stakeholder interests and preferences, stakeholders can start with any of the initial 6 network scenarios generated so far and construct/test variations of those scenarios. Guided by the data and by discussions of the relative importance of the criteria, stakeholders can generate and test many different hypothetical network scenarios and then produce a customized network scenario to meet their goals.

MATERIALS ACCOMPANYING THIS DOCUMENT

1) Figure of decision criteria hierarchy used for the preliminary ozone monitoring network analysis
2) Figures of 6 initial ozone monitoring network scenarios
3) Figures describing the benchmark dataset (UAM-V run)
4) Data spreadsheet (MS Excel) showing all data used and how they are used in the preliminary ozone monitoring network analysis. Stakeholders are encouraged to talk with Region III for a better understanding of the contents of the spreadsheet.
5) Appendices A and B describing the use of the benchmark data set and defining terms used in the analysis

RECOMMENDATION AND NEXT STEPS (by about March 2003)

1) Talk with stakeholders explain the analytical approach used to initialize the ozone monitoring network assessment process.

A. Discuss decision criteria – add, modify

For example, stakeholders should begin by asking questions like the following:

i) Are capital and O/M costs the only costs that should be considered for the monitoring network assessment?

ii) Are there other reasons to keep an ozone monitor other than for producing a good estimate of ozone concentration and historical air quality trends? e.g. NAMS/SLAMS, preserving state budget resources, EPA policy regarding designations/redesignations and ozone implementation, etc. If so, these criteria need to be identified and added.

iii) Are there important pieces of state information that should be included in the analysis? E.g. How state regional offices service monitors, affecting the actual resource/personnel demand relative to existing or new monitors?

iv) Will states consider cooperative arrangements to service each others' monitors if those monitors are closer to them (i.e. less resource demand)? If so, the lowered costs can be reflected in potential networks where monitors are being added close to state boundaries.

v) Since all criteria are judged across broad areas (e.g. Region 3, nonattainment areas, etc.), is it important for states to know the impacts of all criteria on a state by state basis?

B. Determine appropriate data – additional data, correcting data, exploring data uncertainties

For example, stakeholders should discuss questions like:

i) Are updated monitoring cost data available (since 1993)?

ii) What is the effect of uncertain monitoring costs (capital and/or O/M)? i.e. how important is it in distinguishing among the potential monitoring networks?

iii) Are there more appropriate data to use for personnel costs?

2) Discuss the baseline network assessment relative to decision criteria . Use this discussion to examine the other initial monitoring networks and the relative importance of the criteria to each other. This discussion might start with the following kinds of questions:

A) Examine what it means to have a monitor in every county (network scenario #4), to reduce the cost of the monitoring network to least cost (network scenario #5), to maximize existing monitoring station sites by placing an ozone monitor at every site that currently doesn't have one (network scenario #3), and so on. What are the impacts on cost, personnel, air quality estimate? How much more expensive is one scenario relative to another? How much more hassle is it for state personnel servicing these monitors when one scenario is compared to another? How good is the air quality estimate of one scenario vs. another?

B) Continue the discussions by constructing other potential networks, such as the network scenario that would produce the best ozone estimate possible. Iterate using understanding obtained from one scenario to create other scenarios.

3) Talk with stakeholders about the implications of using spatial fields (interpolation) for ozone monitoring network assessment. The design of this assessment currently relies on spatial analysis techniques to evaluate a variety of networks with respect to estimating the complete field of ozone concentrations. What are policy and other programmatic implications? In order to reduce monitoring costs, will stakeholders consider relying on scientific techniques to estimate air quality for policy implementation?

4) Make a final determination as to the ozone monitoring network based on information learned from the above discussions and analysis. Enter into §105 grant process.

Appendix A: Methodology for calculating ozone metrics

To assess a network's adequacy for estimating spatial fields we first construct a benchmark ozone concentration field from area modeling. Then a subset of the benchmark data is assembled by sampling the data at each monitor location within the network. Each concentration in the subset is analogous to measurements taken at a particular monitoring site. The data subset, which represents data taken from the full network, is then kriged to produce an estimated concentration field. The adequacy of the network is then established by comparing the benchmark and estimated fields using a variety of spatial statistics.

The benchmark field used in this assessment is the best modeled representation of an 8 hour ozone design value field that is currently available. This field was created from UAM-V [Systems Applications International, 1995] modeling runs that were based on the 1996 base emissions inventory developed for the Tier 2 rulemaking and a composite of 30 days of meteorology during several episodes in June, July and August of 1995. Eight hour averages are calculated at each grid point for each day during the period. The set of maximum daily 8 hour averages, at each point, is ranked from highest to lowest and the 4th maximum of the 30 days is selected. The resulting field of 4th high 8 hour ozone concentrations is then used as the benchmark field. Figure 8 shows an isopleth plot of the benchmark spatial field. As an example of a network's estimated field Figure 9 presents the estimated field based on a subset of the benchmark data that was created using existing monitor locations (i.e., Network #1 - Base).

In addition to being able to provide data for estimating the complete spatial field, analysts must also be able to construct different ozone monitoring network scenarios that can show how the resources that will be needed to collect the data have been considered. Therefore, criteria have been established to consider the resource demand (both personnel and financial) that a network places on an organization. Additionally, consideration has also been given to monitoring continuity for trends purposes.

For further information, please contact Al Cimorelli at 215-814-2189 or email at cimorelli.alan@epa.gov.

Appendix B: Definitions of Network Assessment Criteria

"Monitor Servicing Distance" – This criterion is defined as the change in the total number of kilometers, from the base (existing) network, that a technician needs to travel to service all monitors in the new network. Therefore, for the existing network the value of the criterion is zero.

"Work Load" – This criterion is dependent on the size of a states monitoring staff and the number of monitors that need to be serviced. This metric is constructed by first calculating,

for each state, the ratio of the state monitoring staff to the number of ozone monitors in that state and then taking the average of six state ratios.

"Costs" – This criterion, which includes both capital and O/M costs, depends on whether the addition of an ozone monitor can be located at an existing monitoring station or a new station has to be constructed. Cost data used to construct this metric was taken from an EPA report [U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, 1993] and represent 1993 dollars. This metric is constructed as the total cost or savings (relative to the base or existing network) that results from adding and/or removing monitors. Costs are calculated over a five year period.

"Trends Impact" – This criterion is defined so as to provide a measure of the impact that removing an existing monitor will have on the historical trends that the present network provides. The larger the number the greater the negative impact. The concept here is that if a monitor is retired then the historical record at that location is broken. However, if there is a monitor nearby with a similar length of record, LOR, then the impact is lessened. This measure is calculated as the sum of the products of (LOR of the retired monitor) & (dist index DI). The distance index is determined as follows:

DI = 0	**if dist to closest monitor is <= 20kms**
DI = 1	**if dist to closest monitor is > 20kms & <= 50 kms**
DI = 2	**if dist to closest monitor is > 50kms & <= 100 kms**
DI = 3	**if dist to closest monitor is > 100 kms**

"Data Fit" – This criterion is defined as the Absolute Fractional Bias (AFB) statistic. To construct the AFB the bias is first normalized to make it dimensionless (creating the fractional bias statistic). Then its absolute value is taken since it is assumed that an over- or under-estimate of the same magnitude has equal importance. The absolute fractional bias (AFB) varies between 0 and +2 with zero indicating a totally unbiased estimation. It is written in symbolic form as $AFB = \left| 2\left(C_b - C_n\right) / \left(C_b + C_n\right) \right|$**, where C_b is the benchmark ozone concentration and C_n is the estimated concentration from network data.**

"Data Scatter" – This criterion is the square of the correlation coefficient (r^2). This statistic is a measure of the average scatter about the best-fit straight line of a plot of C_b (the benchmark ozone concentration) versus C_n (the estimated concentration from network data). The correlation coefficient , *r*, is a measure of how well the data is fitted by a straight line while r^2 quantifies the percentage of the variance in the data that is explained by the best fit straight line.

"Worst Outlier" – This criterion is defined as the 95th percentile of the distribution of absolute residuals. An absolute residual is defined as $\left| C_b - C_n \right|$ **where C_b is the benchmark concentration and C_n is is the estimated concentration from network data.**

"Population Weighting" – This criterion allows stakeholders to consider ozone concentrations in highly populated areas as more important than the same ozone concentrations is sparsely populated areas. This criterion allows stakeholders to consider ozone exposure. The population weights are created by normalizing each gridded population value (2001 census) to the average gridded value. Using the average for normalization preserves the number of pairs after weighting.

"Design Value Weighting" – This criterion allows stakeholders to place more importance on locations where the ozone concentrations are high compared with locations having low ozone concentrations. The design value weights are created by normalizing each value to the average gridded design value concentration. Using the average for normalization preserves the number of pairs after weighting.

"Attainment Threshold Weighting" – This criterion allows stakeholders to place more importance on those estimates that are nearer to the 8 hour ozone standard. It is designed to address the use of the network for attainment status decisions and considers that ozone estimates near the standard must have greater certainty than those farther from the standard in order to avoid the possibility of mis-classification. Using the 2001 design value data (gridded to each of the 4 areas), the following metric

$MIN\left[\left(1/\left|C_{DV} - 84\,PPB\right|\right);\,1\right]$ **(where C_{DV} is the gridded design value concentration) is created to provide a quantitative measure for determining how close the C_{DV} is to the NAAQS. This metric ranges between 0 & 1 with 1 indicating a gridded value that is very close to the standard. The "Attainment Threshold" weights are created by normalizing each metric value to the average value across the grid. Using the average to normalize preserves the number of pairs after weighting.**

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January 15, 2003

Prepared by: Al Cimorelli
Alice Chow
Cynthia Stahl
Denny Lohman
Eva Ammentorp
Ruth Knapp
Ted Erdman

Region III Monitoring Network Assessment – Preliminary Report

Executive Summary

Region III has initiated the NCore 3 assessment of the monitoring networks for ozone (O3), particulate matter (PM2.5 and PM10), sulfur dioxide (SO2), carbon monoxide (CO), lead (Pb), and nitrogen dioxide (NO2). The initial assessment for each of the pollutant monitoring networks is contained in the following sections. This report is intended to begin the discussion with stakeholders that will include ensuring that the monitoring data meets all requirements for its use and stakeholder constraints such as time and finances. This initial assessment meets the requirements in the September 1, 2002 National Ambient Air Monitoring Strategy Summary Document – Final Draft that can be found at http://www.epa.gov/ttn/amtic/files/ambient/monitorstrat/summary.pdf. This strategy anticipates that existing monitoring regulations will need to be modified in order to accommodate the final recommended network changes[8]. The anticipated schedule for completion of the stakeholder discussions and monitoring network assessment contemplates a final report at the end of March 2003. Where possible and agreed upon between EPA and states, this is schedule could allow for changes to the monitoring network to be reflected in section 105 grant negotiations in the Spring 2003.

The methodology used to initialize the assessment allows stakeholders to include many different criteria determined to be relevant to making decisions about which monitors should remain in the network and which can be contemplated for removal. The methodology is illustrated in the most detail for the ozone monitoring network assessment. Forty criteria were used, including the consideration of adequate air quality estimates (using 3 different statistics), demand on state personnel resources, capital and operation/maintenance costs for the monitors, and the value of preserving air quality trends. For the initial ozone monitoring network assessment, the impacts on cost, personnel, air quality estimates, and trends are examined using some extreme conditions such as hypothetically placing a monitor in every county and removing monitors from the existing network while preserving the adequacy of the air quality estimate. These boundary condition scenarios are not intended to be recommendations for a particular monitoring network but rather to initialize stakeholder discussions with regard to the kinds of concerns and issues important to how the monitoring network should be constructed.

Similar to the network assessment for ozone, in the PM2.5 assessment, the impacts of six boundary condition scenarios are examined with respect to 12 criteria. As with the initial ozone monitoring network assessment, stakeholders are expected to discuss, identify, and determine the relevant criteria and associated data important to the PM2.5 monitoring network.

The monitoring networks for the remaining pollutants, SO2, CO, Pb, NO2, and PM10 are presented in lesser detail in this preliminary report but Region III's intention is to use similar

[8] Page 4, item (7), U.S. Environmental Protection Agency, National Ambient Air Monitoring Strategy Summary Document, Final Draft for Comment, September 1, 2002.

methodology to identify, discuss, and determine the important issues and decision criteria with which to analyze the monitoring networks. To begin these discussions, this report makes a recommendation for the monitoring networks for each of these pollutants.

For all of these pollutant monitoring networks, issues such as the importance of sites as design value sites, Air Quality Index (AQI) sites, background monitoring sites for stationary source modeling, air quality designations, and air quality policy implementation should be discussed. Stakeholders are encouraged to begin participating in the process by first examining this report and its accompanying materials and then raising concerns during discussions with Region III. Stakeholders are also encouraged to analyze the currently-identified criteria relative to the network decision by modifying the indexing and preference weights in the accompanying spreadsheets.

Following the analytical procedure above, the assessment of NCore 2 monitors can be conducted to include specific NCore guidance requirements such as the location of urban vs. rural monitors, leveraging existing monitoring sites for new NCore 2 sites, minimum population, consideration as NAMS monitors only, and so on. It is anticipated that the evaluation of NCore 2 sites can use the methodology and much of the same data used for the NCore 3 evaluation. Stakeholders are also encouraged to participate in the NCore 2 assessment to the extent that their resources will permit. Specific questions about data should be directed to Alice Chow (215-814-2144). Questions about the construction of criteria indicators and air quality statistics should be directed to Al Cimorelli (215-814-2189). Questions about the overall decision analysis methodology should be directed to Cynthia Stahl (215-814-2180).