# DRAFT

# National Ambient Air Monitoring Strategy

Office of Air Quality Planning and Standards
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**National Ambient Air Monitoring Strategy**

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# DRAFT
# National Ambient Air Monitoring Strategy

## Preface

This document presents a National Ambient Air Monitoring Strategy (Strategy). This version updates a draft version, dated April 2004. This version differs from that earlier draft in a few substantive ways:

(1) This version does not discuss in as much detail the history and rationale for various strategic decisions as the April 2004 draft, but those rationales for the most part remain valid.

(2) This version is broader in scope and includes several areas of ambient monitoring that, even where mentioned in the April 2004 draft, were not incorporated as primary elements of the overall national Strategy.

(3) The April 2004 draft categorized monitoring stations in three levels. The three levels combined were referred to as the National Core Monitoring Network (NCore). This version of the Strategy dispenses with the three-level concept because it did not encompass all relevant monitoring efforts. This Strategy refers to the collection of all ambient air monitoring -- including research sites, all types of monitoring by states and Tribes, and all types of ambient monitoring by Federal agencies -- as the National Ambient Air Monitoring System (NAAMS).

(4) U.S. Environmental Protection Agency's (EPA) specific strategy with regards to some topics remains in a formative stage. Thus, in several instances, this version of the Strategy focuses more on goals than specific strategic plans. EPA anticipates that further consideration of those topics will occur over the coming year, with a final version of this Strategy released in early 2007. That final version would include additional details on the strategies and implementation plans EPA intends to pursue in those areas.

The documents associated with this Strategy are available at http://www.epa.gov/ttn/amtic. That website includes earlier drafts of this Strategy as well as this current December 2005 draft. Note that even after finalizing this Strategy in early 2007, EPA envisions that it will produce supplements and revisions to this document as conditions evolve, and EPA adjusts its strategy and implementation plans to address emerging air quality developments, technology advances, and other implementation issues.

## Executive Summary

Federal agencies, state and local air agencies, and Tribes operate and maintain a wide variety of ambient monitoring systems across the U.S. Many of these systems now serve multiple environmental objectives, even though they may have been sited originally for a more limited purpose. Over time, regardless of whether the original objective remains or diminishes in importance, air quality management developments may warrant rethinking how best to use the monitoring system for other environmental and air program objectives. One important element of this Strategy is to recognize all of the different types of monitoring and all of the various environmental and other program purposes they serve, and then identify ways in which integration of these monitoring systems may aid in fulfilling those objectives, perhaps with increased efficiency. Collectively, EPA refers to all of these various monitoring efforts as the National Ambient Air Monitoring System (NAAMS). This Strategy is designed to outline EPA's current efforts and future plans to maintain and enhance the NAAMS to meet the nation's air quality goals and challenges.

In addition, technology advances over time. This includes both the capabilities of the monitoring hardware and the ability to record, store, disseminate, and analyze the monitoring data. A second key element of this Strategy is to ensure that our monitoring strategy is flexible enough to provide incentives for improved monitoring and improved use of the monitoring data.

Finally, EPA has developed a systematic data quality approach over the past several years. The quality system requirements for most ambient monitoring predates that development. As such, there is a strong need to reevaluate how agencies should conduct quality assurance and what minimum requirements are appropriate for regulatory provisions.

This Strategy looks at each of these areas and provides EPA's overall approach for achieving these objectives through an integrated NAAMS. As shown in Table ES-1, there are a number of different monitoring programs covered in this Strategy, with various objectives. That table also indicates the key elements of EPA's current strategy and any specific implementation plans that EPA has developed. As the information makes clear, there are a number of situations for which EPA's strategy remains at a formative stage. In those situations, this document presents the overall objectives and goals and indicates EPA's commitment to continue to pursue more specific strategies.

**Table ES-1**
**Overview of December 2005 Draft Monitoring Strategy**

| Monitoring Network/Type | Environmental/Program Objectives | Strategy Components | Implementation Tasks/Elements |
|---|---|---|---|
| Urban Monitoring for NAAQS | • Use for Attainment/Nonattainment determinations, designations, redesignations, classifications, and maintenance plans<br>• Assess long-term trends<br>• Control strategy development and model validation<br>• Conduct high-grade research and methods development at select sites<br>• Support environmental justice analysis, health effects research, and other special studies<br>• Aid in determining source-receptor relationships<br>• Public air quality reporting and forecasting (Air Quality Index) | • Reconfigure existing SLAMS/NAMS, PAMS, and Speciation (STN) into NCore multipollutant sites and additional local scale monitoring sites, with overall reduction in number of sites<br>• Streamline PAMS<br>• Move to continuous PM monitoring<br>• Enhance QA<br>• Investigate ways to integrate with CASTNET, National Air Toxics Trends Stations (NATTS), and other monitoring networks<br>• Acknowledge data management systems as inherent part of monitoring program | • Regulatory revisions (proposal December 2005)<br>• Annual National Program and Grant Guidance documents<br>• Technical guidance documents (pending regulatory finalization)<br>• Continue integration discussion |
| Urban Monitoring for Air Toxics | • Assess potential toxic hot spots to protect human health<br>• Assess effectiveness of air toxic control programs<br>• Long-term trends analysis<br>• Support health effects research<br>• Aid in determining source-receptor relationships | • Maintain NATTS<br>• Support existing state and local program monitoring by continuing to fund local-scale projects to assess conditions at local level<br>• Utilize PAMS, IMPROVE, and CASTNET where possible<br>• Use monitoring data to refine air quality model-based assessment tools (e.g., National Air Toxics Assessment) | • Ongoing development of ambient monitoring component of air toxics strategy |

(cont.)

**Table ES-1**
**Overview of December 2005 Draft Monitoring Strategy (cont.)**

| Monitoring Network/Type | Environmental/Program Objectives | Strategy Components | Implementation Tasks/Elements |
|---|---|---|---|
| Rural Monitoring | • Assess atmospheric deposition trends<br>• Assess mercury and other persistent bioaccumulative toxics (PBT) deposition<br>• Assess visibility<br>• Ensure protection of PSD increments<br>• Provide information on upwind ambient conditions vital to NAAQS strategy development and assessment<br>• Long-term trends analysis<br>• Aid in determining source-receptor relationships<br>• Aid efforts for regional air quality model data input and evaluations | • Maintain and upgrade CASTNET, NADP, and IMPROVE as core elements in national monitoring framework for acid deposition, mercury, and visibility<br>• Retain other rural monitoring generally "as is" (for example, PSD monitoring) for applicable NAAQS<br>• Use rural monitoring networks to track rural background ambient conditions<br>• Seek ways to formally integrate CASTNET, and maybe other rural networks, with urban monitoring networks to enhance ability to manage current and future air quality management challenges<br>• Support PBT monitoring | • Continue integration discussions, and issue more detailed elements of this component in January 2007 strategy document<br>• Take action on pursuing semi-continuous monitoring technology for certain CASTNET sites<br>• Continue to enhance public access to CASTNET data through Data and Maps website portal<br>• Make regulatory requirements for PSD monitoring QA consistent with those for state/local monitoring |
| Tribal Monitoring | • Assess air quality in Indian country<br>• Contribute to long-term trends analysis | • Respect Tribal autonomy<br>• No requirements to be imposed on Tribal monitoring; no mandates linking Tribal air monitoring with national networks | • Continue discussions with Tribes on mutually beneficial efforts and encourage collaboration between Tribal, Federal, state, and local entities<br>• Update Strategy to reflect outcome of those discussions |

(cont.)

**Table ES-1**
**Overview of December 2005 Draft Monitoring Strategy (cont.)**

| Monitoring Network/Type | Environmental/Program Objectives | Strategy Components | Implementation Tasks/Elements |
|---|---|---|---|
| Tribal Monitoring (cont.) | | • Continue to rely on EPA Regional Offices to allocate available Tribal grant funds<br>• Leverage opportunities that simultaneously benefit Tribes and the national network through support for Tribal monitoring efforts and sharing of Tribal monitoring data<br>• Explore opportunity for Tribes to operate rural sites of national/regional interest | |
| Near Roadway Monitoring | • Assess exposure impacts in near roadway environments<br>• Determine long-term trends (potentially NAAQS compliance) | • Stress importance of near roadway exposures and further explore what these exposures mean in terms of urban NAAQS and toxic air monitoring networks<br>• Develop and incorporate into national network as appropriate | • Consult with SLTs and other stakeholders<br>• Issue more detailed elements of this component in January 2007 strategy document |
| Homeland Security | • Surveillance of terrorist threats from intentional releases of radiation or biological agents | • Enhance RadNet as vital element of air program<br>• Support BioWatch | • RadNet approach under review by EPA's Science Advisory Board; to be incorporated in overall strategy once approach and implementation plan finalized<br>• BioWatch strategy undisclosed for national security reasons |

# 1. Need for a National Ambient Air Monitoring Strategy (NAAMS)

## 1.1 Importance of Ambient Monitoring and Primary Goals

Ambient air monitoring systems are a critical part of the nation's air quality management program infrastructure. Environmental management officials and other environmental professionals use the ambient air monitoring data for a wide variety of purposes in managing air quality. Air quality management involves a cycle of setting standards and objectives, designing and implementing control strategies, assessing the results of those control strategies, and measuring progress. Ambient monitoring data have many uses throughout this process, such as determining compliance with the National Ambient Air Quality Standards (NAAQS); characterizing air quality and trends; estimating health risks and ecosystem impacts; developing and evaluating emission control strategies; evaluating source-receptor relationships; providing data for input to run and evaluate models; and measuring overall progress of air pollution control programs. Ambient air monitoring data provide accountability for emission strategy progress through tracking long-term trends of criteria and noncriteria pollutants and their precursors. The data also form the basis for air quality forecasting and other public air quality reports. They also can provide valuable information for broader ecosystem impacts.

Federal agencies, state and local agencies, and Tribes have a long history of providing high quality, credible environmental data. State and local agencies and Tribes (SLTs) have primary responsibility for urban air monitoring in order to demonstrate that areas attain national ambient air quality standards (NAAQS). Many SLTs maintain additional monitoring to assess local air issues and air toxics. In addition, the federal government operates or supports several networks, such as atmospheric deposition and visibility monitoring networks, that provide data on specific issues, particularly focused on rural ambient conditions.

The challenge for SLTs and federal agencies is to maintain and improve upon these valued products despite flat or possibly declining funding. Monitoring programs are subject to continual changes in SLT, federal, and research priorities. New and revised NAAQS, changing air quality (e.g., significantly reduced concentrations of some criteria pollutants), and an influx of scientific findings and technological advancements challenge the response capability of the nation's networks.

One of the findings that continues to present challenges in air quality management is the complex nature of air pollution formation and control. To respond to these challenges, EPA and its partners often need integrated measurements and strategies. The single-pollutant measurement approach, commonly administered in SLT networks, is not an optimal design for integrated air quality management approaches. In addition, as many air quality control solutions move toward large-scale regional, multipollutant control strategies, there is an increasing need for coordinating urban and rural ambient monitoring networks, given that the changes in regional background atmospheric conditions that are critical to reducing urban air pollution generally are observed at the rural monitoring stations. At the same time, ambient air networks need a certain degree of stability so that EPA and others have consistent, long-term data to detect long-term air pollution trends.

Thus, a coordinated national strategy needs to update SLT networks (which largely grew out of efforts dating back to the 1970s), recognize the importance of other monitoring, such as atmospheric deposition monitoring, integrate that other monitoring with the SLT networks where appropriate, and maintain continuity so that an appropriate set of monitors continue to provide valid comparisons of long-term trends.

Given this backdrop, the overarching goals of this air monitoring strategy are:

(1) To ensure that the existing SLT monitoring networks are reconfigured to be consistent with the basic environmental and programmatic needs for current environmental management;

(2) To seek ways to integrate various monitoring networks where opportunities for integration exist;

(3) To improve the scientific and technical competency of the nation's air monitoring networks to ensure high quality data; and

(4) To enhance data storage, dissemination, and analyses so that government agencies, researchers, and the general public have improved access to ambient monitoring data, both in terms of completeness and timeliness.

In developing a strategy that can meet these objectives, EPA and its partners must consider resource constraints and look for opportunities to streamline and integrate existing monitoring resources in a way that maximizes the benefit of the monitoring data collected.

## 1.2 Brief History and Overview of Ambient Air Monitoring in U.S.

### 1.2.1 Monitoring Designed to Implement the NAAQS

State and local ambient monitoring stations (SLAMS) and national ambient monitoring stations (NAMS) represent the majority of all criteria pollutant ($SO_2$, $NO_2$, CO, $O_3$, Pb, $PM_{2.5}$, $PM_{10}$) monitoring across the nation, with over 5,000 monitors at approximately 3,000 sites. These stations use federal reference or equivalent methods (FRM/FEM) for direct comparison to the NAAQS, that lead to determining whether areas are listed as in attainment or nonattainment. NAMS are a subset of SLAMS that are designated as national trends sites and, in some cases, also serve as the design value sites for an area. The EPA has established a suite of regulations that specifies the design and measurement requirements for these networks: 40 CFR Part 58 (design and quality assurance); Part 53 (equivalent methods); and Part 50 (reference methods).

The SLAMS and NAMS were developed in the 1970s. In the early 1980s, the networks began to add $PM_{10}$ monitors, and then expanded to include $PM_{2.5}$ monitors, starting in 1999, to assess attainment with the $PM_{2.5}$ NAAQS promulgated in 1997. The $PM_{2.5}$ network consists of ambient air monitoring sites that make mass or chemical speciation measurements. As of 2005, there were about 900 FRM/FEM filter-based sites and 540 continuous measurement sites for mass measurements.[1] Chemical speciation measurements were made at over 50 trends sites, about 210 SLT sites were used in support of SLT monitoring objectives (including state implementation plan (SIP) development), and there were about 110 IMPROVE (Interagency Monitoring of Protected Visual Environments) sites in Class I visibility protection areas. These sites collect aerosol samples and analyze the filters for trace elements, major ions, and carbon fractions. Most of the IMPROVE sites are operated by other federal agencies within the Department of the Interior (see Section 1.2.3 below). IMPROVE sites support implementation of the NAAQS by providing data to assess $PM_{2.5}$ concentrations from rural areas that may impact urban areas.

The number of monitoring sites for total suspended particulates has declined sharply, as has the number of sites for other pollutants such as lead, $NO_2$, and $SO_2$. The number of ozone and carbon monoxide sites has stayed relatively stable (Figure 1-1). Given the long history of using these sites, and the changing nature of NAAQS attainment and control strategy issues, rethinking the design of SLAMS/NAMS is one of the central topics of this Strategy.

In addition to the SLAMS/NAMS networks, the Photochemical Assessment Monitoring Stations (PAMS) was developed in the 1990s to measure ozone precursors, volatile organic compounds (VOC), and $NO_x$. The PAMS consists of 75 sites in 25 metropolitan areas that were classified as serious ozone nonattainment areas. The addition of PAMS in the early- to mid-1990s was a major addition to the state/local networks, introducing near research grade measurement technologies to produce continuous data for over 50 VOC compounds during summer ozone seasons.

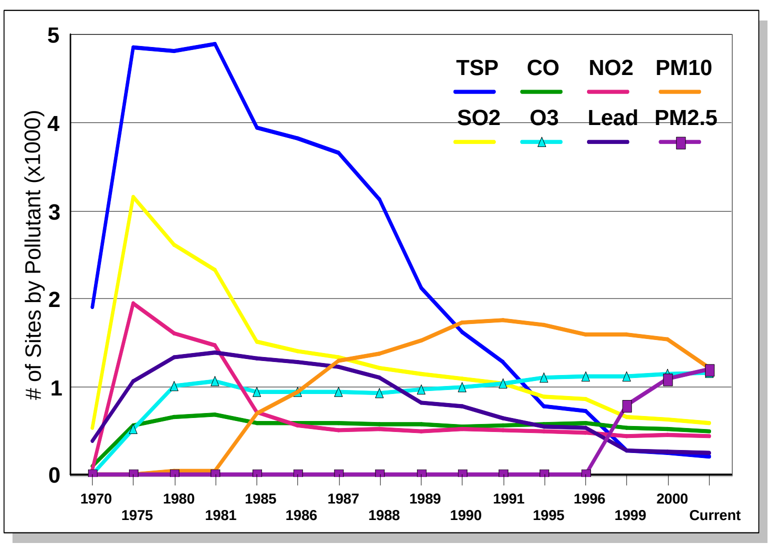


**Figure 1-1**: Growth and decline of criteria pollutant networks.

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[1] The $PM_{2.5}$ continuous monitoring network is the only criteria pollutant reported and forecasted nationally on a year-round basis as part of the Air Quality Index (AQI) -- see http://airnow.gov.

### 1.2.2 Acid Rain/Deposition Monitoring in Rural Areas

The Clean Air Status and Trends Network (CASTNET) originally was designed mostly to account for progress of strategies targeting major electrical generating utilities throughout the eastern U.S., which release acid rain precursor emissions, sulfur, and nitrogen oxides. Network operations are contracted out to private firms funded through Science and Technology (S&T) funds and managed by EPA's Office of Air and Radiation. CASTNET consists of over 80 sites located predominantly throughout the East, with greatest site densities in states along the Ohio River Valley and central Appalachian Mountains (Figure 1-2). Unlike SLAMS/NAMS, most CASTNET sites are located away from local sources of pollution in order to assess broad, regional air quality trends.

The National Atmospheric Deposition Program (NADP) comprises three subnetworks: the National Trends Network (NTN), the Mercury Deposition Network (MDN), and the Atmospheric Integrated Research Monitoring Network (AIRMoN). NTN collects weekly samples for hydrogen, sulfate, nitrate, ammonium, chloride, and base cations (such as calcium and magnesium). NTN provides a long-term, high-quality database that is useful for assessing the magnitude of the acid rain problem and for determining spatial and temporal trends in the chemical composition of the atmosphere and the removal of atmospheric compounds as deposition. The NTN has grown from 22 sites in 1978 to over 200 sites currently. MDN collects mercury samples, and supports a regional database of the weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. Lastly, AIRMoN was formed for the purpose of studying precipitation chemistry with greater temporal resolution (precipitation samples are collected daily). The samples are analyzed for the same constituents as NTN sites. AIRMoN currently operates eight sites, with the full network expected to grow to about 20-30 wet and dry deposition sites. The AIRMoN sites provide a research-based foundation for operations of the other deposition monitoring networks (NADP for wet deposition and CASTNET for dry deposition).

### 1.2.3 Visibility Monitoring

The Interagency Monitoring of Protected Visual Environments (IMPROVE) program is a cooperative measurement effort by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE program was established in 1985 to aid the creation of Federal and state implementation plans for the protection of visibility in Class 1 areas (156 national parks and wilderness areas) as stipulated in the 1977 amendments to the Clean Air Act (CAA). The IMPROVE network presently comprises 110 monitoring sites. Note that the IMPROVE sites also provide $PM_{2.5}$ speciation data, as noted in Section 1.2.1, above.

**CASTNET Site Locations**

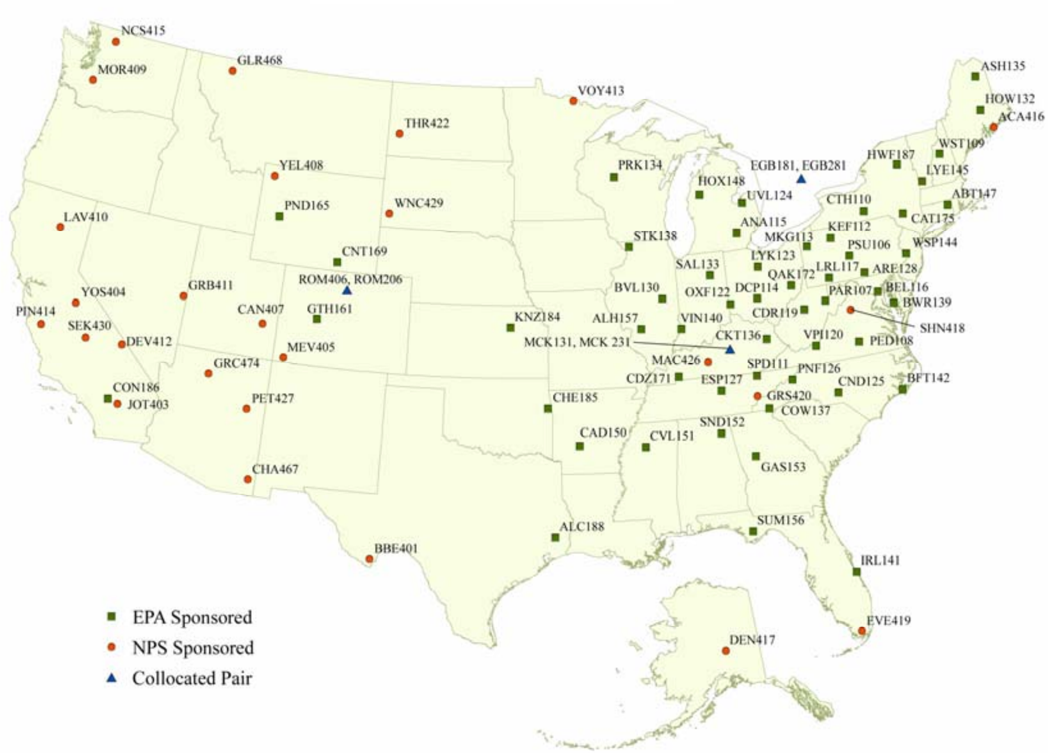


**Figure 1-2:** Clean Air Status and Trends Network (CASTNET)

### 1.2.4 Air Toxics Monitoring

Unlike NAAQS pollutants, the Clean Air Act does not require monitoring for air toxics. Because the primary focus of the air toxics program to date has been on reducing air toxics emissions by application of available control technology for industrial sources and more stringent mobile source emission standards, the success of the program so far has been measured more often by the level of emissions reductions achieved as opposed to measured changes in air quality. EPA has used air dispersion modeling to estimate the impact of air toxics emissions on ambient air concentrations of air toxics and, ultimately, on human health.

EPA now has an active national air toxics monitoring program that includes three distinct monitoring efforts:

- National Air Toxics Trends Stations (NATTS);
- EPA funded local-scale projects to assess conditions at the local level; and
- Existing state and local program monitoring.

The NATTS network is intended to provide long-term monitoring data for certain priority air toxics across representative areas of the country in order to establish overall trends for these pollutants. EPA has established 23 NATTS, 17 of which are in urban areas and six of which are in rural areas. In the near term, this Strategy documents EPA's commitment to maintain NATTS.

Initial ambient air toxics monitoring pilot studies have shown that across a city significant variations in pollutant concentrations occur that cannot be characterized by a single monitoring site. Thus, EPA has incorporated into the national air toxics monitoring strategy support for local-scale projects consisting of several monitors operated for one to two years.

Many state and local agencies for some years have operated ambient air toxics monitoring networks in support of their state or local air toxics programs. These can include monitors to address "hot spots," environmental justice concerns, or citizen complaints. About 250 separate air toxics sites exist at the state and local levels.

In addition to these air toxic-specific monitoring activities, other monitoring programs primarily intended to address other air pollution concerns incorporate aspects of air toxics monitoring. EPA's Photochemical Assessment Monitoring Stations (PAMS) collect data on certain volatile organic compound and carbonyl air toxics, while the IMPROVE and CASTNET networks collect data on certain air toxics metals. To identify certain air toxics compounds, the results of some particulate matter monitoring is speciated.

In addition to these existing efforts, EPA has an ongoing effort to develop a strategy for persistent bioaccumulative toxics (PBT) monitoring, including expanded mercury monitoring.

### 1.2.5 Tribal Monitoring

Currently, there are well over 100 Tribal air quality programs in various stages of development across the United States. This is a dramatic increase from only nine programs in 1995. Many of these Tribes currently report data to EPA's Air Quality Subsystem (AQS) from about 120 monitors in Indian country for several types of pollutants, including $PM_{2.5}$ and $PM_{10}$, ozone, nitrogen and sulfur oxides. Tribes also operate monitors in other national networks such as CASTNET, IMPROVE and NADP.

EPA's Tribal air policy emphasizes that, as sovereign governments, Tribes set their own air program goals and determine how monitoring is to be used in achieving these goals. Thus, EPA's role for Tribal air programs is to help the Tribes understand their air quality problems and to establish and meet their air quality goals, rather than to set goals or timetables for the Tribes.

### 1.2.6 Research-level and Other Monitoring

In addition to the monitoring networks described above, there are many additional recent or ongoing ambient monitoring initiatives that provide valuable data, some of which are comparable in terms of being a network design and others that are targeted for particular research or other purposes. There is a wide range of these types of efforts. Some critical examples that will play a role in this Strategy include:

- PM Supersites. This ambient monitoring research program was designed to characterize particulate matter, support health effects and exposure research, and conduct methods testing. The supersites were established through cooperative agreements with universities and EPA. These sites operated over various periods spanning 1999 to 2005 and conducted a wealth of standard and research grade measurements. Supersites were designed to address the extremely complicated sampling issues associated with fine aerosols and constituted an ambitious technology transfer and liaison effort across research level and routine network operations.

- Near Roadway Monitoring Efforts. Research monitoring efforts to characterize the impacts of mobile sources near roadways are emerging as a key area for ambient air monitoring development. An estimated 35 million Americans live near four-lane roads, and EPA and others will need to investigate how to incorporate near roadway conditions and exposures into NAAQS attainment monitoring. To date, ambient monitoring in these areas consists of targeted research efforts. For example, the Traffic-Related Exposure Study (T-REX) has measured concentration gradients along roads, identified intrusion into nearby buildings, and evaluated air quality and exposure models. As another example, the Detroit Exposure and Aerosol Research Study (DEARS) has measured personal exposure and assessed residential proximity to roads and other sources. These and other research efforts indicate the need to evaluate methods of integrating near roadway monitoring into NAAQS compliance monitoring network design and siting.

- New Source Review Permit Monitoring. The Prevention of Significant Deterioration (PSD) provisions in the CAA establish permitting requirements for new or modified major sources located in areas that attain the NAAQS. In general, PSD requires the classification of all land areas as either class I, II, or III. The Clean Air Act specifies that certain large, federally owned, publicly accessible lands (generally, National Parks, Monuments, Forests, and Wilderness Areas exceeding 5,000 acres) must be treated as Class I areas. The Act classifies all other areas as Class II areas, but states can redesignate areas as Class I or Class III areas through a process laid out in the Act. Generally, Class I areas receive the most significant protection from increased air pollution under the PSD program and Class III areas the lowest. Under the PSD provisions for Class I areas, a facility owner seeking a permit must demonstrate through air quality modeling that their facility will not degrade the Class I area's air quality. Monitoring may be required before construction begins on a new facility to establish baseline conditions. In addition to monitoring ambient concentration pollutants emitted from permitted facilities, PSD provisions allow states to require meteorological monitoring in order to determine whether the permitted source is degrading air quality in a class I area. Monitoring may continue for as long as the facility is in operation. These PSD monitoring provisions have contributed to the establishment of many industry-operated monitoring sites in so called "clean" areas. In addition to meeting the basic needs of the PSD program those sites have contributed to a greater understanding of atmospheric processes in general and the transport and fate of certain pollutants in particular.

- Radiation and Homeland Security Monitoring. Currently, RadNet is the nation's only comprehensive radiation monitoring network, with more than 200 sampling stations located throughout the United States. The network is multi-media and provides broad geographical coverage as well as coverage of many major population centers. For air monitoring, RadNet samples twice per week at 59 locations. In addition to RadNet, there are other radiation monitoring programs in the U.S. The Department of Homeland Security's (DHS) Environmental Measurements Laboratory operates the Surface Air Sampling Program (SASP). This global air particulate monitoring network is comprised of approximately 41 active sampling stations worldwide. In addition, DHS operates a global precipitation monitoring network with 45 U.S. sampling locations.

  The Department of Energy (DOE) Los Alamos National Laboratory, in cooperation with EPA, operates the Neighborhood Environmental Watch Network (NEWNET). This network measures gamma radiation exposure rate, humidity, barometric pressure, wind speed, and wind direction using real-time monitoring devices with satellite uplink at locations in Alaska and New Mexico. The majority of the sampling sites are located in New Mexico in support of efforts at Los Alamos National Laboratory.

  In the United States, DOE has research and development responsibility for monitoring and verification of the Comprehensive Test Ban Treaty (CTBT). In support of the CTBT, which was signed by President Clinton in September 1996, an International Monitoring System and National Data Center has been developed. The monitoring system consists of a worldwide network of seismic, hydro-acoustic, infrasonic, and radionuclide monitoring stations that provide near-real-time data to the National Data Center. There are 80 radionuclide monitoring stations worldwide. Eleven radionuclide monitoring stations are operated by the United States.

  Some states also perform environmental radiation monitoring. For example, the Illinois Emergency Management Agency's Division of Nuclear Safety operates a system comprised of gamma dose rate monitoring devices and air particulate sampling at approximately 60 sites. The program, however, is basically directed at in-state nuclear power plants. Similarly, other radiation monitoring systems in the country focus on facility and site monitoring and special studies monitoring. RadNet remains the only comprehensive national environmental ambient radiation monitoring network that focuses on major population centers and broad geographical areas.

  In addition to radiation monitoring, EPA has partnered with several other federal agencies in the establishment and operation of the BioWatch network. Details about this network are not provided due to national security; however, the system may be described as a network to monitor for biological material in largely urban areas. In addition, the federal government conducts additional biological monitoring at various defense installations.

## 1.3 Current Air Quality Management Challenges and Opportunities

Dramatic and mostly positive changes in air quality have been observed over the last two decades, despite increasing population, vehicle usage, and productivity. Most criteria pollutant measurements read well below national standards (see Figure 1-3).

As Figure 1-3 shows, control measures adopted under the CAA and state and local laws have generally solved the widespread, elevated levels of lead and gaseous criteria pollutants. However, current and future problems in particulate matter, ozone, and air toxics damage continue to challenge air programs.

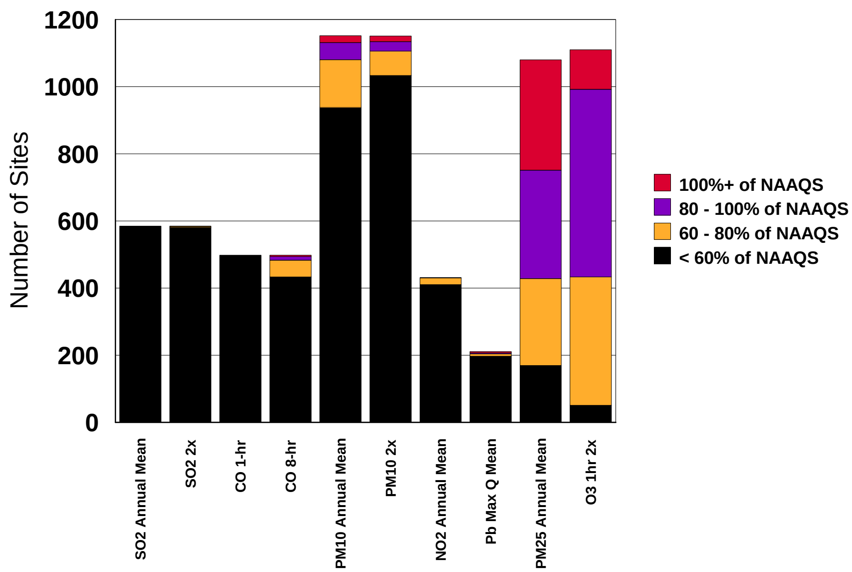


**Figure 1-3.** Number of monitors measuring values relative to the National Ambient Air Quality Standards based on AIRS data through 1999. Great progress has been made in reducing ambient concentrations of most criteria measurements. Ozone and $PM_{2.5}$ dominate the nonattainment picture on a national scale.

Many of the key air quality management challenges were outlined recently in a major National Academy of Sciences (NAS) report: Air Quality Management in United States (2004). These include:

- Meeting new standards for ozone, particulate matter, and regional haze;
- Understanding and addressing the human health risks from exposure to air toxics;
- Responding to evidence that there may be no identifiable threshold exposure below which harmful effects cease to occur for some pollutants;

- Mitigating pollution effects that may disproportionately occur in minority and low-income communities;
- Understanding and protecting ecosystems affected by air pollution;
- Understanding and addressing multistate and international transport of pollutants; and
- Adapting the air quality management system to a changing climate.

Among the NAS recommendations to address those challenges were enhancing assessments of air quality and health, ecosystem monitoring, and exposure assessment. Reconfiguring existing monitoring networks can reflect our progress in reducing many forms of air pollution and incorporate new scientific findings and technologies to address the remaining challenges. This Strategy is one prong of working to implement those recommendations by coordinating ambient monitoring efforts and looking for ways to strengthen, update, and link together existing monitoring systems.

### 1.4 Identifying the Need for a National Strategy

As EPA looks at the air quality management challenges ahead, it is clear that a national strategy to maintain effective ambient monitoring systems is a vital component of meeting those challenges. The Strategy needs to address the following types of gaps, inefficiencies, and overlaps:

- The existing NAAQS compliance networks, SLAMS/NAMS, need to be reconfigured to emphasize persistent attainment problems, such as $0_3$ and $PM_{2.5}$ (and the proposed new $PM_{10-2.5}$ standard). In part, this will require shifting resources currently being expended on NAAQS attainment problems that largely have been addressed (such as CO, lead, $NO_2$, and $SO_2$). While reducing the overall number of NAAQS-oriented sites for these pollutants, the national networks need to maintain adequate sites for these pollutants to address other objectives such as long-term trends analysis, photochemical reaction evaluations, inputs for regional modeling efforts, and a variety of other purposes.

- The existing networks need to move toward enhanced data collection by incorporating continuous and multipollutant measurements where possible.

- The importance of rural background monitoring for evaluating long range transport, cross-border flux concerns, NAAQS control strategies (such as the 2005 Clean Air Interstate Rule and Clean Air Mercury Rule), and long-term NAAQS trends needs to be recognized. EPA must seek opportunities for better integrating non-NAAQS networks, such as IMPROVE and CASTNET, with NAAQS monitoring networks.

- The linkages between ambient air monitoring and ecosystem impacts need to be recognized. These ecosystem impacts can include acid, nitrogen, and mercury deposition, and ecosystem impacts of elevated ozone levels. These linkages are important not only for developing general ecosystem protection strategies, but also for evaluating secondary NAAQS established under the Clean Air Act to protect the public welfare.

- The quality system and other technical requirements for monitors need to be performance-based, which ensures high quality data but allows for technological advances in monitor design and components.

- Storage and dissemination of the full range of ambient data that SLTs and EPA collect needs to be improved. This will enhance the usefulness of the data for modeling, other research, and general public access.

## 1.5 Strategy Development Steps to Date

A National Monitoring Steering Committee (NMSC) was developed to provide oversight and guidance to develop this Strategy.[2] The NMSC included representatives from SLTs and EPA's Office of Air Quality Planning and Standards (OAQPS), Office of Research and Development (ORD), and Regional Offices. This NMSC structure reflected both the partnership across EPA and its major grantees as well as an intent to limit participation initially to focus on a manageable subset of clients and increase probability for progress. With input from the NMSC, EPA released a series of draft Strategy materials. This December 2005 draft updates an earlier April 2004 draft, which in turn was a combination of work on a series of earlier draft documents. This update reflects input from other EPA offices, such as Office of Atmospheric Programs and Office of Transportation and Air Quality, so that this draft Strategy reflects an Office of Air and Radiation-wide position, and addresses the full array of critical national ambient air monitoring components.

In addition, EPA has been conducting national assessments of the criteria pollutant monitoring networks. An assessment was conducted in 2000 to catalyze subsequent regional level assessments. A copy of the FY 2000 national assessment can be found on the Web at: www.epa.gov/ttn/amtic/netamap. This assessment established weighting parameters to determine relative "value" of individual sites. The weighting factors included concentration level, site representation of area and population, and error uncertainty created by site removal. In addition, the assessment evaluated site redundancy. The national assessment calculated error uncertainty by modeling (i.e., interpolating between measurement sites) surface concentrations with and without a specific monitor. The difference reflects the error uncertainty (Figure 1-4). Areas of low uncertainty (e.g., less than five ppb error difference for ozone) suggest that removal of a monitor would not compromise the ability to estimate air quality in the region of that monitor as nearby stations would provide adequate acceptable predictions.

[2] The NMSC has evolved into the present National Ambient Air Monitoring Steering Committee.

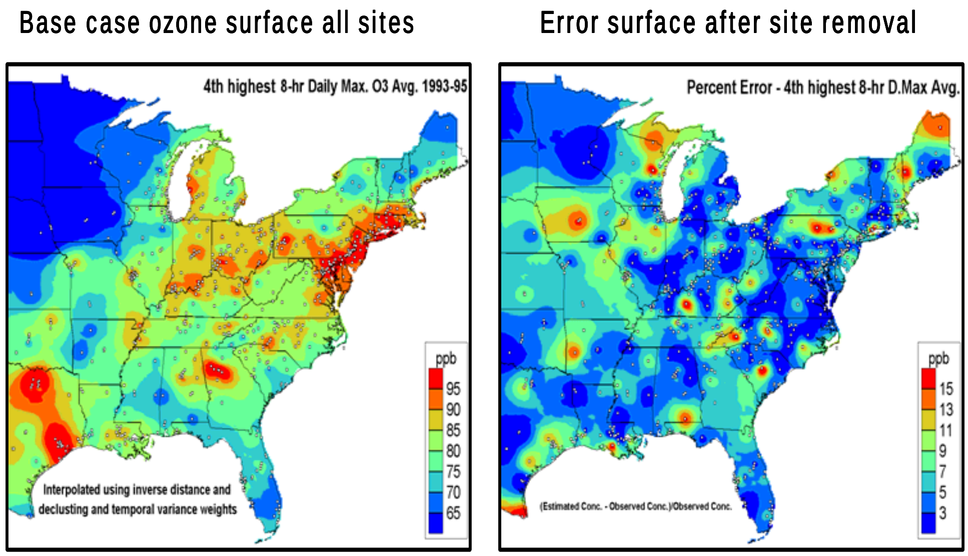


**Figure 1-4:** Surface depiction of estimated absolute errors (right) in ozone concentrations produced by removing existing monitors on a site by site basis, relative to base case (left). Areas showing low errors (<5 ppb) suggest neighboring monitors could accurately predict ozone in area of a removed site. Areas of high error suggest necessity to retain existing monitors and perhaps increase monitoring.

The key findings of the national network assessment were as follows:

- **Investment Needs:** New monitoring efforts are needed to support new air quality challenges, including monitoring for air toxics and new technology for criteria pollutants and precursor species. Air toxics have emerged as a top public health concern in many parts of the country, and a national air toxics monitoring network is currently under development under special funding for air toxics monitoring. New technology, especially continuous measurement methods for pollutants, such as fine particles, are needed to provide more complete, reliable, and timely air quality information, and to relieve the burden of manual sampling. Resources and guidance are needed for this activity.

- **Divestment Opportunities:** To make more efficient use of existing monitoring resources and to help pay for (and justify additional resources) the new monitoring initiatives noted above, opportunities exist to reduce existing monitors. Two areas of potential divestment are suggested. First, many historical criteria pollutant monitoring networks have achieved their objective and demonstrated that there are no national (and, in most cases, regional) air quality problems for certain pollutants, including $PM_{10}$, $SO_2$, $NO_2$, CO, and Pb. A substantial reduction in the number of monitors for these pollutants should be considered. (However, considerations need to be made to retain a certain number of trace level monitors especially for $SO_2$ and CO, because of their utility as tracers for certain sources of emissions and for model performance evaluation.) As part of this adjustment, it may be desirable to relocate some of these sites to rural areas to provide regional air quality data. Second, there are many monitoring sites with only one (or a few) pollutants. To the extent possible, sites should be combined to form multipollutant monitoring stations. Any resource savings from such divestments must remain in the monitoring program for identified investment needs. In addition, a reasonable period of time will be required to smoothly transition from established to new monitoring activities.

It should be noted that this type of network assessment produces recommendations on removing or relocating samplers based largely on technical merit. In some instances, these recommendations may be in conflict with existing policy or other needs. For example, a recommendation that an ozone monitor be discontinued in a "nonattainment" county due to redundancy of neighboring sampling sites raises interesting policy/technical issues. These and other issues require attention in concert with technical recommendations developed through assessments. It should not be assumed that policy should override a technical recommendation, nor should technical approach override existing policy. Rather, reasonable solutions can be achieved on a case-by-case basis. See Section 3.4 for further discussion of siting approaches under this Strategy.

- **Importance of Regional Input:** The national analyses were intended to provide broad directional information about potential network changes. Regional/local analyses are a critical complement to the national analyses, and are necessary to develop specific monitoring site recommendations. See Section 2.5.3 for further discussion of the regional assessment process.

In 2005, EPA conducted an assessment specifically focused on the $PM_{2.5}$ speciation monitoring network. In consultation with STAPPA/ALAPCO, EPA evaluated these sites to determine which might be shutdown so as to provide resources for future monitoring needs. EPA ranked the sites according to their overall information value. The ranking was based on several factors, including whether the site was in a nonattainment area and whether other sites were nearby. There was general agreement that many of the sites should be shutdown once FY 2005 funding had run out. Other sites were identified as high value sites, particularly with regard to the $PM_{2.5}$ NAAQS program. In the case of these sites, EPA evaluated each in developing FY 2006 Regional funding allocations for continued operation and maintenance of speciation sites. In doing so, the Agency balanced filter-based $PM_{2.5}$ speciation against other uses of $PM_{2.5}$ funding, such as FRM site operations, filter analysis, starting up additional precursor gas sites, and starting up continuous speciation sites.

## 1.6 Process and Timeline for Continued Development and Implementation of the Strategy

This draft Strategy reflects EPA's emerging position on the appropriate elements of a national approach to ambient monitoring improvement and implementation. In some areas, the Strategy indicates that further discussion and input is needed to develop the Strategy into specific objectives and plans. EPA's goal is to obtain further input through comments and information from the proposed revisions to the monitoring regulations being proposed in December 2005, to continue to work on topics where this draft indicates further analysis and strategy development is needed, and to complete a final document by January 2007.

The final document will remain a living document that EPA and its partners can evaluate and update on an ongoing basis. During this process, EPA will continue to work with the National Ambient Air Monitoring Steering Committee, as well as other entities where leveraging and common interest opportunities exist. EPA anticipates that this process will involve input from discussions with the North American Research Strategy for Tropospheric Ozone (NARSTO), the Committee for Environment and Natural Resources (CENR), and other stakeholders.

## 2. Overview of Strategy

This Strategy has a number of different elements, not all of which apply to all forms of ambient air monitoring. The major impetus behind this Strategy is EPA's recognition that the monitoring historically undertaken to determine NAAQS compliance needs to be significantly reconfigured and updated to meet the challenges facing air quality management in the U.S. At the same time, EPA recognizes that other ambient monitoring networks and programs, including some that are just now coming into development, play a vital role in responding to those challenges as well, and that continued maintenance, and in places enhancement, of those networks is an important element of a national monitoring strategy. Finally, EPA also realizes that while these various monitoring programs may have developed initially to provide data for different objectives, there are synergies and needs between those objectives that provide opportunities to integrate some of these systems.

Thus, this Strategy has three main elements:

- In place of the current SLAMS/NAMS networks, implement the NCore multipollutant sites and streamline the number of single pollutant sites (still called SLAMS) that are designed principally to assess NAAQS compliance and long-term NAAQS trends.

- Maintain and enhance where necessary other existing monitoring programs so they meet their environmental objectives effectively and efficiently.

- Identify and pursue opportunities for integrating monitoring networks and programs where synergies exist.

In addition to these primary elements, the Strategy includes several secondary elements as well:

- Encourage quality system enhancements.

- Update outdated technology and streamline requirements to encourage technology innovations over time.

- Promote data management, access, and analysis tools to maximize agency, research, and public use of the data collected.

- Ensure adequate resources to implement all necessary elements of the Strategy and take on other elements of the Strategy in a way that is consistent with available resources.

These primary and secondary elements of the Strategy are laid out in the following sections, after briefly reviewing high level operating principles that govern development and implementation of this Strategy.

## 2.1 Principles for Design and Management of Ambient Air Monitoring into the Future

The maintenance of effective ambient monitoring networks involves no single EPA office or other entity, but a wide range of groups. These groups can have different objectives for ambient monitoring, different funding, and other constraints. The following operating principles reflect the important partnership elements across EPA and its grantee organizations that must be recognized in embracing the goal and objectives of the Strategy:

- <u>Partnership</u>. Consensus building is used to corroborate strategic planning elements among EPA, SLTs, and other partners.

- <u>Flexibility by Balancing National and Local Needs</u>. Network design, including divestment and investment decisions, must achieve a balance between prescription (consistency) and flexibility to accommodate national and local monitoring objectives. Although localized issues are "national" issues, and nationally consistent data bases serve SLT agency interests, allowances must be made for differing needs arising from both perspectives.

- <u>Effective Interfacing with Science</u>. An emphasis should be placed on more active engagement with the scientific community, recognizing the important role science plays in network design and technology and the role of networks in assisting scientific research. The perspective that a clear demarcation exists between science-oriented and Agency-based monitoring is counterproductive to the larger goal of improving air monitoring.

- <u>Zero Sum Resource Assumptions</u>. This Strategy is not a vehicle to promote adding significant resources for air measurements as a whole, although it does not preclude EPA or state/local agencies from seeking additional resources. The Strategy assumes relatively stable but flat projected spending for air monitoring activities. This level resource assumption requires a reduction in current efforts to accommodate new monitoring needs. This reduction would occur through the types of divestments discussed in Section 1.5. Given those savings, the Strategy includes modest resource proposals to act as a catalyst for enhancing the use of updated technology. EPA believes these resource proposals represent an insignificant fraction of current monitoring resources. Furthermore, the Strategy intends to retain the basic infrastructure and operational stability of existing agencies. Reallocation implies shifts to different pollutant measurements and technologies. Significant resource shifts across geographical regimes and agencies should be made only to remedy obvious long-term disparities between programs where the programmatic needs no longer support such disparities.

- <u>Data Analysis and Interpretation</u>. Too often, large data collection programs sacrifice data analysis tasks because of a lack of protected or dedicated analysis resources, available guidance and expertise, or declining project interest. Networks will operate more efficiently when periodic active analyses are performed that identify strengths and weaknesses and provide more dynamic direction for modifications. A good example has been established by the emerging air toxics program, which set aside significant resources for analysis of historical and new pilot city data prior to large scale network deployment.

Consistent with these overall partnering principles, the NMSC recommended several key changes for inclusion in this Strategy. These changes will allow for more efficient collection and universal use of air quality data, and greater flexibility in air monitoring to meet the challenges of the 21st Century in ways that meet both national and local monitoring needs. The key recommendations were:

- The networks need to produce data more closely aligned with current challenges by:

  - including a greater level of multipollutant monitoring sites in representative urban and rural areas across the nation;

  - expanding use of advanced, continuously operating instruments and new information transfer technologies;

  - integrating emerging hazardous air pollutant (HAP) measurements into mainstream monitoring networks; and

  - supporting advanced research level stations.

- A new national monitoring network design should accommodate these recommendations and the major demands of air monitoring networks, such as:

  - trend determinations;
  - reporting to the public;
  - assessing the effectiveness of emission reduction strategies;
  - assessing source-receptor relationships;
  - providing data for health assessments and NAAQS review; and
  - determinations of attainment and nonattainment status.

- Existing monitoring regulations require modification and promulgation by EPA to accommodate recommended network changes.

- Flexibility must be maintained and even increased for SLTs to address local and area-specific issues including, for example, environmental justice concerns, episodic PM and ozone events, and "local" or hot spot air toxics concerns.

- Periodic assessments of air monitoring networks must be performed to determine if the existing network structure is optimally meeting national and local objectives. The current national review of the networks indicates that many criteria pollutant measurements (e.g., nitrogen and sulfur dioxides, carbon monoxide, $PM_{10}$) are providing only limited value, which present opportunities to realign air monitoring resources in more relevant areas.

Such assessments and network decisions are best addressed through regional level evaluations.

- The network modifications should be conducted within current resource allocations used to support monitoring (e.g., with respect to staffing). However, there need to be modest investments in new equipment to upgrade monitoring systems to meet new priorities and accommodate advanced technologies.

- Recommendations for network changes should engage the public.

EPA has in large part used these recommendations as a framework for fashioning this Strategy. The remaining parts of this Section 2 describe the major elements of the Strategy.

## 2.2 Strategy for Urban Areas

### 2.2.1 NCore Multipollutant Sites

Urban monitoring systems need to build on the current air monitoring networks, but also incorporate changes to address new directions in air monitoring and to begin filling measurement and technological gaps that have accumulated over the years. This Strategy emphasizes multipollutant sites, continuous monitoring methods, and important pollutants previously not included in SLAMS/NAMS, such as ammonia and reactive nitrogen compounds ($NO_y$). When completed, this modified network will meet a number of important needs: improved data flow and timely reporting to the public; NAAQS compliance determinations; support for development of emissions strategies; improved accountability for control programs; and support for scientific and health-based studies.

Structurally, the central component of this Strategy will be a network of National Core (NCore) multipollutant monitoring sites. Monitors at NCore multipollutant sites will measure particles ($PM_{2.5}$, speciated $PM_{2.5}$, $PM_{10\text{-}2.5}$), $O_3$, $SO_2$, CO, nitrogen oxides ($NO/NO_2/NO_y$), and basic meteorology. Monitors for all the gases except for $O_3$ would be more sensitive than standard FRM/FEM monitors, so they could accurately report concentrations that are well below the respective NAAQS but that can be important in the formation of $O_3$ and PM. EPA expects that each state would have from one to three NCore sites, and EPA will collaborate on site selection with states individually and through multistate organizations. The objective is to locate sites in broadly representative urban (about 55 sites) and rural (about 20 sites) locations throughout the country to help characterize regional and urban patterns of air pollution. In many cases, states likely will collocate these new stations with PAMS sites already measuring $O_3$ precursors and/or NATTS sites measuring air toxics. By combining these monitoring programs at a single location, EPA and its partners can maximize the multipollutant information available. This greatly enhances the foundation for future health studies and NAAQS revisions.

The NCore multipollutant stations are part of an overall strategy to integrate multiple monitoring networks and measurements, including research grade and SLAMS sites. Research grade sites would provide complex, research-grade monitoring data for special studies; see

Section 9.5 for further discussion. The SLAMS monitors would provide NAAQS comparisons and other data needs of monitoring agencies. The number and placement of SLAMS monitors would vary according to the pollutant, population, and level of air quality problem. See Section 4 for further discussion.

### 2.2.2 Rationalization of NAAQS Pollutants Networks

In shifting to the new framework outlined in Section 2.2.1, EPA and its partners will seek to continue to assess existing monitoring, reduce monitoring where no longer needed to assure NAAQS attainment or meet other policy needs (such as trends analysis), and move to continuous monitoring where possible. The key efforts in this area include:

- A significant reduction in the number of sites, especially for pollutants such as lead that no longer pose widespread air quality problems in the U.S.; and

- The regulatory changes proposed in December 2005, which will provide the regulatory framework necessary to restructure the existing SLAMS/NAMS networks, harmonize quality assurance requirements, and provide additional changes necessary to implement elements of this Strategy.

The efforts will ensure that the NAAQS monitoring networks focus resources on the most pressing needs and continue to modernize technology in ways that will enhance use of the data and timely access to the data. In addition, these changes need to take into account the possibility of more stringent NAAQS being established in the future, especially for $PM_{2.5}$.

### 2.2.3 Coarse PM

The proposed regulations EPA is releasing will address monitoring for the proposed new $PM_{10-2.5}$ NAAQS. Based on public comments, EPA will finalize those regulations, and it expects to incorporate the specific elements for this Strategy in a final version of this document scheduled to be released in January 2007.

### 2.2.4 PAMS

Consistent with the NCore multipollutant objectives, the PAMS sites already provide reasonably comprehensive data pertinent to ozone air pollution in non-attainment areas classified as serious, severe, or extreme. There are four types of PAMS sites, but the primary focus of the new urban monitoring strategy will promote the continued use of Type 2 PAMS sites: those areas where maximum ozone precursor emissions are expected. As shown in Table 2-1, the primary changes to PAMS would include:

- The number of required PAMS sites would be reduced. Only one Type 2 site would be required per area regardless of population and Type 4 sites would not be required. Only one Type 1 or one Type 3 site would be required per area.

- The requirements for speciated VOC measurements would be reduced. Speciated VOC measurements would only be required at Type 2 sites and one other site (either Type 1 or Type 3) per PAMS area.

- Carbonyl sampling would only be required in areas classified as serious or above for the 8-hour $O_3$ standard.

- $NO_2/NO_x$ monitors would only be required at Type 2 sites.

- $NO_y$ will be required at one site per PAMS area (either Type 1 or Type 3).

- Trace level CO would be required at Type 2 sites.

**Table 2-1**
**Proposed New Minimum Requirements for PAMS Sites**

| Measurement | Where Required | Sample Frequency (except upper air meteorology) |
|---|---|---|
| Speciated VOC | Two sites per area; one must be at a Type 2 site | During PAMS monitoring periods:<br>– hourly auto GC<br>– 8 3-hr canisters<br>– 1 morning, 1 afternoon canister plus continuous NMHC measurement |
| $NO_x$ | All type 2 sites | Hourly during ozone season |
| $NO_y$ | One site per area, either at Type 1 or Type 3 site | Hourly during ozone season |
| CO (ppb level) | All sites | Hourly during ozone season |
| Ozone | All sites | Hourly during ozone season |
| Surface met | All sites | Hourly during ozone season |
| Upper air met | One site in PAMS area | Sample frequency must be approved as part of the PAMS Network Description |

### 2.2.5 PM Speciation

As of 2005, $PM_{2.5}$ chemical speciation measurements are collected at approximately 50 Speciation Trend Network (STN), about 210 SLAMS, and 110 IMPROVE Class I area sites

(Figure 2-1).[3] The majority of these sites collect aerosol samples over 24 hours every third day on filters that are analyzed for trace elements, major ions (sulfates, nitrates, and ammonium), and organic and elemental carbon fractions. As part of this Strategy, EPA is moving toward a cheaper shipping method and a single method for analyzing carbon from samples from all of these sites. Both of these shifts should reduce costs associated with existing speciation measurements.

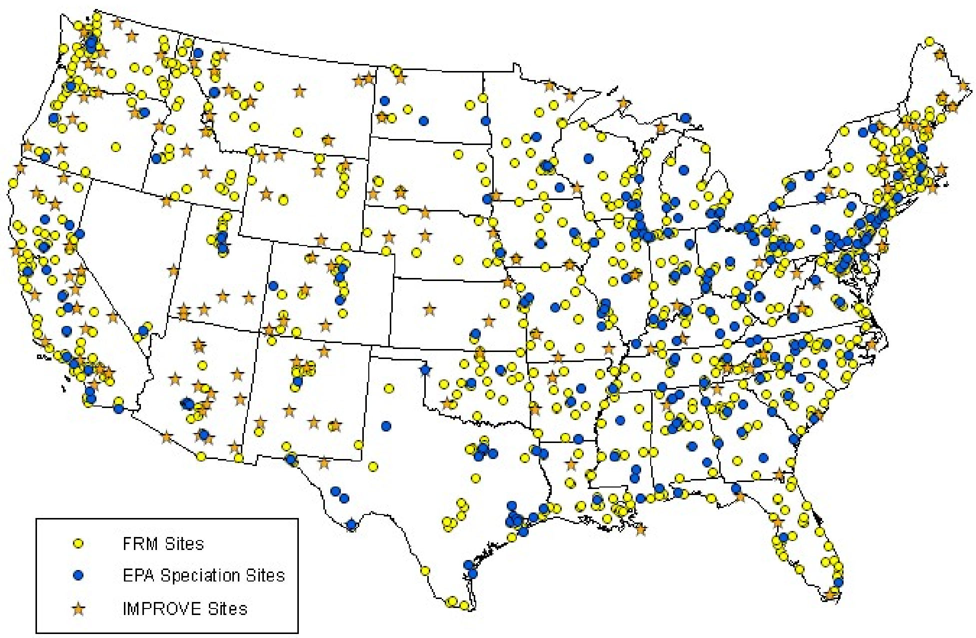


**Figure 2-1**: $PM_{2.5}$ Monitoring Sites, Including Chemical Speciation Sites

In addition, under the new urban monitoring strategy, continuous or semi-continuous speciation monitors will provide the ability for monitoring networks to deliver data with a high temporal resolution so that the atmosphere can be characterized on a time scale relevant to how it changes and how people are exposed under dynamic processes. Initially, the strategy will not require states to operate continuous speciation samplers, with the exception of 22 National Air Toxics Trend Stations (NATTS). These NATTS locations use the Aethalometer™ instrument to measure black carbon. Nevertheless, EPA's strategy is that there should be a gradual evolution of continuous sampler operations at NCore multipollutant sites. EPA is committed to supporting a 10-site continuous speciation network, including carbon, sulfate, and nitrate. This network evolved from early discussions with the health effects community related to a series of recommendations forwarded by the National Academy of Sciences in the late 1990s and continued by CASAC. EPA will continue to take a cautious approach toward continuous speciation monitoring, based largely on findings from the Supersites and other programs indicating mixed performance across a variety of monitors.

[3] The 250 SLAMS sites currently use either of two sampling and speciation analysis protocols, one the same as the STN sites and the other the same as the IMPROVE Class I area sites.

### 2.2.6 Air Toxics

In 1999, EPA began designing a national ambient air toxics monitoring network. As set out in the July 2004 National Monitoring Strategy Air Toxics Component, EPA is developing a national air toxics program that increases the role of ambient monitoring in support of efforts to reduce human exposure and health risks from air toxics. The primary objectives of ambient air toxics monitoring include (1) to discern trends and account for program progress by measuring key air toxics in representative locations to provide a basic measure of air quality differences across cities and regions, and over time in specific areas; (2) to support exposure assessments by providing ambient concentration levels for comparison with personal measurements; and (3) to provide basic grounding for models used for exposure assessments, development of emission control strategies, and related assessments of program effectiveness.

This Strategy includes four elements of a national air toxics monitoring program:

- National Air Toxics Trends Stations (NATTS);
- EPA funded local-scale projects to assess conditions at the local level;
- Existing state and local program monitoring; and
- Long-range strategy development to address PBT monitoring within existing resource constraints.

The NATTS network is intended to provide long-term monitoring data for certain priority air toxics across representative areas of the country in order to establish overall trends for these pollutants. As of January 2004, EPA had established 23 NATTS in 22 cities. In the near-term, this Strategy documents EPA's commitment to maintain NATTS. EPA intends to review with stakeholders the list of pollutants monitored at NATTS sites.

In FY 2004, EPA selected 16 local-scale project proposals for grant awards totaling $6.2 million. For FY 2005, EPA solicited bids for $6.3 million in grant funds. EPA works with SLTs to define the goals and priorities for this monitoring. In FY 2005, EPA reduced the emphasis on community-scale assessments and increased the emphasis on source characterization and monitoring methods development. Under this Strategy, EPA anticipates continued funding for these types of local-scale projects, and a continued dialogue with SLTs on the appropriate priorities for these efforts.

Many state and local agencies for some years have operated ambient air toxics monitoring networks in support of their state or local air toxics programs. EPA has assisted these monitoring efforts since 1997 by providing laboratory analysis of air toxics samples collected by state and local agency monitors. In FYs 2003 and 2004, EPA re-directed $6.5 million in Section 105 grant funding from criteria pollutant monitoring to air toxics monitoring, and anticipates maintaining this approach under this Strategy in the future.

In the area of PBT monitoring, EPA currently has been developing a draft strategy that has not been implemented to date because of resource constraints. Within those constraints, EPA remains committed to developing further monitoring of PBTs. At this time, EPA's primary focus will be to work towards a mercury network that can provide ambient concentration and meteorological data for estimating dry deposition (see also Section 2.3, below).

### 2.2.7 Near Roadway Exposure

Monitoring near roadways has, to date, been limited to research-level monitoring. As the national air monitoring network matures, it is vital that monitoring near roadways continue and that EPA and others evaluate strategies for incorporating this monitoring into the other components of the NAAMS as a means of determining health risks and impacts on urban attainment. EPA fully intends to consult with SLT and other stakeholders in developing the near roadway component of the Strategy, and issuing more detailed elements of this component of the Strategy in January 2007.

### 2.2.8 Homeland Security

EPA has an ongoing implementation plan to enhance RadNet, with a focus on homeland security concerns. The planned approach to enhancing RadNet is currently being reviewed by EPA's Science Advisory Board. After the approach and implementation plan are finalized, those elements will be incorporated into this overall Strategy. In addition, EPA has partnered with several other federal agencies in the establishment and operation of the BioWatch network. The network is used to monitor the air for biological material in largely urban areas.
Greater details about this network are unavailable in this Strategy because of national security reasons.

## 2.3 Strategy for Rural Areas

EPA has a multi-prong strategy for rural monitoring networks, including CASTNET, NADP, IMPROVE, and smaller scale rural programs (such as specific PSD monitoring sites):

(1) Recognize that these existing systems represent a core element in our national monitoring framework that is vital to assessing progress in the program areas for which they were created (such as atmospheric deposition and visibility). Based on that recognition, maintain their ability to continue that function and upgrade equipment and data dissemination as necessary.

(2) Use these systems to track rural background ambient conditions in support of regional control strategies aimed at reducing long range $PM_{2.5}$ and ozone transport, including the 2005 Clean Air Interstate Rule (CAIR). This objective has emerged in recent years as an important rationale for continued support to these systems, in addition to their other primary purposes (including tracking atmospheric deposition, trends, and visibility). Data from these systems are important to understand both in terms of identifying solutions to urban NAAQS attainment problems and tracking progress of regional control strategies in reducing background ambient concentrations of $PM_{2.5}$ and ozone.

(3) Identify opportunities to use these systems for integrated ecosystem assessments.

(4) Consistent with items (2) and (3), seek ways to formally integrate these systems with the urban monitoring networks where such integration would enhance our ability to manage current and future air quality management challenges. From a technology standpoint, integration includes measuring the same constituents on the same time scale, and using similar, if not the same, methods. In addition, integration includes coordinating the management infrastructure so that decisions about network modifications and other issues are coordinated, both internally at EPA and externally with EPA's partners.

(5) Strengthen existing mercury monitoring to assess the long term effectiveness of strategies to reduce mercury exposure, including CAIR and the 2005 Clean Air Mercury Rule (CAMR).

At this time, much of the implementation of this strategy either is static (because the systems generally are operating smoothly as they are presently established) or is at an early discussion stage (in terms of system integration plans). In some cases, however, there are short-term plans for actions needed to implement this strategy. For example, EPA is pursuing hourly gas and particle measurement systems and trace gas analyzers at select CASTNET sites. In addition, EPA has recently been expanding public access to CASTNET data by enhancing the Data and Maps website portal at www.epa.gov/airmarkets. EPA will continue to pursue these short-term, ongoing improvements. In addition, EPA will engage in dialogue to seek further system integration opportunities. The final 2007 Strategy document will incorporate additional details on the integration strategy and the corresponding implementation plans. Finally, EPA will stay committed to maintaining the ability of these monitoring programs to support both their original core mission and the analysis of regional control strategies and trends.

For mercury monitoring, EPA has proposed a collaboration with the NADP to design and implement an ambient, speciated mercury monitoring network for temporally and spatially characterizing total mercury concentrations in the atmosphere. The MDN provides the beginning of a network which currently measures wet deposition. However, an enhanced mercury network will be necessary to assess progress under CAIR and CAMR. The network EPA is proposing in collaboration with the NADP would begin to fill the national data gap in dry ambient mercury compounds by initiating a core federal component of a broader, spatially representative mercury monitoring network in the United States. The goals in filling this gap are to better understand atmospheric mercury and to track its fate. EPA believes that it is important to build on the successes of the existing long-term monitoring infrastructure. The Agency hopes that using an existing and successful long-term multi-stakeholder model, like NADP, as a foundation for long-term mercury monitoring will encourage other agencies and states to join the effort.

## 2.4 Tribal Monitoring

In the 1990 Clean Air Act, Congress recognized EPA's obligation to work with the Tribes in addressing air quality in Indian country. Promulgation of the Tribal Authority Rule (TAR) in 1998 provided Tribes with the leverage to begin assessing the air quality on Tribal lands. Tribal nations generally are seeking to expand ambient air monitoring efforts, and it is generally recognized that there exists substantial need for Tribal air monitoring support. At the same time, nothing in this national Strategy imposes requirements on Tribal monitoring or mandates linkages of Tribal air monitoring with national networks.

The national networks clearly can benefit from Tribal participation by gaining additional monitoring sites in those areas where Tribes participate in the national network. Tribes share a spectrum of technical issues with states, since pollutant transport and meteorological systems ignore political boundaries. Accordingly, any measurement contribution from Tribal efforts should be viewed as an asset to a larger integrated national need for air quality measurements, and Tribes should perceive some level of ownership of air quality data collected in non-Tribal lands that has relevance to Tribal air quality issues. Tribal participation can benefit all parties as opportunities exist for Tribes to operate NCore multipollutant sites, particularly in rural areas where there remain significant spatial gaps in monitoring. There are many rural tribal airsheds that could be considered pristine and therefore excellent candidates for background monitoring sites, potentially filling in important gaps in the nation's network. Under this Strategy, Tribes will be given fair consideration for hosting sites of national interest, and the associated funding.

These comments should not be perceived as suggesting that the Tribal monitoring priority is or shall be to foster a connection to national networks. Monitoring priorities must be based on Tribal decisions, which in many cases involve developing a better characterization of local exposure to air pollutants, and involve funding separate from funds that would be used to host national network sites. The linkage to national programs should be perceived as leveraging opportunities that simultaneously benefit Tribes and the national network.

## 2.5 Common Elements Applicable to All Monitoring

### 2.5.1 Quality System

Quality assurance is a major component of the air monitoring programs. The goal of this Strategy is that all of the ambient monitoring networks in the NAAMS produce high quality data that maximize the usefulness and confidence in the monitoring results. The specific steps for implementing a quality system for the NAAMS include:

- Move toward a performance-based measurement process with specified data quality objectives;
- Minimize start-up problems with a phased implementation approach;
- Provide a reasonable estimate of the costs associated with QA programs;
- Develop certification and/or accreditation programs;
- Develop generic quality assurance program plans (QAPPs);

- Accelerate data review and certification programs for quicker data access into the national air quality data system (AQS);

- Eliminate redundancies in performance evaluation programs;

- Develop appropriate data quality assessment tools (e.g., software); and

- Streamline regulations, and more specifically identify those actions that should be mandated through regulation and that should be recommended through guidance.

Both regulatory changes and necessary guidance will be developed as separate actions to accommodate the implementation of the Strategy. Additional actions that will have to be part of the implementation plan for this Strategy's approach to a monitoring quality system include:

- the development of standard operating procedures (SOPs) to accompany the employment of new instrumentation; and

- appropriate requirements for the infrastructure necessary to accommodate monitoring sites (e.g., so that sufficient space, power, access, etc, are included in site designs).

### 2.5.2 Monitoring Technology Development and Transfer

The explosion of computer and communications technologies over the past 15 years presents significant opportunities for air quality monitoring networks. The potential for improving monitoring methods; monitoring support capabilities such as computer controlled instrument calibrations and quality assurance functions; and information transfer (i.e., getting data quickly to the public) is greater now that at any time in the past. Yet, some components of our monitoring networks are still functioning under more manual and time consuming regimes.

EPA, working with its state and local partners, has established a Technology Working Group to examine the prospects for incorporating new technologies and making recommendations as to the best ways to embrace these. The focus is in three key areas:

- Moving toward continuous PM monitors in place of the more cumbersome, labor-intensive filter-based methods;

- Encouraging the utilization of new technologies to measure a more robust suite of pollutants, such as reactive nitrogen compounds ($NO_y$); and

- Fostering the utilization of advanced information transfer technologies (e.g., replacing antiquated phone communication telemetry systems with internet-based, radio, and satellite communications media).

There are several recognized impediments in moving forward in these areas:

- Regulations that support the "old" way of doing things need to be revised to reflect the current technological environment;
- Special funding needs to be identified to invest in the equipment capital costs of replacing older monitors and data transfer systems;
- Investments in staff training are needed to ensure that EPA and SLT staff will be able to operate and maintain the new equipment; and
- In some cases, currently available instrumentation has not been demonstrated to operate successfully without extensive operator oversight and maintenance.

In addressing these impediments, regulation changes are in progress as part of this Strategy, and funding/training issues will be addressed as part of the implementation plan (see Section 9 for an outline of an initial implementation plan).

### 2.5.3 Planning and Assessment Processes

State and local agencies typically conduct an annual network review, and recommend changes to their networks. As a result, the networks are ever-changing to meet more current needs. However, for many years there was no concerted effort to take a critical look at our monitoring sites and determine if there were redundancies and inefficiencies in network designs. Furthermore, our networks have traditionally been laid out in overlapping fashion, such as an ozone network, a carbon monoxide network, a $PM_{10}$ and $PM_{2.5}$ network, an atmospheric deposition network, a visibility network, and so forth.

In 2000, EPA commissioned a national assessment of the SLAMS/NAMS networks, with considerations for population, pollutant concentrations, pollutant deviations from the NAAQS, pollutant estimation uncertainty, and the area represented by each site. Based on this national assessment, it was determined that substantial reductions in monitors could be made for pollutants that are no longer violating national air standards on a widespread basis, namely lead, sulfur dioxide, nitrogen dioxide, and $PM_{10}$, with the caveat that the measurement of some pollutants, such as sulfur dioxide, may be useful as source tracers even though ambient levels may be low. Even for those pollutants of greatest national concern, ozone and $PM_{2.5}$, sufficient redundancy was found to suggest reductions of 5 to 20% of our monitors without seriously compromising the information from our monitors.

With this as a backdrop, each of the 10 EPA Regional Offices was charged with conducting regional assessments of the SLAMS/NAMS networks. This process began in early 2001, and this Strategy reflects many of the findings of these assessments and the 2000 national assessment. As part of EPA's commitment to maintaining this Strategy as a living document, EPA intends to continue the assessment process, with regional assessments targeted to occur on a five year cycle basis. EPA also is developing standardized guidelines for these assessments.

The procedures for previous regional assessments were not standardized. Even though differences in air quality, population, monitoring density, and other factors necessitate some varying approaches in evaluating networks, generalized guidelines are needed to avoid unwarranted regional inconsistencies. A Subcommittee of CASAC (Clean Air Science Advisory Committee) met in July 2003 and recommended that regional assessment guidelines be developed, and in response, definitive guidelines will be in place for subsequent regional assessments.

The network assessment process, too, is a collaborative effort between EPA and the SLTs. While some factors for network changes may be developed from statistical evaluations, there are also local policy considerations that have a bearing on decisions to change monitors. Ultimately, the combined efforts among national, regional, and local perspectives and needs will result in an optimized realignment of air monitoring networks that remains responsive to the many objectives for conducting the monitoring.

In summary, network assessment is not a new process. State and local agencies historically have conducted annual network evaluations, and changes to monitoring networks have been undertaken and reported as part of this process. However, periodically, it is necessary to take a more holistic review on a multi-level basis: national, regional, and local. As part of this Strategy, EPA intends to conduct a multi-level network assessment every five years.

The primary objectives of the network assessments are to ensure that the right parameters are being measured in the right locations, and that network costs are kept at a minimum. Some of the related secondary objectives include the following:

- Identify new data needs and associated technologies;
- Increase multipollutant sites versus single pollutant sites;
- Increase network coverage;
- Reduce network redundancy;
- Preserve important trends sites; and
- Reduce manual methods in favor of continuous methods.

### 2.5.4 Data Access

A primary objective of this Strategy is to enhance access to ambient monitoring data. Within resource constraints, EPA's ongoing approach will be to make available more timely and effective data than is currently available. EPA already is addressing these issues with a variety of approaches emerging from a long range "Data Warehouse" OAQPS planning effort as well inter office collaboration with the Agency's Office of Environmental Information (OEI). Several pilot projects to gauge the usefulness of new data products and access methods are being launched as part of these efforts. For instance, EPA's air quality data system (AQS) was taken off-line for several days so that a "static" copy of the data could be made available, at the request of a community of EPA research grant recipients.

Another effort is underway to make all measured (versus reduced) data in AQS available on demand, allowing a customer to extract a data file based on his or her selection of geographic area, time frame, and pollutants of interest. A subsequent addition of the more timely AIRNow data (including quality assurance caveats) would provide an exponential enhancement in data delivery.

Another goal is to make detailed air quality data summaries available to anyone at any time by offering a variety of self-service tools to access the data. Currently web pages exist allowing querying of annual summary information, and air quality professionals can access any data in the system. The relevant databases and tools are being upgraded to enable public availability of daily summary information through internet access. The timeliness of this information also will improve as EPA reduces the time necessary to process data before making it available to the public and its external partners.

Finally, the collaboration with OEI offers the longer range potential to merge multimedia data sets that could be used, for instance, to support ecosystem assessments. EPA will continue to examine those responsibilities and to broaden its outreach efforts beyond traditional SLT partners to key consumer communities, such as academia, public health organizations, and the private sector, to ensure delivery of effective products and services.

### 2.5.5 Data Analysis

This Strategy emphasizes that an effective monitoring program must include an appropriate analysis and interpretation component. Without that component, the value of collecting the monitoring data is diminished. The CASAC Subcommittee criticized EPA's lack of organized archival processes, as well as access to and analysis of air quality data. By allotting resources annually to data analysis and interpretation, sufficient funding would be available to make adequate use of the data, enhance information transfer, and provide a higher order of quality control and network assessment that emerges from data reviews and analysis. A specified resource allotment would require an integrated perspective across pollutant categories and could serve as a catalyst for numerous local and other specific, topic-based analyses.

EPA notes that a portion of funds currently allocated to the PAMS network will become available as EPA scales back PAMS requirements. As part of this Strategy, EPA has proposed to set aside some of the PAMS-related funds to conduct data analysis. Ideally, this funding should be combined with additional data analysis resources set aside for air toxics and $PM_{2.5}$. EPA will be discussing this proposal with SLTs in more detail, for possible implementation in FY 2007 or later. A steering group of SLTs and EPA participants could establish a plan for this analysis that can include an allocation of these resources to SLTs or to other analytical groups.

Some examples of additional data analysis capacity building are included in the implementation plan in Section 9.

### 2.5.6 Funding

A fundamental objective of this Strategy is to maintain adequate funding for all elements in this Strategy, including NAAQS-oriented networks, rural-oriented networks such as IMPROVE and CASTNET, and other initiatives such as development of near roadway monitoring sites. Of critical importance in the near-term is ensuring adequate funding for the quality systems in all monitoring programs. The timeframe that is anticipated for full implementation of NCore multipollutant and other modified urban monitoring sites will dictate the resources needed on a year to year basis to implement the QA activities at Headquarters/EPA Regions/SLTs. In addition, QA activities need to be intimately tied to the monitoring process, so that costs for the quality system increase/decrease commensurately with monitoring costs. Resource and funding related action items include:

- **Providing a reasonable estimate of the "cost of QA" -** Identify quality system elements for a "typical" SLT monitoring organization and provide an estimate of the costs of an adequate quality system. Use these estimates to provide a percentage of monitoring costs that typically should be allocated by a monitoring agency to the implementation of a quality system. The QA Strategy Workgroup developed a questionnaire that could be distributed to SLTs in order to get a reasonable handle on these costs. Similar procedures could be developed for EPA Regions and Headquarters.

- **Ensuring SLT funds are available for QA training** - EPA provides regular and continuing training on many aspects of air programs. It is important to include QA training as part of the overall training program.

- **Automating quality control procedures** - There are a number of implementation activities that are still being performed manually by some monitoring organizations (i.e., zero/span and precision checks) that can be automated. The technology section addresses the aspects of increasing awareness of this technology and moving to more automated systems. However, an initial expenditure of capital for both equipment and training will be required to ensure the achievement of this modernization.

- **Providing contractual support** - EPA will provide a mechanism to allow SLTs to tap into statistical expertise for development of data quality objectives, data quality assessments, and other statistically-related assessments.

- **Responsibility and Funding for Quality Assurance Performance Evaluations**
Currently, STAG funds pay for the $PM_{2.5}$ Performance Evaluation Program and NATTS Proficiency Test Program but not the NATTS field component, $PM_{2.5}$ speciation program, or the National Performance Audit Program. Quality assurance is especially critical as EPA and its partners undertake new monitoring approaches, such as increased use of continuous monitors. Accordingly, this Strategy focuses on ensuring that quality assurance performance evaluations are adequately funded and conducted in a consistent manner. To ensure this result, EPA will propose rule revisions that provide for holding

back STAG funds where SLTs rely on EPA conducted evaluations or for obtaining EPA certification of data comparability for audit services not provided by EPA.

# 3. Multipollutant Sites in Urban Areas

## 3.1 Introduction and Objectives

The modified urban area network outlined in this Strategy is both a repackaging and an enhancement of existing networks. The reconfiguration of the networks reflects their multifaceted roles. While these networks are critical in assessing NAAQS attainment, they also can complement more specific applications, such as intensive field campaigns to understand atmospheric process dynamics, or personal and indoor measurements to assess human exposure. To produce a more integrated and multipollutant approach to air monitoring, this Strategy outlines changes in nomenclature for existing networks, reconfiguring the allocation of monitoring sites within the networks, and additional new measurements to foster a multipollutant measurement approach. Such measurements would replace existing ones that either do not have the measurement sensitivity attendant with current atmospheric concentrations or have reached a point of strongly diminished value.

These changes provide an opportunity to address new directions in monitoring and begin to fill measurement and technological gaps that have accumulated in the networks. The Strategy recognizes that there are both nationally and locally oriented objectives in monitoring that require different design approaches despite the best attempts at leveraging resources and maximizing versatility of monitoring stations. The Strategy takes a proactive approach in addressing national needs that often had to make the most of available data sources, regardless of their design basis. The Strategy addresses the following objectives:

- Timely reporting of data to public by supporting AIRNow, air quality forecasting, and other public reporting mechanisms;
- Support for development of emission strategies through air quality model evaluation and other observational methods;
- Accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors;
- Support for long-term health assessments that contribute to ongoing reviews of the NAAQS;
- Compliance through establishing nonattainment/attainment areas through comparison with the NAAQS;
- Support to scientific studies ranging across technological, health, and atmospheric process disciplines; and
- Support to ecosystem assessments recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analyses.

All of these objectives are equally valued, a departure from an historical emphasis on NAAQS attainment compliance. This is not meant to imply that EPA is committing to a research grade network, as the measurements generally are produced through routine operations conducted by most monitoring organizations. The underlying philosophy adopted in the new monitoring system is that regulatory assessments are strengthened through a more comprehensive measurement approach that is well integrated with scientific applications. In turn, science and research efforts become more focused and effective because of the integration with the regulatory program perspective.

The new network system provides a basic group of data that are needed to support a broad spectrum of objectives and analyses (Table 3-1). It is important to point out that, by itself, this new system cannot meet all of the data requirements for most assessments. It will always be necessary to expand the specific spatial, temporal and compositional parameters suited for a particular analysis. Accordingly, it is appropriate to view this new system as a main trunk of information upon which the necessary branching of specific monitoring needs can be grafted. The design assumes that pollutant measurements inherently serve multiple data needs and, therefore, that network efficiencies are enhanced through collocating measurements. There is a tension between designing for a specific data objective and taking a more holistic design approach that risks a dilution of attention toward a specific need. Such caution must be acknowledged in communicating the limitations of a nationally designed network and recognizing the equal importance of local and other program-specific monitoring efforts that branch off from the core design.

**Table 3-1**
**Relationships Across New Monitoring System Measurement Types and Data Objectives**

| Objective | Monitor Types (Primary/Secondary Purpose) | Example Analyses/Rationale |
|---|---|---|
| Public reporting (continuous PM and ozone) | Local sites (primary)<br>NCore sites (secondary) | direct reporting through AIRNow |
| Emission strategy development (trace gases, $PM_{2.5}$ speciation, VOCs) | NCore sites (primary) | model evaluation, source apportionment and other observational models |
| Assessing effectiveness of emission reductions and AQ trends (trace gases, $PM_{2.5}$ speciation, VOCs) | NCore sites (primary)<br>Local sites (secondary) | time series comparisons to emissions projections |
| Support health assessments and NAAQS reviews (trace gases, $O_3$, PM (mass and species)) | NCore sites (primary)<br>Research and local sites (secondary) | ambient input to exposure models; direct association analyses |

(cont.)

**Table 3-1**
**Relationships Across New Monitoring System Measurement Types and Data Objectives (cont.)**

| Objective | Monitor Types (Primary/Secondary Purpose) | Example Analyses/Rationale |
|---|---|---|
| Compliance (NAAQS comparisons) ($PM_{2.5}$, $PM_{10\text{-}2.5}$, ozone) | Local sites (primary)<br>NCore sites (secondary) | point and spatial field comparisons to NAAQS |
| Science support (all pollutants) | Research sites (primary)<br>NCore sites (secondary) | methods evaluation, size distribution analyses, diagnostic analysis (model processes, particle formation) |
| Ecosystem assessment ($NO_y$, $HNO_3$, $NH_3$, $O_3$) | NCore sites | mass balance analysis, deposition calculations |

## 3.2 System Design Attributes

Given the NCore multipollutant site data objectives, there are several basic design attributes for the NCore sites:

- **Collocated multipollutant measurements**. Air pollution phenomena across ozone, particulate matter, other criteria pollutants, and air toxics. From an emissions source perspective, multiple pollutants or their precursors are released simultaneously (e.g., a combustion plume with nitrogen, carbon, hydrocarbon, mercury, sulfur gases, and particulate matter). Meteorological processes that shape pollutant movement, atmospheric transformations, and removal act on all pollutants. Numerous chemical/physical interactions underlie the dynamics of particle and ozone formation and the adherence of air toxics on surfaces of particles. Yet, the current monitoring infrastructure is developed on a style pollutant basis.

  The overwhelming programmatic and scientific interactions across pollutants demand a movement toward integrated air quality management. Collocated air monitoring will benefit health assessments, emissions strategy development, and monitoring. Health studies with access to multipollutant data will be better positioned to identify confounding effects of different pollutants, particularly when a variety of concentration, composition, and population types are included. Air quality models and source attribution methods used for strategy development also will benefit from a multipollutant approach. Modelers will be able to perform more robust evaluations by checking performance on several variables to ensure the model produces results for correct reasons and not through compensating errors. Just as emission sources are characterized by a multiplicity of pollutant releases, related source apportionment models yield more conclusive results from use of multipollutant measurements. Multipollutant measurements also streamline monitoring operations and offer increased diagnostic capabilities to improve instrument performance.

In addition, in moving aggressively to integrate continuous PM (e.g., both mass and speciation) monitors in the network, it is important to retain a number of collocated filter and continuous instruments, as the relationships between these methods are subject to future changes brought on by modifications of aerosol composition. For example, assuming proportionally greater sulfur reductions from nitrogen reductions, nitrate will replace sulfate as the major inorganic component, and aerosol sampling losses because of volatility may increase at different rates depending on instrument type.

As it is not possible with constrained resources to measure everything everywhere, a natural conflict arises between the relative value of spatial richness and multiple parameters at fewer locations. This Strategy assumes that there is a geometric increase in value gained from combining measurements at a single location, rather than spreading out single measurements in a very rich spatial context.

- **Emphasis on continuously operating instruments**. Continuous systems allow for immediate data delivery through state-of-the art telemetry transfer and support reporting mechanisms such as AIRNow, and critical support for a variety of public health and monitoring agencies charged with informing the public on air quality. Continuous data add considerable insight to health assessments and address a variety of averaging times, source apportionment studies that relate impacts to direct emission sources, and air quality models that need to perform adequately over a variety of time scales to increase confidence in projected emissions control scenarios.

- **Diversity of "representative" locations** across urban (large and medium size cities) and rural (characterize background and transport corridors) areas. National level health assessments and air quality model evaluations require data representative of broad urban (e.g., 5 to 40 km) and regional/rural (> 50 km) spatial scales. Long-term epidemiological studies that support review of national ambient air quality standards benefit from a variety of airshed characteristics across different population regimes. The basic urban air monitoring networks must include sites in locations that allow EPA to develop a representative report card on air quality across the nation, a report that can delineate differences among geographic and climatological regions. Although "high" concentration levels will characterize many urban areas, it is important to include cities that also experience less elevated pollution levels or differing mixtures of pollutants for more statistically robust assessments. It also is important to characterize rural/regional environments to understand background conditions, transport corridors, regional-urban dynamics, and influences of global transport. These design issues are discussed further in Section 5, which addresses rural monitoring.

These various design attributes differ from historical approaches that emphasized maximum concentration locations, often dependent on a particular pollutant. Those perspectives remain valid from a local perspective and need to be addressed through elements of local, single pollutant-focused measurement sites, as well as through local discretionary monitoring conducted outside the scope of the basic urban monitoring networks.

## 3.3 NCore Multipollutant Measurements

### 3.3.1 General Measurement Considerations

The approximate total number of NCore multipollutant sites (75), as well as the number of proposed measurements reflect a modest recommendation for balancing total network growth while introducing manageable network realignment. Site locations will be based on design criteria that also balance technical needs with practical considerations, such as leveraging established sites and maintaining geographic equity. The network is to be phased in over several years after promulgation of the applicable regulatory revisions.

The minimum recommended measurements (Table 3-2) include continuous gaseous $SO_2$, CO, $NO_x$ and $NO_y$, and ozone ($O_3$) measurements, and continuous $PM_{2.5}$ and $PM_{10-2.5}$ measurements. $PM_{10-2.5}$ measurements have been included in anticipation that EPA will promulgate a new PM NAAQS that includes requirements for measuring $PM_{10-2.5}$. In addition, the inclusion of $PM_{10-2.5}$ as part of multipollutant measurements will support health studies and emission strategy development. Additional parameters include filter-based $PM_{2.5}$ (with FRMs), $PM_{2.5}$ speciation, and basic meteorological parameters, including temperature, relative humidity, wind speed, and direction. In addition, integrated nitric acid and ammonia samples will be collected, although the methods and sampling frequency remain under consideration at this time.

Although these parameters include most criteria pollutants except nitrogen dioxide [$NO_2$] and lead [Pb], they are not chosen for compliance purposes. Instead, they represent a robust set of indicators that support multiple objectives, including accountability, health assessments, and emissions strategy development (e.g., air quality model evaluation, source apportionment, and numerous observational model applications). In most cases, these minimum measurements will be accompanied by existing measurements. For example, aerosol sulfate from the speciation program combined with gaseous $SO_2$ provides valuable insight into air mass aging and transformation dynamics.

The monitoring for most of these parameters will be conducted using near continuous monitors, with reporting at 1-hour intervals or less. The continuous PM measurements are not expected to use FRM monitors, given that no $PM_{2.5}$ continuous monitor currently has equivalency status. As a peripheral benefit, the presence of collocated integrated and in-situ continuous aerosol methods will provide a continuing reference check for the performance of continuous instruments and will address some of the network collocation requirements to meet Regional Equivalency (see Section 8). Collocation with FRMs is an important component of the $PM_{2.5}$ continuous implementation strategy, as the relationship between FRMs and continuous monitors drives the integration of these systems. These relationships will vary in time and place as a function of aerosol composition (e.g., gradual evolution of a more volatile aerosol in the East as carbon and nitrate fractions increase relative to more stable sulfate fraction).

### 3.3.2 Measurement Issues

The philosophy for the NCore multipollutant measurements is to use commercially available, reasonably priced continuous instruments that are not considered research grade or laboratory bench operations. Admittedly, the list of new measurements includes trace gases that pose challenges. Although these measurements may not be viewed as classic research level operations, they nevertheless will require a level of attention not typically associated with routine monitoring. EPA has included trace gas measurements in these multipollutant sites, because they are of such national importance and need to be adequately characterized in the ambient atmosphere. EPA expects that some of the additional burdens for conducting these measurements will be offset by the efficiencies gained from locating multiple instruments and enhancing the Information Transfer Technology capabilities, such as frequent zero baseline adjustments, at monitoring platforms. EPA continues to consider ammonia and nitric acid monitoring methods and sampling frequency issues, in part to ensure that the resources needed to monitor those constituents are reasonable. These technology issues are discussed further in Section 8, below.

**Table 3-2**
**NCore Parameter List**

| Measurements | Comments |
|---|---|
| $PM_{2.5}$ speciation | Organic and elemental carbon, major ions and trace metals (24 hour average; every 3rd day) |
| $PM_{2.5}$ FRM mass | typically 24 hr. average every 3rd day |
| continuous $PM_{2.5}$ mass | 1 hour reporting interval for all cont. species |
| continuous $PM_{(10-2.5)}$ mass | in anticipation of $PM_{(10-2.5)}$ standard |
| ozone ($O_3$) | all gases through cont. monitors (except $HNO_3$ and $NH_3$) |
| carbon monoxide (CO) | capable of trace levels (low ppb and below) where needed |
| sulfur dioxide ($SO_2$) | capable of trace levels (low ppb and below) where needed |
| nitrogen oxide (NO) | capable of trace levels (low ppb and below) where needed |
| total reactive nitrogen ($NO_y$) | capable of trace levels (low ppb and below) where needed |
| ammonia ($NH_3$) | currently under consideration |
| nitric acid ($HNO_3$) | currently under consideration |
| surface meteorology | wind speed and direction, temperature, pressure, RH |

### 3.3.3 Future Multipollutant Measurements

The minimum recommended NCore multipollutant measurements reflect a balance across a constrained resource pool, available monitoring technologies, and desired measurements. Consideration should be given to introducing additional measurements at selected sites in the future. Examples of nationally important measurements that support multiple objectives include true nitrogen dioxide and continuous measurements of nitric acid, ammonia gases, and particle size distributions. Consideration also should be given to routine particle size distribution measurements at selected locations. As multipollutant stations, EPA and its partners should over-design these sites in terms of space and power consumption with the expectation of additional future measurements. Such over-design also will encourage collaboration between research scientists and government agencies, given that the NCore sites should accommodate periodic visits from health and atmospheric scientists who may conduct specialized intensive sampling.

## 3.4 Siting Considerations

The siting goal for NCore multipollutant sites is to produce a sample of representative measurement stations to service multiple objectives. Siting criteria include:

- Collectively
  - -- Approximately 75 locations that are predominantly urban, with 10 - 20 rural/regional sites.
  - -- Urban: a cross section of urban cities, emphasizing major areas with a population greater than 1 million. Also include a mix of large (0.5 to 1.0 million) and medium (0.25 to 0.5 million) cities with geographically and pollutant diverse locations suitable as reference sites for long-term epidemiological studies.
  - -- Rural: capturing important transport corridors, including national, continental, and intercontinental scales, and regionally representative background conditions. In addition, some sites should allow for characterizing urban-regional coupling (e.g., how much additional aerosol does the urban environment add to a larger regional mix).
- Individual site basis
  - -- "representative" locations not impacted by unique local sources (urban sites, 5-40 km; rural sites, greater than 50 km), which is important for using the data in air quality modeling development and validation.
  - -- leverage with existing sites where practical, such as the speciation, air toxics, PAMS, and CASTNET trends sites.

-- consistency with collective criteria (i.e., does the selected site add holistic network value).

-- logistical practicality.

### 3.4.1 Guidance for Site Selection and Site Allocation Proposal

**a. Broad-based Technical Guidance.** The NCore multipollutant network design is initiated by considering a cross-section of urban locations to support long-term epidemiological studies, with subsequent addition of rural/regional locations to support national air quality modeling evaluation and emissions strategy accountability assessments, followed by a practical mapping of these general locations with existing sites, and finally an equitable and objective allocation scheme. This sequential approach is captured in Figure 3-2. This procedure provides a modest, objective basis on which to judge the adequacy of the site allocation process (see below).

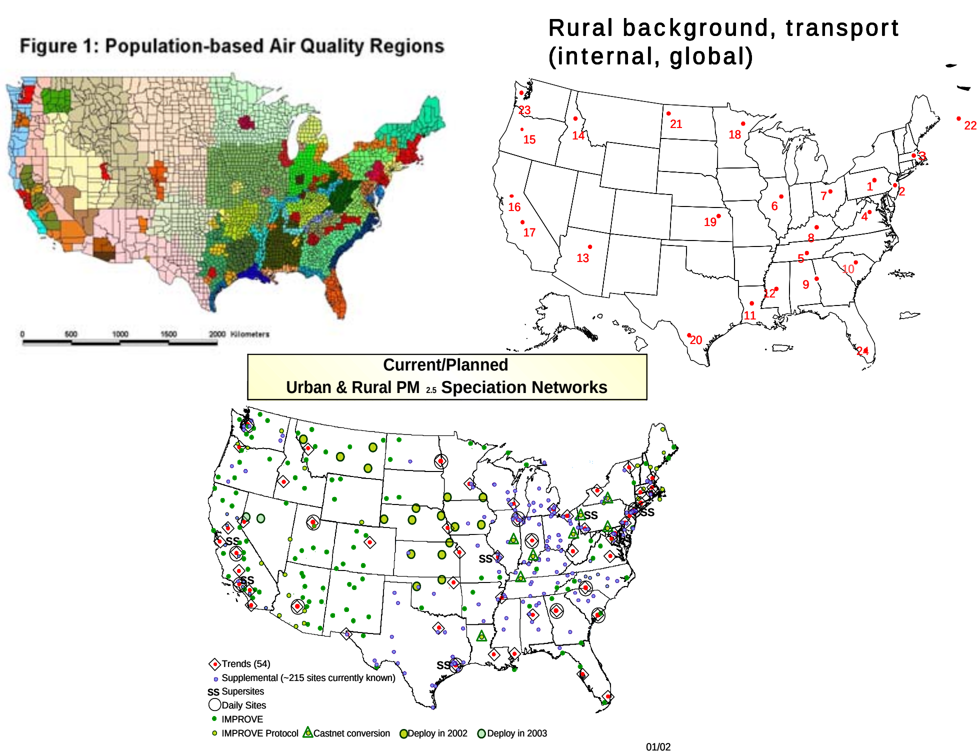


**Figure 3-2**: National maps providing initial broad scale siting guidance for NCore multipollutant sites. The maps include recommendations based on supporting long-term health assessments (top left) that emphasize an aggregate of representative cities and air quality mode evaluations that rely on rural background and transport locations (top right). Existing site locations in most cases will be used for NCore siting (bottom).

**b. Site Allocation Process**. The allocation scheme (summarized in Table 3-3) is based largely on historical and political considerations (e.g., one NCore site per state) that distributes monitoring resources based on a combination of population and geography, which in broad terms is consistent with several technical design aspects. Technical guidance sets a framework for assessing the development of NCore multipollutant sites, while the allocation scheme provides a process for facilitating implementation. This allocation scheme provides a sweeping range of metropolitan areas. Clearly, the allocation must be flexible enough to ensure that sites add meaningful value and avoid redundancies. Suspected shortcomings in the proposed allocation scheme that need to be reconciled include, for example, a lack of rural locations in California, lightly populated Western states that may not provide a meaningful rural location, multiple Florida locations with generally moderate air quality due to marine influences, and possible redundant locations along the East Coast and Midwest. To ensure that the collective national siting criteria are followed, NCore sites will require approval by the EPA Administrator (or delegate). An NCore network design committee will be constituted to review site locations and facilitate site selection approval.

**Table 3-3**
**Proposed NCore Multipollutant Site Allocations**

| | Total | Major Cities > 1.0 M | Large Cities 0.5 - 1.0 M | Medium Cities 0.25 - 0.5 M | Rural |
|---|---|---|---|---|---|
| 1 per state minimum | 50 | TBD | TBD | TBD | TBD |
| added 2 in most populated states (NY, CA, TX, Fl) | 8 | TBD | TBD | TBD | TBD |
| added 1 in each second tier populated states(OH, IL, PA, MI, NC) | 5 | TBD | TBD | TBD | TBD |
| additional rural sites | 12 | TBD | TBD | TBD | TBD |
| ***total*** | ***75*** | ***32*** | ***13*** | ***10*** | ***20*** |

Note: allocation does not cover every major, large, medium sized city in United States; states lacking cities greater than a 250,000 population can provide rural coverage

**c. Process for Input into Specific Site Locations.** The number of sites and their distribution portrayed in Table 3-3 is only a first approximation that requires added input and consideration to reach decisions on actual site locations. Site locations will be influenced by a combination of logistics associated with SLT capabilities and existing infrastructures, and input from SLTs and the health effects/exposure, atmospheric sciences, and ecosystem assessment communities. OAQPS and the Regional Offices will serve largely as facilitators for this siting effort. EPA Regional Offices will work with their states (including local agencies and Tribes) and RPOs to provide initial suggestions based on logistics and design considerations with which the states and Regional Offices are most familiar. EPA OAQPS will solicit input from the research community through a combination of existing committee and organization structures, workshops and meetings. There likely will be some iteration and negotiation involved in this outreach effort. The multi-year phased approach for implementation will allow for the necessary outreach and adjustments to start the NCore multipollutant approach on the right track.

**d. Design Concerns.** Inevitably, there will be spatial coverage gaps given the limited number (75) of NCore sites. This concern is balanced by the expectation that these sites are only minimum recommendations that serve as models for additional network modifications. This concept is similar to the $PM_{2.5}$ speciation program, where the majority of state SIP sites operate similarly to the National trend sites.

Also, although the proposed allocation scheme is based largely on population and existing EPA Regions, the intention is to set the basic design goal and allow for regional flexibility to choose the most appropriate and practical locations. This type of flexibility is necessary to ensure that the siting decision process takes into account the needs of the multiple environmental and program objectives for the monitoring. For example, long-term epidemiological studies are best served by obtaining data from a cross-section of different cities with varying climates, source configurations, and air quality characteristics. Air quality model evaluations require similar locations, as well as proportionately more information on rural and background locations (along with vertical characterization of the atmosphere, which is beyond the scope of NCore multipollutant monitoring). Siting for accountability purposes benefits from "representative" locations. Often, this factor may favor obtaining information from rural locations more so than urban locations, given the difficulty of separating source signals in urban environments. For example, nitrogen in urban locations is dominated by mobile sources, whereas in selected rural locations, such as CASTNET sites, the emission signals from major utility sources are less affected by area-wide sources.

**e. Accurate Site Characterization Data.** In using ambient data for modeling and assessments, EPA promotes the use of spatial analysis techniques to resolve the spatial gradients based on point measurements. For that reason, it is important to have an accurate characterization of the spatial representativeness of monitoring sites. Under this Strategy, the NCore multipollutant sites are intended to represent relatively broad spatial scales. Accordingly, these sites will require a dedicated effort to characterize their spatial representativeness. A key element of future network assessments should be a technically sound analysis through modeling or other means that establishes the average (as well as some indication of variance as driven by topography and meteorology) of spatial representation of a monitoring site.

### 3.5 Measurement Technology Strategy

The minimum measurements required at NCore multipollutant sites require the implementation of some advanced continuous and semi-continuous measurement technologies. With the exception of trace level CO, $SO_2$, and $NO_y$, these measurements can be made using methods that are currently available in 40 CFR and the QA guidance provided in the QA Handbook, http://www.epa.gov/ttn/amtic/qabook.html. Trace level CO, $SO_2$, and $NO_y$ will require the development of additional technical guidance to allow implementation of continuous monitoring. The following provides an outline of the implementation strategy by measurement type needed.

- ***Filter-based FRM $PM_{2.5}$ Mass and Ozone***: Approved FRM and FEMs will be used to implement the procedures described in 40 CFR Part 50, Appendices D and L.

- ***Continuous $PM_{10}$/$PM_{10-2.5}$***: EPA is proposing regulatory requirements to measure $PM_{10-2.5}$ to support implementation of emerging PM NAAQS. Forthcoming guidance on $PM_{10-2.5}$ monitors will provide the basis for implementation. $PM_{10-2.5}$ will be phased in during the latter stages of the NCore network.

- ***Continuous $PM_{2.5}$ Mass***: These methods will be implemented through the strategy outlined in the "Continuous Monitoring Implementation Plan." These methods may include, but are not limited to, TEOMs, beta attenuation monitors (BAM), beta gauges, and nephelometers.

- ***Basic Surface Meteorology***: Temperature, relative humidity, wind speed, and wind direction measurements will be obtained through a variety of methods described in the guidance provided in "Meteorological Monitoring Guidance for Regulatory Modeling Applications," EPA-454/R-99-005, February 2000 (http://www.epa.gov/scram001/guidance/met/mmgrma.pdf). These methods include, but are not limited to, anemometers, wind vanes, resistance temperature detectors, and hygrometers.

- ***Total Reactive Oxides of Nitrogen ($NO_y$)***: $NO_y$ measurement methods will be based on the technical guidance prepared for PAMS in June of 2000. This guidance lacks calibration procedures that include difficult-to-convert organic nitrate compounds (e.g., n-propylnitrate) to provide a more stringent test of converter efficiency. Implementation of $NO_y$ monitoring methods will require an update to the existing PAMS guidance to incorporate new calibration procedures.

- ***Continuous, trace level CO***: Commercially available, non-dispersive infrared (NDIR) monitors that include modifications to enhance performance and offer "high-sensitivity" options to meet the requirements of monitoring non-urban air will be implemented. The principal constraints on lower detection limits of these devices are water vapor interference and background drift. These limitations can be reduced by drying the sample air and frequent chemical zeroing of the baseline. Currently, these modifications are done manually by the user. Prior to implementation, technical guidance will be developed that will include a detailed description of the interferences and limitations, and how to address them to obtain trace level measurements.

- ***Continuous trace level $SO_2$***: Measurements of $SO_2$ suffer similar issues with sensitivity in rural areas as CO. Technical guidance will be developed prior to implementation of trace level $SO_2$ measurements.

- ***Direct $NO_2$***: Measurement methods will be incorporated as the measurement technology advances and is commercially available. EPA's Office of Research and Development is currently evaluating prototype instruments.

- ***Integrated nitric acid and ammonia***: While both of these constituents will be monitored at NCore sites, the specifics on the methods and sampling frequency for these two gases will be determined after EPA establishes appropriate data quality objectives for these monitors. See Section 8.1.1, below, for further discussion of the possible methods and other technology issues for these monitors.

## 3.6 Using the NCore Multipollutant Site Approach to Enhance Network Integration

Initial reviews of the monitoring strategy have suggested the need for greater integration into areas that extend beyond the traditional roles of routine networks operated by SLTs. More specifically, CASAC and CENR have advocated for greater attention to ecosystem assessment support, coordination with intensive process oriented field campaigns, consideration of sites dedicated to inter-continental pollutant transport, and a linkage to a wealth of satellite data. Sections 4 through 6 below, look more closely at other monitoring networks in the urban, rural, and Indian Country areas, and suggest some of the ways in which this Strategy can foster integration and cooperation between those monitoring resources.

# 4. Other Monitoring in Urban Areas

## 4.1 Streamlined SLT NAAQS Monitoring

In addition to the NCore multipollutant sites, SLTs will continue to operate additional sites designed for NAAQS compliance and local issues. These sites are much more numerous than the NCore sites, focus generally on the more important criteria pollutants, augment the NCore multipollutant site network, and are sometimes referred to as "adjunct sites." Primarily dedicated to defining needed information for nonattainment areas, many of these sites will continue to be single pollutant and targeted mainly to $PM_{2.5}$ and ozone. Such sites will help define the nonattainment areas and boundaries, monitor in areas with the highest concentrations and the greatest population exposure, provide information in new growth areas, meet SIP needs, and evaluate local background conditions. Many of these sites already function as part of the current SLAMS/NAMS air monitoring program. For other pollutants, this Strategy anticipates a significant reduction in the number of operating sites (see Table 4-1). Although these sites need only include one pollutant measurement, this Strategy strongly encourages collocating other measurements at these sites.

**Table 4-1**
**Potential Reductions in Number of Monitors for Various Pollutants**

| Pollutant | Operating Number of Monitors (Approximate) | Long Term Number (Approximate) |
|---|---|---|
| $PM_{10}$ | 1,072 | 0<br>(except as part of $PM_{10-2.5}$) |
| Carbon Monoxide | 445 | 250 |
| Sulfur Dioxide | 465 | 300 |
| Nitrogen Dioxide | 413 | 50 |
| Lead | 184 | 50 |

These sites will continue to implement the FRM and FEM (or Network approved methods as are expected to be developed for regional equivalency of $PM_{2.5}$ continuous methods) required for criteria pollutant monitoring and attainment/non-attainment decisions as currently described in 40 CFR, Part 50. No new monitoring technologies or methods will need to be developed for implementation. However, siting for this monitoring requires Regional Administrator approval. Where possible, sites should be optimized for multipollutant purposes, although multipollutant monitoring is not required. For example, there may be opportunities to collocate ozone and PM monitors without degrading the network information that is derived from having separate ozone and PM locations.

## 4.2 Local, Flexible Monitoring Component

In addition to the NAAQS monitoring described in Section 4.1, there is also a local, flexible component to the Strategy. This part recognizes that there are specific local needs that need to be addressed with air monitoring. Local considerations include such things as addressing environmental justice concerns, air toxics "hot spots," community concerns, local source impacts, political considerations, and a host of other elements that can be important on a local level. EPA will continue to support these efforts. For instance, as part of this Strategy, EPA remains committed to supporting local-scale toxics monitoring and other local toxics programs (generally through Section 103 and Section 105 grant funds).

By incorporating this flexible part of the overall monitoring structure, both national and local needs can be addressed. In many situations, monitoring conducted for local needs can also be of value from a national perspective. Thus, SLTs are encouraged to utilize available monitoring funding, after NCore multipollutant and other NAAQS monitoring requirements have been met, toward local needs.

## 4.3 Near Roadway Monitoring

Over 1,000 compounds have been identified in exhaust and evaporative emissions from motor vehicles. These compounds include criteria pollutants and air toxics. Motor vehicle emissions significantly impact air quality and contribute to national emission inventories for criteria and air toxic pollutants. Mobile sources account for over 75 percent of national CO emissions, over 50 percent of national $NO_x$ emissions, and over 25 percent of national $PM_{2.5}$ emissions. For air toxics, mobile sources significantly contribute to air pollutant concentrations of gaseous and particulate phase compounds. For example, mobile sources emit over 50 percent of the nation's benzene, toluene, and acetaldehyde. PM air toxic emissions include metals, ions, and semi-volatile organic compounds.

Given that an estimated 35 million people live within 100 meters of a four-lane roadway, near roadway exposure from these mobile source emissions is an important concern. It cannot properly be thought of as either a "hotspot" issue affecting relatively few areas in a city or a broader component of particulate matter NAAQS attainment issues. Near roadway exposure may, in fact, emerge as one of the dominant urban air quality issues. Air quality measurements collected near roads often identify elevated pollutant concentrations at these locations, as well as pollutant composition and characteristics that differ from those measured at a distance from roadways.

Elevated pollutant concentrations near roadways may lead to elevated exposures for populations working or residing near these roads. In addition, these populations may experience exposures to differing physical and chemical compositions of certain pollutants. The location of schools near major roads may also result in elevated exposures for children due to potentially increased concentrations indoors, increased exposures during outdoor activities, or increased exposures while commuting to school (e.g., walking along roads or riding in a school bus or passenger vehicle). Mobile sources influence temporal and spatial patterns of regulated gases, air toxics, and PM concentrations within urban areas. Since motor vehicle emissions generally occur near the breathing zone, near roadway populations may be exposed to "fresh" combustion emissions as well as combustion pollutants "aged" in the atmosphere.

Results from emissions and exposure studies suggest that simple methods of estimating the contribution of motor vehicle exhaust to exposure likely do not capture the substantial variability in the chemical and physical characteristics of motor vehicle exhaust that may be leading to adverse health effects. Comprehensive assessments of exposure will be a critical factor in identifying which compounds are leading to adverse health effects in the near roadway environment.

With this background, EPA's Strategy currently involves (1) recognition of the importance of near roadway exposures, and (2) the need for further exploration of what these exposures mean for both urban NAAQS-oriented monitoring networks and air toxics networks. EPA anticipates discussing these issues both internally and with partners and other stakeholders over the coming months, and then continuing to develop specific elements of a near roadway monitoring strategy that can be adopted into this overall Strategy document.

## 4.4 RadNet and Homeland Security

Currently, RadNet is the nation's only comprehensive radiation monitoring network, with more than 200 sampling stations located throughout the United States. In February of 2001, a key national monitoring system meeting was held in Montgomery, Alabama, the purpose of which was to redefine the mission and objectives of the network and to develop an initial conceptual design to guide the reconfiguration of the network into the future. A significant outcome of the meeting was the determination and agreement that support of the Agency's emergency response responsibilities was to be the primary purpose of the network's current and future radiation monitoring capability. The working mission of the system to be designed, it was agreed, would be: *To monitor radionuclides released into the environment during significant or major radiological emergencies.* Three basic objectives that would support the system's mission also were defined:

- To the extent practicable, maintain readiness to respond to emergencies by collecting information on ambient levels capable of revealing trends.
- Ensure that data generated are timely and are compatible with other sources.
- During events, provide credible information to public officials (and the public) that evaluates the immediate threat and the potential for long-term effects.

The RadNet planning team not only recognized the linkage between emergency response and the monitoring network, but considered the relationship of the monitoring network to other related emergency response assets. In August of 2001, the planning team provided a vision of the new monitoring system that was developed on the basis of four design goals:

- Better Response to Radiological Emergencies
- More Flexible Monitoring Capability
- More Integrated and Dynamic Network
- Meet Needs within Realistic Costs

The terrorist attacks on the United States on September 11, 2001 expedited and strongly influenced the subsequent planning for updating and expanding RadNet. In January 2002, EPA's Office of Radiation and Indoor Air (ORIA) began a self-assessment of the existing monitoring program in light of homeland security concerns, and very early on decided that the air program could best support homeland security objectives. As a result, the review of the other sampling networks in RadNet was deferred to a later time, and the air network received full scrutiny in the system assessment.

The ORIA self-assessment of the RadNet air network identified two major system weaknesses and three proposals to solve them, as shown in Table 4-2.

**Table 4-2**
**Post-9/11 Weaknesses Discovered in and Solutions Proposed for the RadNet Air Monitoring Network**

| Weakness | Proposed Solution |
|---|---|
| • Decision makers need data more quickly than is currently possible. | • Add real-time monitoring capabilities. |
| • Assessing widespread impacts from an incident that might occur anywhere in the United States will require data from more locations than are currently monitored. | • Significantly expand the number of locations with fixed monitors.<br>• Provide the flexibility to augment the fixed locations with "deployable" monitors that can be either pre-deployed to a location where there is an increased threat potential (such as a national political convention, Olympics), or quickly deployed after an incident to provide higher monitoring density. |

Since planning prior to 9/11 had already endorsed the value and appropriateness of deployable monitors in a new RadNet air monitoring design, and because these monitors could be implemented more quickly, the first available homeland security funding (late 2001) was committed to acquiring them. The attention then turned to updating the fixed system. Based on the findings of the post-9/11 assessment and reinforced by similar findings in the earlier 2001 assessment, ORIA turned its attention to the system of fixed monitors to determine the most appropriate equipment; to find the most acceptable plan for siting the monitors across the nation; and to design an electronic capability for delivering verified data (from fixed as well as deployable monitors) quickly to decision makers and the public. By 2005, ORIA was able to purchase an initial order of upgraded fixed station radiation monitors.

The specific objectives and data uses that have guided the development of the RadNet air monitoring network are shown in Table 4-3. The objectives encompass the fixed monitoring network augmented by deployable (mobile) monitors operating in either routine or emergency mode. The objectives and data uses are presented in sequential phases reflecting the chronological progress of an event and the parallel status of the system from routine, to emergency, and back to routine.

## Table 4-3
## Overview of Objectives and Data Uses for the RadNet Air Monitoring Network

| | Ongoing Operations/ Pre-incident | Early Phase (0-4 days) | Intermediate Phase (up to 1 year) | Late Phase (after 1 year) |
|---|---|---|---|---|
| **Fixed Monitors** | | | | |
| Objectives | • Provide baseline data<br>• Maintain system readiness | • Provide data to modelers<br>• Develop national impact picture<br>• Provide data to decision makers and the public | • Continue national impact assessment<br>• Reestablish baseline<br>• Provide data to decision makers and the public | • Determine long-term impact<br>• Monitor baseline trends<br>• Provide data to decision makers and the public |
| Data Uses | • Pre and post event comparisons<br>• Provide public information | • Adjust model parameters and verify outputs<br>• Assist decision makers in allocation of response assets<br>• Identify non-impacted areas<br>• Help determine follow-up monitoring needs<br>• Verify or assist in modifying protection action recommendations | • Assist in determining if delayed contamination transport is occurring<br>• Assure citizens and decision makers in unaffected areas<br>• Assist in dose reconstruction<br>• Determine short- or long-term baseline changes from event | • Assist in determining if delayed contamination transport is occurring<br>• Assure public that conditions are back to normal<br>• Ensure that recovery efforts are not causing contamination spread<br>• Verify return to previous baselines |
| **Deployable Monitors** (Options: May be Returned to Laboratories or Remain in Field) | | | | |
| Objectives | • Provide baseline data (if deployed)<br>• Ensure readiness by conducting regular exercises | • Provide data to modelers<br>• Provide data to decision makers and the public | • Assess regional impact<br>• Provide data to decision makers and the public | • Provide continuity of data in impacted or non-impacted areas<br>• Provide data to decision makers and the public |
| Data Uses | • Pre- and post- event comparisons<br>• Provide public information | • Adjust model parameters and verify outputs<br>• Assist in identifying un-impacted areas<br>• Help determine follow-up monitoring needs<br>• Verify or assist in modifying protection action recommendations | • Assist in determining if delayed contamination transport is occurring<br>• Assure citizens and decision makers in unaffected areas<br>• Help determine when to relax or reduce protective actions | • Assist in determining if delayed contamination transport is occurring<br>• Ensure that recovery efforts are not causing contamination spread |

**Note:** Objectives and data uses may overlap from one phase to another.

Currently, the plan for upgrading the RadNet network answers the overarching question of "What changes should be made to the RadNet air monitoring component to best meet the current needs for national radiation monitoring?" Instead of targeting just nuclear or radiological accidents, the mission envisioned in this plan for RadNet now includes homeland security concerns and the special problems posed by possible intentional releases of radiation to the nation's environment. The plan proposes new monitoring equipment, more monitoring stations, more flexible responses to radiological and nuclear emergencies, significantly reduced response time, and much improved processing and communication of data. The ultimate goal of RadNet air monitoring is to provide timely, scientifically sound data and information to decision makers and the public. The plan currently is being reviewed by EPA's Science Advisory Board, and remains subject to change. However, Table 4-4 provides a snapshot of the draft improvements to the RadNet air monitoring network currently being considered.

**Table 4-4**
**Main Improvements Proposed for RadNet Air Monitoring Network**

| Improvement Area | New System | Old System |
|---|---|---|
| Number of Stations | 180 (approximately) fixed; 40 deployable | 59 fixed; 0 deployable |
| Time for Data Availability | Near-real-time (4-6 hrs) | 36 hours minimum (if on alert) |
| Criteria for National Siting | Population and Geography | Population and Fixed Nuclear Facility Proximity |
| Local Siting Criteria | Derived from Title 40 Code of Federal Regulations (CFR) Part 58 | None |
| Data Dissemination | Central Database with Internet Access | Hard copy |
| Meteorological Data | Yes -- deployables<br>Optional -- fixed monitors | No |
| Telemetry | Phone (land line); cell phone; internet; satellite link | None |
| Station mobility | 40 deployable monitors<br>(in addition to 180 fixed stations) | None |
| Data Security | High | None |
| Operator Dependency | Primarily for air filter changes; no operator action required for near-real-time data transmission to central database to support emergency response | Completely operator dependent |
| Gross alpha/beta data at station location | Gross alpha and beta | Gross beta only |

(cont.)

**Table 4-4**
**Main Improvements Proposed for RadNet Air Monitoring Network (cont.)**

| Improvement Area | New System | Old System |
|---|---|---|
| Gross alpha/beta data at station location | Gross alpha and beta | Gross beta only |
| U.S. Population Proximity (see Section 3.6) | Approximately 60% | Approximately 24% |
| Frequency of Data Collection | Continuous (hourly data transmission during routine conditions) and two air filters per week for fixed lab analysis | Two air filters per week for fixed lab analysis |

In addition to RadNet, EPA and partner federal agencies have deployed and will continue to maintain and upgrade the BioWatch network. The goal of this network is to monitor the air for biological material in largely urban areas. Further details about this network are unavailable in this Strategy for national security reasons. In addition, the federal government will continue to undertake biological and other monitoring of various defense installations for security and surveillance purposes.

# 5. Rural Monitoring

## 5.1 Importance of Maintaining and Enhancing Existing Rural Monitoring Networks

EPA fully recognizes the importance of such existing rural monitoring networks as NADP, CASTNET, and IMPROVE for their core objectives of tracking atmospheric deposition and visibility. In addition, EPA recognizes the importance of these networks in tracking regional background concentration levels for evaluating the effectiveness of regional control programs such as CAIR. The current focus of EPA's strategy on reconfiguring the SLAMS and NAMS networks for urban monitoring in no way diminishes the importance of rural monitoring to this national Strategy. In fact, the reconfiguration of these networks provides an opportunity to explore ways to integrate the rural monitoring networks with urban NAAQS-oriented networks. Such integration must maintain the rural networks' core activities while making optimal use of the data they produce. What follows is a brief description of these networks, and ongoing strategic elements to enhance these networks.

### 5.1.1 NADP

The NADP now comprises several networks: the NTN, the MDN, and AIRMoN. The NADP was established in 1978 to provide information on geographical patterns and temporal trends in U.S. precipitation chemistry. A major objective of the program is to characterize geographical patterns and temporal trends in atmospheric deposition of the United States.

**a. National Trends Network**. The NTN consists of about 250 long-term wet deposition monitoring stations across the U.S. These sites are sponsored by cooperating agencies and organizations that volunteer personnel, equipment, analytical costs, and other resources and agree to follow the network's standard established procedures. The network involves over 100 organizations, including eight federal agencies, state and local agencies, universities, and private industries. Five of the stations are located on Tribal lands within the states of Maine, South Carolina, Michigan, Minnesota, and New York. NADP/NTN criteria and protocols ensure uniformity in siting, sampling methods, analytical techniques, data handling, and overall network operation. The NTN involves measurement of hydrogen (acidity as pH), sulfate, nitrate, ammonium, chloride, and base cations such as calcium and magnesium. The network has one of the longest multi-site records of precipitation chemistry in the world and has maintained an effective quality assurance program throughout the years. EPA remains committed to supporting this monitoring network.

**b. Mercury Deposition Network**. The MDN was established in 1996 to develop a regional database on the weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. Atmospheric deposition is the prevalent source of mercury to aquatic ecosystems. The data are used to develop an information database on spatial and seasonal trends in mercury deposited to surface waters, forested watersheds, and other sensitive receptors. Mercury is of special concern to state and local governments because most states now post health advisories for the consumption of gamefish with excessive mercury levels. A national network is important to assist these state and local efforts given that most advisories are issued in areas lacking point sources of mercury, and monitoring for mercury transport plays an important role. With about 90 sites currently in operation, the MDN has grown to be the largest network in the United States measuring total mercury in precipitation. Around 20 state, Federal, and private organizations support the NADP/MDN. The Minnesota Pollution Control Agency and the Wisconsin Department of Natural Resources are the two largest participants in the program.

The deposition of atmospheric mercury occurs in wet and dry forms over multiple geographic scales, with various environmental effects. The MDN provides data on wet mercury deposition from precipitation. Although MDN is a step in the right direction for mercury monitoring, a lack of scientific information on the dry mercury components as well as limited geographic coverage over broader scales provide an insufficient picture of total (wet + dry) mercury deposition and mercury atmospheric transport. Based on current model estimates, dry deposition of mercury can be from 0.25 to 3 times the rate of wet deposition, depending on location. The nation's ability to characterize and detect changes in mercury ambient air concentrations and deposition rates is severely compromised due to a lack of ambient-air speciated-mercury measurements needed to estimate dry mercury deposition. Tracking these changes is an important component of EPA's obligations to assess and account for implementation of emission control strategies to reduce exposure to mercury, including promulgation of both CAIR and CAMR in 2005.

Monitoring mercury in the atmosphere is a relatively new concept that presents a number of scientific assessment challenges. The three mercury compounds which contribute to dry deposition - reactive gaseous (RGM), particle-bound (PHg), and elemental ($Hg^0$) - are currently not monitored systematically in the U.S. Close to sources that emit RGM and PHg, the impact of mercury dry deposition can be substantial. Even though the estimated deposition rate of $Hg^0$ is small, $Hg^0$ comprises more than 95 percent of the total mercury in air. Monitoring all three forms of mercury compounds will enable better understanding of mercury deposition and tracking of contributions from emission sources within and external to the United States.

EPA is proposing to work collaboratively with the NADP to build a foundation for detecting future CAIR- and CAMR-driven changes in atmospheric mercury levels and expand EPA's capacity for atmospheric mercury monitoring, modeling, and assessment. This collaboration would plan and initiate an ambient-air speciated-mercury monitoring network for temporally and spatially characterizing mercury concentrations in the atmosphere that will help to ensure that baseline and long-term information needed to evaluate CAMR and CAIR is high quality, transparent, and accessible. In addition, the new speciated mercury monitoring network will provide data necessary to validate and improve existing mercury deposition models. The EPA's ability to defend the existing models used to estimate mercury deposition is limited due to the shortage of dry deposition data necessary to ground truth these models. Defensible predictive air deposition models will be essential for further examination of this issue. Additional objectives of the proposed speciated mercury monitoring network include: identifying geographic and temporal variability and trends, characterizing regional and global transport, and examining emission-source and deposition-ecosystem relationships.

Initial development through this initiative would facilitate network start-up activities (e.g., site selection, external quality assurance, and limited instrumentation purchase, installation, and operation). Additional steps would be required to populate a broad scale network and sustain operations longer-term. The plans for this mercury network development remain in the formative stage. EPA anticipates that the final 2007 Strategy document will outline these plans and EPA's implementation approach in greater detail.

**c. Atmospheric Integrated Research Monitoring Network**. The National Oceanic and Atmospheric Administration (NOAA) sponsors the AIRMoN network. AIRMoN brings together wet and dry deposition components to reveal the causes of observed trends. The AIRMoN-wet program relies on common field equipment, a single analytical laboratory, and centralized quality assurance. Daily samples are collected, and samples are analyzed for nitrate, sulfate, and ammonium. The AIRMoN-dry program relies on a two-tiered approach that infers dry deposition from air quality, meteorology, and surface observations and directly applies eddy flux and/or gradient techniques. These methods yield average dry deposition rates to areas, typically many hundred meters in radius, surrounding observation points. Observation sites are located within areas that are both spatially homogeneous and representative of the large region.

AIRMoN provides a research-based foundation for operations of NADP and CASTNET. A part of AIRMoN is dedicated to detecting the benefits of emissions controls mandated by the Clean Air Act Amendments of 1990, and to quantify these benefits in terms of deposition to sensitive areas. AIRMoN is designed to quantify the extent to which changes in emissions affect air quality and deposition at selected locations. AIRMoN sites are to be chosen to optimize the probability for detecting the change that is sought, and to serve related needs of effects researchers. Specific sites are (and will be) emphasized, where operations of different observing arrays can be collocated. Such Collocated Operational Research Establishments ("CORE sites") will serve two additional distinct purposes: (a) to provide linkages among network programs operating to address different needs with different protocols and (b) to provide the detailed measurements necessary to understand important processes. A strong linkage with the emerging National Environmental Monitoring Framework has been forged. NOAA continues to expand AIRMoN, which currently includes eight sites, and anticipates a 20-30 site network.

### 5.1.2 CASTNET

In contrast to the NADP, which (except for the AIRMoN dry deposition sites) measures wet atmospheric deposition, CASTNET focuses on dry deposition and, more recently, an additional component to address fine particles and visibility. CASTNET measures ambient concentrations of gaseous phase pollutants and aerosols ($O_3$, $SO_2$, $HNO_3$, particulate nitrate, and sulfate and ammonium species), along with meteorological parameters needed to estimate deposition velocities and dry deposition fluxes of these constituents. CASTNET is the only broad source of dry deposition data in the country. The data are used to determine relations among emissions, air quality, and deposition and to provide information necessary to understand the ecological effects of atmospheric deposition.

With over a decade of data collected, CASTNET provides critical information necessary in bench marking and understanding the impact of pollution on the environment and the effectiveness of pollution management programs. CASTNET was deployed in the 1980s as part of EPA's National Acid Precipitation Assessment Program (NAPAP). An assessment in the mid-1990s led to a more optimized and less extensive network. The National Park Service, in cooperation with EPA, operates 27 of the CASTNET sites.

Currently, EPA and other CASTNET partners are selecting, developing, and evaluating an automated, semi-continuous monitoring system for routine use in CASTNET. The new instrument will provide hourly sampling and analysis for a suite of particulate and aerosol components, and allow for rapid, real-time availability of data. As part of the ongoing development of this Strategy, EPA also will continue to explore ways to integrate CASTNET with other networks, including deployment of rural NCore multi-pollutant sites (see Section 5.2, below).

### 5.1.3 IMPROVE

The IMPROVE program is a cooperative measurement effort by a steering committee composed of representatives from Federal and regional-state organizations. The IMPROVE program was established in 1985 to aid the creation of Federal and state implementation plans for the protection of visibility in Class 1 areas (156 national parks and wilderness areas) as stipulated in the 1977 amendments to the Clean Air Act. The program currently consists of 110 aerosol visibility monitoring sites and additional instrumentation that operates according to IMPROVE protocols. The 110 IMPROVE network monitoring sites were selected to provide regionally representative coverage and data applicable to all 156 Class I federally protected areas.[4] Additional IMPROVE protocol sites include 65 aerosol samplers, plus transmissometers, nephelometers, and cameras that fill identified data needs and enhance and fill spatial gaps in the core IMPROVE network. The first sites began collecting data in 1988, and along with the IMPROVE network expansion in 2000-01, provide the only long-term record available for tracking visibility improvement and degradation.

The objectives of IMPROVE are to (1) establish current visibility and aerosol conditions in mandatory Class 1 areas; (2) identify chemical species and emission sources responsible for existing manmade visibility impairment; (3) document long-term trends for assessing progress towards the national visibility goal; and (4) with the enactment of the Regional Haze Rule, provide regional haze monitoring representing all visibility-protected federal Class 1 areas where practical.

To fulfill this regulatory objective, the 110 IMPROVE sites collect and analyze every third day 24-hour duration particle samples at sites chosen to represent the federal Class I areas. Specifically, the network is set up to collect and process aerosol speciation data that can establish the five-year averaged baseline and subsequent five-year averages of haze levels for the haziest

[4] The Bering Sea Wilderness, on an uninhabited island in the Bering Sea about 200 miles off the Alaska Coast, is deemed impractical for routine monitoring under the IMPROVE network.

(worst) and clearest (best) 20% of days for as long as the regional haze rule is in effect (currently envisioned as a 60-year process).

The IMPROVE network has been generally viewed as an efficient, uniform, and cost-effective means to generate the required Class I area representative data needed for regional haze trends tracking. While long-term consistency is the hallmark of a successful trends monitoring program, a number of issues should be explored that may result in changes to monitoring for trends tracking over the next 10 years. These include: the degree to which the current monitoring sites represent the visibility-protected Class I areas, and the advisability of continued use of filter-based sampling with the current suite of analyses.

The ultimate question for the issue of representativeness is whether the current network sites adequately represent all of the Class I areas without redundancy. Some of the Class I areas are large and situated in complex terrains, so that even if a monitoring site represents some portion of the Class I area, it may not represent conditions in other parts of the same area. On the other hand, the levels and temporal variations of some of the measured species (e.g. sulfates, nitrate, and organic carbon) are similar at multiple IMPROVE monitoring sites within a region, which raises the question of redundancy. However, simple comparisons of data from neighboring sites could be misleading since sites that currently measure similar concentrations may not do so under future emissions configurations. IMPROVE is planning to conduct a network assessment that should be complete early in 2006 to explore these concerns.

Possible changes to the IMPROVE sampling and analysis protocols need to be carefully tested and considered prior to implementation because of the possibility of introducing artifacts that would detrimentally impact trends assessments. However it is likely that some changes will be made over the next ten years. These may result from monitoring technology advancements (e.g., high-time resolution speciation instrumentation for long-term monitoring application), or changes in our understanding of atmosphere processes that identify other critical components that should be monitored (e.g., inclusion of ammonium ion monitoring), or identification of problems with the current monitoring approach that need to be rectified in order to generate data of adequate quality. In addition to understanding their impacts on the data trends, any potential change in the funding and practical consequences of potential changes need to be factored into all protocol change decisions. The IMPROVE program continually assesses and adjusts protocol for issues related to data quality, as well as considering the possible application of innovated technology or changes to characterize additional atmospheric parameters.

In summary, the regional haze rule clearly calls for tracking haze trends via monitoring of aerosol species at sites representative of the Class I areas over the anticipated 60-year period of haze reductions as a means to assess the effectiveness of SIP-mandated emissions changes. The 110-site IMPROVE network supplemented by some IMPROVE Protocol sites selected to represent some of the larger Class I areas currently fills this need. Over the next 10 years this trends monitoring approach may evolve somewhat (i.e., minor changes in the number of sites and/or monitoring protocols), but remains necessary for implementation of the regional haze rule.

#### 5.1.4 Additional Rural Monitoring

In recent years, additional measurements have been made by a number of organizations (principally regional planning organizations, or RPOs) to supplement IMPROVE and answer fundamental questions about particle formation, speciation, transport, and precursors. All of these studies are tied through collocation, correlation, or method to the foundation provided by IMPROVE. These measurements are typically more specialized, regionally focused, and generally have a 1-3 year lifetime. Establishing a longer-term or permanent monitoring network is difficult for RPOs or states because a stable funding mechanism is not available and the available funding varies from year to year. The data collected is used in multiple ways, but the overarching goal of most monitoring programs is to provide information that can be used to develop more technically sound State and Tribal Implementation Plans (SIPs and TIPs). For example, data collected from the Midwest RPO urban organic speciation study is being used as part of a comprehensive source apportionment analysis, which includes comparison with previous source apportionment studies based on less detailed data. The study data will also be used in photochemical model evaluation, emission inventory evaluation, and model development, as well as contributing to the general characterization of organic carbon in urban environments (sources, concentrations, seasonality) and continued growth of the regional conceptual model for $PM_{2.5}$ and haze. All of these analyses are part of a weight-of-evidence approach to determining the contribution of emissions from states to downwind Class I areas, as required by 40 CFR 51.308.

#### 5.1.5 Conclusion on Existing Rural Monitoring

This Strategy seeks to foster continued support and enhancement of these networks and to recognize the valuable contributions of additional monitoring studies conducted through RPOs and others. Already, EPA and its partners have sought to optimize resources for these systems by collocating monitors at various sites. In addition, EPA intends to seek ways to integrate these rural networks with the NAAQS-oriented NCore multipollutant sites and other SLT monitoring networks. The next two sections explore EPA's initial concepts for this type of integration.

### 5.2 NCore Monitoring: Urban/Rural Connection

NCore multipollutant measurements represent the mainstream national sites in the urban monitoring network. The approximate total number of sites (75) as well as proposed measurements are modest recommendations that attempt to balance total network growth while introducing a manageable realignment in the networks. Site locations will be based on design criteria that also balance technical needs with practical considerations, such as leveraging established sites, and maintaining geographic equity. One element of designing appropriate site location is the growing importance of capturing rural background conditions to support urban air quality modeling and strategy development.

The multipollutant sites require diversity of "representative" locations, across urban (large and medium size cities) and rural (characterize background and transport corridors) areas. National level health assessments and air quality model evaluations require data representative of broad urban (e.g., 5 to 40 km) and regional/rural (> 50 km) spatial scales. Long-term epidemiological studies that support review of national ambient air quality standards also benefit from a variety of airshed characteristics across different population regimes. The NCore sites should be perceived as developing a representative report card on air quality across the nation, capable of delineating differences among geographic and climatological regions. While "high" concentration levels will characterize many urban areas, it is important to include cities that also experience less elevated pollution levels or differing mixtures of pollutants for more statistically robust assessments. It also is important to characterize rural/regional environments to understand background conditions, transport corridors, regional-urban dynamics, and influences of global transport.

A related factor is that air quality modeling domains continue to increase. Throughout the 1970s and 1980s, localized source oriented dispersion modeling evolved into broader urban scale modeling (e.g., Urban Airshed Modeling for ozone) to regional approaches in the 1980s and 1990s (e.g., Regional Oxidant (ROM) and Acid Deposition (RADM) Models to current national scale approaches (Models 3 - CMAQ) and eventually to routine applications of continental/global scale models. The movement toward broader spatial scale models coincides with increased importance of the regional/rural/transport environment on urban conditions. As peak urban air pollution levels decline, slowly increasing background levels impart greater relative influence on air quality. Models need to capture these rural attributes to be successful in providing accurate urban concentrations.

Thus, a starting point to foster integration of networks, such as IMPROVE and CASTNET, with the NCore site network, will be to look for opportunities to coordinate NCore siting with existing rural monitoring sites. Numerous issues will arise related to site selection and measurement needs that will benefit from better communications across networks and organizations. As part of this Strategy, EPA will seek to engage three separate disciplines (ecosystems, health, and atmospheric processes) during the NCore siting process. These disciplines often have different objectives, participants, and perspectives, but often they do share data needs.

The possible steps taken to assimilate CASTNET measurements into the SLT national networks also provide an important linkage to the NADP networks: NTN, MDN, and AIRMoN. For instance, several CASTNET sites share locations with NADP sites. In addition, the MDN will provide enormous value to the nation as it is the only infrastructure in place to monitor mercury on a routine basis. EPA has been developing a specific strategy to increase our ability to characterize PBTs that include mercury, dioxins, and persistent organic pollutants (POPs). In addition, the promulgation of the Clean Air Mercury Rule in 2005 increases EPA's need to obtain ambient gaseous measurements, in combination with precipitation and fish tissue mercury data, to assess the rule's long-term impacts. Currently, gas phase mercury measurements are too technically demanding and too cost prohibitive to be instituted routinely. However, the linkages between the MDN and CASTNET, if also then linked into the NCore multipollutant network, could enhance the ability to evaluate mercury measurements in coordination with a suite of other pollutant measurements.

Another area where EPA has identified opportunities for integration is between the IMPROVE network and the $PM_{2.5}$ Speciation Trends Network. IMPROVE data from Class I areas are the key component of the regional haze monitoring strategy, but because these Class I areas are nationally distributed, and since there is also a relatively widespread incidence of urban areas (and some regions) which fail to meet the primary health standard for $PM_{2.5}$ (15 ug/m3 annual average), IMPROVE data have taken on an important added objective of defining both the fine mass and chemical composition of "regional background" $PM_{2.5}$. The value of these data for illuminating PM attainment issues may take on added future importance as EPA is currently considering revisions to standards which include: a large reduction in the 24-hour primary $PM_{2.5}$, a new secondary sub-daily $PM_{2.5}$ standard (for protecting visibility outside of Class I areas) and new primary and secondary $PM_{10-2.5}$ standards (see for example: http://www.epa.gov/ttn/naaqs/standards/pm/data/pmstaffpaper_20050630.pdf).

The new $PM_{2.5}$ STN was established in 1999, using methods adapted from (but not identical to) IMPROVE. STN sites are primarily urban but there are also a number of new rural speciation sites, many of which employ IMPROVE methods. These include the former CASTNET "Visibility" sites, a number of state operated "SIP" sites, and several rural and urban methods comparison sites where IMPROVE and STN sampling is conducted concurrently. The new rural IMPROVE protocol sites help fill in the national map, enhancing regional coverage in areas where Class 1 areas are sparse, and this expanded IMPROVE coverage, in turn, defines regional-scale $PM_{2.5}$ concentration and composition, enhancing the value of the urban STN data, by allowing distinction between regional and local species composition and source contributions. The urban STN data may in turn help identify the nature and location(s) of urban or industrial sources that contribute to haze in downwind Class I areas, and can also help quantify the spatial and temporal scales of large regional events (forest fires, dust storms, sulfate or nitrate episodes) that affect urban and rural sites alike. As EPA moves to implement NCore multipollutant sites and general (3-6) research-grade sites under this Strategy, EPA will assess the opportunities to collocate rural NCore sites with IMPROVE sites in Class I areas (or other RPO sites). This kind of multi-species, highly time-resolved information would provide a valuable complement to existing routine regional haze monitoring programs.

Finally, recognizing the increasing importance of contributions from global scale interactions, the network should include an explicit measurement linkage that addresses international pollutant transport. Such a linkage can be established through integration with PBT measurements, which often are impacted by global scale transport phenomena, as well as though Sentinel sites located at key inflow and outflow locations near the coastlines and elsewhere. EPA anticipates that a fraction of NCore multipollutant resources may be set aside for such Sentinel sites.

# 6. Tribal Monitoring

Currently, there are well over 100 Tribal air quality programs in various stages of development across the United States. This is a dramatic increase from only nine programs in 1995. Many of these Tribes operate approximately 120 monitors in Indian Country that report to AQS for several types of NAAQS pollutants, including $PM_{2.5}$ and $PM_{10}$ (including some speciation), ozone, nitrogen dioxide, and sulfur oxides. Tribes also operate sites in the CASTNET, and NADP networks, and there are currently 11 Tribal IMPROVE protocol sites operating in six different EPA regions. These numbers may increase as Tribes continue to build the capacity to assess air quality on their respective lands. However, the maintenance and growth of air quality monitoring also will remain linked to the availability of Tribal grant funds to support these activities.

Within the context of the national air monitoring strategy set out in this document, it is critical to note that in working with the Tribes on air monitoring, EPA is not setting a national strategy for Tribal monitoring. Nevertheless, EPA does not intend to exclude Tribes from the national air monitoring program as that program develops. It is also important to note at the outset that EPA believes that Tribal monitoring is important within the broader national ambient air monitoring strategy. While acknowledging these points, this strategy document does not attempt to canvas the entire subject of Tribal monitoring. Two guidance documents that are being developed by EPA in consultation with Tribes will provide considerably more detail on the subject.

As the Tribes are autonomous, they are not bound by EPA's monitoring rules. However, monitors in Indian country must be properly sited, use adequate technology, and follow prescribed QA procedures if a Tribe wants to use data from the monitor to demonstrate NAAQS attainment or nonattainment.

There is a growing movement in the United States of Tribal organizations taking an increased interest in ambient air quality issues on Tribal lands. Tribes wishing to examine ambient air quality issues on their reservations or Tribal lands should have a good working strategy in place as they decide what their interests and concerns are in the development of their work plan and program strategy. Tribal entities often decide that the best way to assess the current air quality situation is through the use of ambient air quality monitors. A strategic approach to monitoring should incorporate specific planning stages.

Initially, a Tribe will need to work with its EPA regional contacts to begin development of a work plan that will be required for EPA operational grant funds and used to organize the direction of the program. This is especially important in the planning phase, as many of the air monitoring development steps can be incorporated into the work plan objectives and funded by EPA, which will be committed to providing guidance and technical assistance throughout the whole process. Note that, given the limited monitoring throughout Tribal lands, EPA believes that Tribal network assessments similar to the national and regional efforts discussed in Section 2.5.3 are inappropriate for the relatively new Tribal programs, because those assessments addressed aged and relatively dense monitoring networks.

The national networks clearly can benefit by gaining additional monitoring sites in those areas where Tribes participate in the national network. There are many rural Tribal airsheds that could be considered for rural monitoring sites, potentially filling in important gaps in the national network. In making determinations for siting rural monitors, EPA is committed to considering Indian country on an equal basis, such as for CASTNET or a possible new mercury deposition network. It is also possible that some NCore multipollutant rural stations might best be sited in Indian country. These comments should not be perceived as suggesting that the Tribal monitoring priority is fostering a connection to national networks. Monitoring priorities must be based on Tribal decisions, which in many cases involve developing a better characterization of local exposure to air pollutants. The linkage to national programs should be perceived as leveraging opportunities that simultaneously benefit Tribes and the national network.

Another recent development over the past 3 years has been the establishment of the Tribal Air Monitoring Support (TAMS) Center, which is a unique partnership between Tribes, the Northern Arizona University Institute for Tribal Environmental Professionals (NAU ITEP), and EPA. Together, Tribal environmental professionals, ITEP, and EPA provide the full range of air monitoring technical support, including monitoring network design, monitor siting, quality assurance and quality control, and data analysis and interpretation. The TAMS Center recognizes the sovereignty and diversity of Indian nations and is designed to build capacity and empower Tribes to successfully manage their respective programs with equanimity on a national scale.

Beginning in 2001, Tribes also have been active participants in the RPOs. The RPOs have provided leadership in establishing needed rural monitoring throughout the central core of the nation. As active participants in technical planning and monitoring operations of the RPO, Tribes have been integrated for perhaps the first time in a large scale national monitoring program. Through this interaction with RPOs, as well as participation in the current NAMS, Tribes will likely operate some number of NCore multipollutant sites.

Finally, EPA is currently developing two new documents related to tribal air monitoring. One will address internal EPA processes and goals. The other will provide guidance to Tribes that are operating air monitoring stations or that are considering doing so.

## 7. Quality System

Quality assurance is a major component of an air monitoring program and is necessary for ensuring the availability of data of sufficient quality to justify investments made in the program. Any reevaluation of air monitoring networks must include a reassessment of quality assurance programs. To undertake such a reassessment, in 2000 EPA and individuals representing state, local, and tribal interests established a Quality Assurance Strategy Workgroup charged with developing the elements and activities of a quality system for an ambient air monitoring program. A quality system is a structured and documented system that describes an organization's policies, objectives, principles, authority, responsibilities, and implementation plan for ensuring quality in its processes, products, and services. A quality system is a framework for the organization's required quality assurance and quality control efforts, which are essential to have confidence in the data collected.

The Quality Assurance Strategy Workgroup developed these key recommendations:

- move toward a performance-based measurement process with specified data quality objectives;
- minimize start-up problems with a phased implementation approach;
- provide a reasonable estimate of the costs associated with QA programs;
- develop certification and/or accreditation programs;
- accelerate data review and certification programs for quicker data access into the national air quality data system (AQS);
- eliminate redundancies to improve cost efficiencies;
- develop appropriate data quality assessment tools (e.g., software); and
- streamline regulations and, more specifically, identify those actions that should be mandated through regulation and recommended through guidance.

Implementing the Strategy will require changes to the regulations and the development of guidance. In addition, standard operating procedures (SOPs) to accompany the employment of new instrumentation will have to be developed, as will appropriate requirements for the infrastructure necessary to accommodate various sites within the national networks (so that sufficient space, power, and access are included in site designs).

Any reevaluation of air monitoring networks must include a reassessment of quality assurance programs. This section addresses the reassessment of these programs, as well as the need for redeveloping a quality system that is germane, flexible, and responsive to changes in the monitoring program.

## 7.1 The Quality System

The primary requirements or elements for the Ambient Air Monitoring Program quality system will be described in 40 CFR Part 58, Appendix A, and in guidance format in the second volume of the QA Handbook for Air Pollution Measurement System. The elements are identified in Table 7-1.

**Table 7-1**
**QA Element and Activity List**

| Quality System Elements | Activities |
|---|---|
| Planning | Data Quality Objectives<br>Performance Based Measurement Approach<br>Regulation Development<br>Graded approach to QA - QMPs/ QAPPs and SOPs<br>Guidance Documents |
| Implementation | Training<br>Internal Quality Control Activities<br>Data verification/validation<br>Data Certification |
| Assessment/ Reporting | Site Characterizations<br>Performance Evaluations (NPAP, PEP, Region/SLT Performance audits)<br>Assessment of Quality Systems & Technical Systems Audits<br>Data Quality Assessments<br>QA Reports |

## 7.2 Planning Activities

### 7.2.1 Development of Data Quality Objectives (DQO)

The Data Quality Objectives (DQO) process is designed to ensure that the data collected and/or funded by EPA meets the needs of decision makers and data users. The DQO process establishes the link between the specific end use(s) of the data and the data collection process, which is important for identifying the quality and quantity of data needed to meet a program's goals. The result of the DQO process is a series of data quality indicators (e.g., precision, bias, completeness, detectability) and acceptance requirements (called measurement quality objectives) for those indicators.

OAQPS will be responsible for developing DQOs for federally mandated data collection efforts such as the NCore multipollutant objectives. DQOs for other data collection activities (e.g., non-trends speciation sites) would be the responsibility of other federal agencies and the

SLTs using the graded approach to QA described later in this section. OAQPS will develop DQOs on the basis of resource availability and current priorities set by the National Ambient Air Monitoring Steering Committee; the process should be completed within two years, or at least prior to full implementation of monitoring for an NCore or other NAAQS pollutant. $PM_{2.5}$ and ozone DQOs have already been developed. The precision and bias data quality indicators for these two pollutants have been included in 40 CFR Part 58, Appendix A. As DQOs are completed, they are added to the Code of Federal Regulations.

### 7.2.2 Move Towards a Performance-Based Measurement Process

A performance-based measurement system (PBMS) should be the primary tool for selection or identification of appropriate methods for ambient air monitoring. The purpose of a PBMS is to determine "what is needed" rather than "how to do it." Specifically, a PBMS is a set of processes that specify the data quality needs, mandates, or limitations of a program, and serve as the criteria for selecting appropriate, cost-effective methods to meet those needs. An important element of a PBMS is the development of DQOs, which, in turn, help in the development of federal reference method acceptance criteria (where needed). For example, the DQOs developed for $PM_{2.5}$ are now being used to determine the "acceptability" of continuous $PM_{2.5}$ monitors. Use of a PBMS helps to underscore the importance of identifying appropriate data quality indicators and measuring quality objectives, and it will ensure that these are consistently defined and measured so as to allow for the assessment of data comparability.

a. PBMS for NAAQS comparison objectives. Due to the regulatory requirements for NAAQS comparisons, instruments used for this purpose will continue to meet the performance specifications of the Federal Reference and Equivalency Method criteria.

b. PBMS for NCore objectives. Monitoring instruments used for the NCore objectives that do not serve a dual purpose for comparison to the NAAQS do not necessarily need to meet FRM/FEM criteria but must meet the minimum data quality requirements developed through the DQO process that will be defined in the regulations and guidance.

c. PBMS for other non-Federal objectives. SLTs will be responsible for selecting methods that will meet their data quality requirements for monitoring. The performance-based approach lends itself to flexibility but will put more responsibility on the SLTs for developing quality systems that meet their needs. Therefore, there will be a greater importance and emphasis on QA project plan (QAPP) development.

### 7.2.3 Regulation Development

The QA Strategy Workgroup reviewed 40 CFR Part 58, Appendix A, in order to determine what in the Appendix remained relevant to the Ambient Air Quality Monitoring Program quality system. In addition to restructuring this Appendix for readability, the Workgroup recommended these changes (see http://www.epa.gov/ttn/amtic/geninfo.html):

- Combine PSD (40 CFR Part 58, Appendix B) into Appendix A. Appendix A and B are very similar, and the Workgroup believed that these two sections could be combined.

- QMP and QAPP approval: Regulatory revisions should provide more explanatory information on quality management plans (QMPs) and QAPPs and mention that QAPP approval can occur at the monitoring agency level as long as it is described and approved in a QMP.

- DQOs: OAQPS should have responsibility for providing DQOs for NCore and other NAAQS objectives.

- Graded approach to QA: The regulations should describe this process in order to provide flexibility.

- Quality assurance lead: Monitoring organizations should designate a quality assurance lead with certain QA responsibilities.

- Reporting organization and primary quality assurance organization: The regulations should define these two terms in order to clarify the organization primarily responsible for the quality of the data. An additional field in AQS may be necessary to accommodate this change.

- $SO_2$ and $NO_2$ manual audit checks (formerly Sections 3.4.2 and 3.4.3): These sections should be removed.

- Biweekly precision check concentration range: The regulations should change the ranges to allow for lower concentration checks to be acceptable in cases where the majority of the data from a site are below the current range requirements.

- The regulations should change the $PM_{10}$ collocation requirement to 15% of routine sites, similar to $PM_{2.5}$.

- Provide for quarterly data certifications: Because of the emphasis on real-time reporting, data quality validation and evaluation is occurring earlier in the monitoring process than in the past. In addition, the QA Reports distributed by OAQPS (i.e., 1999 and 2000 $PM_{2.5}$ QA Reports) have limited usefulness because the data are not evaluated until after they are officially certified, typically 6 months after the calendar year in which they were collected. Certifications could occur sooner, and a proposal for quarterly certifications is being considered.

- Revised Automated Precision and Bias Statistics: Statistics used to estimate precision and bias should be changed, and should be calculated on a site basis as opposed to a reporting organization basis, as appropriate. The paper on this approach has been published for review.

Based on these recommendations, EPA is proposing revisions to the QA requirements in Part 58. That proposed rulemaking is expected to be signed in December 2005.

### 7.2.4 Using a Graded Approach to QA

As with any EPA-funded activity, EPA QA Policy requires monitoring organizations to develop QMPs and QAPPs. Under the Strategy, the use of air monitoring data will have multiple applications. Therefore, some monitoring objectives may not call for quality systems and quality assurance documentation (i.e., QAPPS) to meet the stringent requirements for NAAQS comparison purposes and may have data quality needs that differ. The revised EPA QA Policy allows for a graded approach to quality assurance. This approach provides for some flexibility in the development of QMPs, QAPPs, and DQOs. The Quality Assurance Strategy Workgroup has developed and supports a graded approach for the Ambient Air Monitoring Program (see http://www.epa.gov/ttn/amtic/geninfo.html).

### 7.2.5 Guidance Documents

OAQPS will continue to develop guidance documents relevant to federally implemented monitoring programs. Within the next few years, guidance will be revised or developed for:

a. The QA Handbook. The primary guidance document for the Ambient Air Quality Monitoring Program Quality System will continue to be the QA Handbook for Air Pollution Measurement Systems, Volume II, Part 1. The Handbook was revised in 1998, at which time it was recommended that it be revised at five-year intervals. Although it is due for an update, EPA has decided to wait until the regulations are promulgated. It is expected that QA requirements for the NATTS and for a coarse particulate program ($PM_{10-2.5}$) will be included in the next revision. Part 2 of the Handbook is used for the reference and equivalent methods and will also be used for generic technical guidance for other pollutant monitoring procedures used at NCore and other SLT sites.

b. Generic QAPP. Using the EPA Quality Staff QAPP guidance, OAQPS, in cooperation with the Institute of Tribal Environmental Professionals (ITEP), is in the process of planning for the development of a generic ambient air monitoring QAPP software product that would allow the SLTs to input the appropriate QA information into each section of their QAPP for their particular monitoring program. In FY 2003, OAQPS received $50,000 of Tribal initiative funds to start development of this software product. The final product will be available in September 2006.

## 7.3 Implementation Activities

### 7.3.1 Training

Section 9 contains additional details on training for QA. This section considers the implementation items related to training.

One way to place more emphasis on training is to establish a national accreditation process to certify QA personnel. At a minimum, OAQPS will pursue the development of an accreditation process for the Quality Assurance Lead defined in 40 CFR Part 58, Appendix A. Although not mandatory, this accreditation process would foster a level of consistency across the nation. As of April 2003, the EPA Quality Staff meets the criteria for certification established by the Certified Provider Commission of the International Association for Continuing Education and Training (IACET) and is authorized to issue Continuing Education Units (CEUs) when EPA Quality Staff conduct the EPA Quality Systems training courses. EPA will develop a Quality Assurance Lead accreditation curriculum using the Quality Staff courses and the courses provided by the Air Pollution Training Institute (APTI). The following training related activities provide potential opportunities:

- Retraining: If capital expenditures are to be made on automating QC activities, personnel normally performing these activities will have to be trained for alternate activities. EPA will explore placing increased emphasis on data and network assessments.

- Conduct a poll for training: SLTs should be polled, perhaps through STAPPA/ALAPCO, to determine what QA related training is needed.

- Training at the annual QA conference: Since 2002, OAQPS has facilitated two days of presentations and training at the annual EPA National Conference on Managing Environmental Quality Systems. Approximately 30 to 50 SLT representatives have attended the last four conferences. This conference provides training on a number of courses that will be required for quality assurance lead certification mentioned above. An ambient air monitoring QA related course (e.g., APTI courses) could also be taught at the National Conference. SLT QA leads should be provided opportunities to attend this meeting.

- Develop web-based training programs: Based upon priority training needs, OAQPS will pursue the use of web-based training courses, in particular, the APTI courses and a training module related to the QA Handbook for Air Pollution Measurement Systems, Volume II, Part 1.

### 7.3.2 Internal Quality Control Activities

The majority of the day-to-day QA activities at the SLT monitoring organizations involve implementing or assessing quality control information, whether it be zero/span checks, collocated precision, or field trip or lab blanks. Each monitoring method has required and suggested quality control samples that can be used to assess data quality of a phase (i.e., sampling) of the measurement system or the total measurement system. These QC checks will be included in validation templates that will be developed for each of the NCore multipollutant sites and for other SLT NAAQS-oriented measurements.

Accordingly, the PBMS principal will be used to develop the necessary quality control samples in the regulations without mandating frequency and acceptance criteria. The CFR should identify the types of QC samples that will provide assessments of attaining the DQOs. As the $PM_{2.5}$ DQO software tool shows, various combinations of uncertainty (i.e., precision, bias) affect attainment of the data quality objectives. The CFR would be revised to identify the uncertainties that would need to be measured, as well as the confidence sought in the estimate of those uncertainties. The SLTs would then be responsible for developing a quality system that would measure, assess, and control these uncertainties. Thus, SLTs would determine how often to perform various QC checks, as well as the appropriate acceptance criteria. Using the data in AQS, OAQPS would also assess data uncertainty to determine if an SLT had developed a quality system that was "in control." For organizations with fewer QA resources or less experience, the QA Handbook will continue to provide the suggested acceptance criteria and QC sample frequencies through the use of the validation templates.

SLTs are strongly encouraged to invest in cutting edge data logging and automated quality control and assessment technology. This technology would allow for more frequent QC checks while reducing manpower burdens of site visits, and would provide monitoring personnel more opportunity for data verification, reduction, and assessments.

### 7.3.3 Data Validation/Verification

Verification and validation are processes used to ensure that specified requirements (i.e., collocated sampling) have been fulfilled and that particular requirements for a specified use (i.e., collocated precision acceptable for NAAQS comparison) also have been fulfilled. Improvements and activities to be implemented in this area include:

a. Developing validation templates. Since the development of the $PM_{2.5}$ Validation Template, there has been an interest in developing similar templates for all criteria pollutants. The Quality Assurance Strategy Workgroup is nearing completion on validation templates for the remaining criteria pollutants that will be incorporated into the next version of the QA Handbook. Following the PBMS paradigm, use of the template will not be considered mandatory but will provide useful guidance for organizations developing QAPPs. As part of this Strategy, EPA intends to develop similar templates for other NCore multipollutant measurements.

b. Providing more automated requirements for data review/verification/validation. An initial capital expenditure on information capture and transfer technologies (e.g., data loggers, telemetry, automated quality control) for automatic transfer of routine and quality control information to central facilities should be considered. Included in this expenditure would be quality control systems for automating various QC checks, such as zero/span checks, or bi-weekly precision checks. Various automated data evaluation processes would be used to provide for more real-time consistent screening and data verification/validation activities. Real-time data transfer technology would allow personnel at centralized offices to implement various verification/validation techniques, identify problems, and take corrective actions in real-time.

#### 7.3.4 Data Certification and Quicker Data Access on AQS

The recent emphasis on real-time reporting of data means that real-time review, verification, and validation of data have gained importance as well. Given more timely data assimilation, the schedule for certification of a calendar year's worth of data must be improved over the current six months following the end of the previous calendar year. Some SLTs have already automated a majority of the data verification and validation efforts.

### 7.4 Assessment and Reporting

The following activities describe the various assessment and reporting features of the quality system.

#### 7.4.1 Site Characterizations

Site characterizations are a type of audit used to assess whether samplers or monitors at the monitoring site meet the applicable siting criteria for existing monitoring objectives. Siting criteria have been described for SLAMS, NAMS, and PAMS sites in 40 CFR Part 58, Appendix E. Siting criteria for NCore multipollutant sites need to be addressed. The on-site visit consists of physical measurements and observations of such elements as height above ground level, proper spacing from various instruments, or distance from obstructions and roads. All NCore sites should undergo complete site characterizations at the start of the program and/or at the start of site implementation to ensure that the sites are appropriately characterized. As part of the technical systems audit function, EPA Regions should confirm the site information for all NCore and other SLT NAAQS-oriented sites every three years. It is also possible during audits that Environmental Services Assistance Team (ESAT) personnel can perform certain aspects of the site characterizations. This would allow for more frequent update and confirmation of site characteristics.

Recommendations and action items for site characterization include:

- Setting minimal levels and tracking. The requirements for the frequency of such characterization would be changed, as necessary. In addition, better tracking of site information would ensure that adequate site characterizations were being performed. There is an area in AQS that can be revised for this tracking activity.

- Ensuring updates made in AQS. Information such as that obtained from the inspection of monitors, from sampling equipment added to the site, and from latitude/longitude changes could be described in the AQS tracking area noted above. The information would be deleted once the changes had been confirmed.

- Developing and using a site characterization form. A site characterization form (and possibly software) could be developed and distributed to provide some consistency in performing site characterizations.

- Speeding up approvals for discontinued sites. SLTs submit paperwork for discontinuing sites, but EPA approvals often take considerable time. OAQPS will review this process and determine how to expedite the approval process.

### 7.4.2 Performance Evaluations

Performance evaluations (PE) are a type of audit in which the quantitative data generated in a measurement system are obtained independently and compared with routinely obtained data to evaluate the proficiency of an analyst or laboratory. Performance evaluations are an obligation of the program agency, but the evaluation is conducted by a separate agency. OAQPS will offer the following two types of audits. State and local agencies can either defray the expense through a hold-back of STAG funds, or make arrangements for non-EPA independent audits. In the latter case, EPA must certify that the independent audit services will provide data comparable to EPA conducted audits.

**National Performance Evaluation Program (NPEP).** The NPEP program will service NCore multipollutant and other SLT NAAQS-oriented sites. The following PE programs will be included under the NPEP.

- $PM_{2.5}$ Performance Evaluation Program (PEP): This program has been operating since 1999 using the ESAT contractors to collocate FRM $PM_{2.5}$ instruments at 25% of a reporting organization's sites. In addition, during $PM_{2.5}$ audits, EPA will audit speciation monitors at both Speciation Trends sites and supplemental sites. This additional auditing will cost approximately $150,000 per year.

- National Performance Audit Program (NPAP): NPAP has been operating since 1970 and is currently being retooled into a through-the-probe audit system implemented by EPA Regional personnel and/or ESAT personnel currently implementing the PEP. OAQPS has expended internal capital for the outfitting of five trailers and one vehicle. Eventually, the PEP and NPAP programs will be combined into a single program. In addition, OAQPS will evaluate the need for through-the-probe auditing in the NATTS and may opt to outfit the NPEP laboratories for this activity.

- NATTS proficiency tests samples: OAQPS will contract the development and distribution of quarterly audit samples to the laboratories analyzing NATTS samples. Details of these audits can be found in the NATTS Strategy document.

**Certification Programs.** Certification programs provide independent testing of products and/or instrumentation and are used to provide a sense of quality and comparability. The following certification programs (with the exception of protocol gas) will be implemented for NCore and other sites.

- Standard Reference Photometer Program (SRP): The Standard Reference Photometer, which is used to certify SLT monitoring organizations' ozone primary and transfer standards, will continue to be implemented through the Office of Radiation and Indoor Air (ORIA). The SRPs have been updated recently, and the Standard Operating Procedures have been revised.

- PAMS and NATTS gas cylinder certifications: ORIA currently performs gas cylinder certifications for the PAMS program and is proposing a similar service for certifying calibration standards for laboratories participating in the NATTS. Details of these audits can be found in the NATTS Strategy document.

- Re-investing in the protocol gas program: ORD for many years implemented a program that tested gas standards supplied by gas manufacturers to monitoring organizations in order to ensure some level of quality control over the gas manufacturers. The program was discontinued in 1997 as part of the ORD divestment. Recently, in the face of market in-roads by smaller vendors with potentially inferior quality products, some gas manufacturing vendors have expressed an interest in resurrecting the program.

### 7.4.3 Assessments of Quality Systems and Technical Systems Audits

The following types of qualitative assessments will be implemented in the National Ambient Air Monitoring System:

a. <u>Assessments of quality systems</u>. These assessments are systematic, independent, and documented examinations that use specified criteria to review an organization's quality system, mainly through the assessment of the organization's adherence to its quality management plan. Every three years, EPA Quality Staff will assess OAQPS' quality system, which will, in turn, assess the EPA Regions' quality systems. As part of the technical system audits described below, the EPA Regions will assess the quality systems of SLTs. This process should provide feedback on the strengths and weaknesses at all levels of the Ambient Air Monitoring Program quality system.

b. <u>Technical Systems Audit (TSA)</u>. TSA is a thorough, systematic, on-site, qualitative audit of a system's facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects. EPA will continue to require that the EPA Regions perform a TSA of the primary quality assurance organization once every three years. The TSA audit checklist, currently in the QA Handbook, will be revised to reflect new monitoring methods and/or objectives, and to include questions relative to an organization's quality management plan. An area for tracking audits will be developed on AQS.

### 7.4.4 Data Quality Assessments

A data quality assessment (DQA) is a statistical evaluation of a data set to establish the extent to which it meets user-defined application requirements (e.g., DQOs). Historically, DQAs have received little attention in the ambient air monitoring community. There will be more emphasis on DQAs, however, given the move towards performance-based measurements systems and DQOs. OAQPS will be responsible for the development of DQAs for all objectives in which OAQPS has developed DQOs. DQAs will be performed with the same frequency as priority decisions are made. For example, $PM_{2.5}$ NAAQS comparisons are made with an aggregation of three years of data; thus, DQAs for $PM_{2.5}$ data would be performed once every three years.

As DQOs are developed for the criteria pollutants, DQA tools will also be made available, much like has happened with the modified $PM_{2.5}$ DQO software. The tools are expected to be integrated into AQS.

### 7.4.5 QA Reports

QA reports provide a means for distributing information on the Ambient Air Monitoring Program Quality System. Two general types of reports will be developed at the Federal level.

a. Annual assessments of data quality indicators. OAQPS now offers automated reports through AQS that provide assessments of the data quality indicators (e.g., precision, accuracy, bias, and completeness) that are reported to AQS.

b. Interpretive reports. Following the discussion in the data quality assessment section, above, interpretive QA reports will be developed at the same time as DQA and will provide a more thorough discussion of the quality system. DQA results would be included in these interpretive QA Reports.

## 7.5 Funding and Resource Issues

The expected schedule for full implementation of NCore and other monitoring will determine the year-to-year resources required to implement the QA activities at EPA Headquarters, EPA Regional Offices, and SLTs. To ensure that expectations are met, it is imperative that the resources required to implement this quality system be enumerated and acknowledged as appropriate. If an agency believes the funds are not appropriate, they should be adjusted accordingly. In addition, QA activities must be intimately tied to the monitoring process so that costs for the quality system either increase or decrease commensurate with monitoring costs. Resource and funding related action items include:

- **Ensuring SLT funds are available for QA training.** EPA provides regular and continuing training on many aspects of air programs. It is important to include QA training as part of the overall training program.

- **Automating quality control procedures.** Some implementation activities that are still being performed manually by monitoring organizations (i.e., zero/span and precision checks) could be automated. The technology section that follows discusses how to increase awareness of this technology and move to more automated systems. However, this Strategy recognizes that this modernization will require an initial expenditure of capital for both equipment and training.

- **Applying STAG resources for EPA Conducted Audits.** Currently, STAG funds pay for the $PM_{2.5}$ Performance Evaluation Program and NATTS Proficiency Test Program, but not the NPAP, $PM_{2.5}$ speciation, or NATTS (field component) programs. Quality assurance is especially critical as EPA and its partners undertake new monitoring approaches, such as increased use of continuous monitors. EPA's proposed rule revisions will provide for a hold back of STAG funds to cover the cost of EPA conducted evaluations. As discussed above in Section 7.4.2, EPA must certify data comparability for other organizations that SLTs use to conduct audits.

## 7.6 Network Assessments

Network assessment is not a new process. State and local agencies historically have conducted annual network evaluations, and changes to monitoring networks have been undertaken and reported as part of this process. However, periodically, it is necessary to take a more holistic review involving national, regional, and local agencies. As part of this Strategy, EPA expects that a multi-level network assessment be conducted every five years.

The primary objectives of the network assessments are to ensure that the right parameters are being measured in the right locations, and that network costs are kept at a minimum. Some of the related secondary objectives include the following:

- Identify new data needs and associated technologies;
- Increase multipollutant sites vs. single pollutant sites;
- Increase network coverage;
- Reduce network redundancy;
- Preserve important trends sites; and
- Reduce manual methods in favor of continuous methods.

Guidance and training materials are needed for these future network assessments to provide more structure to the assessment process. The guidance must promote greater national consistency while allowing for flexibility due to the substantial differences among the regions. OAQPS is currently preparing a Regional Assessment Guideline Document, which will be complete by the beginning of the next round of network assessments.

With this in mind, the following steps are provided as a preliminary guide for the regional network assessments, recognizing that further elaboration is forthcoming in the guideline document currently under preparation:

- **Step 1**: **Description** - Each assessment should contain some basic descriptive material of the region, to include topography, climate, population and trends, and general air quality conditions. This section should be considered more of a boilerplate section, needing updating as appropriate for each subsequent assessment.

- **Step 2**: **Network History** - A description of the network evolution over at least the previous 10 years is important in helping to establish a sense of changes that have already been made in response to changing network needs. At a minimum, this description should depict the total number of monitors in the region by pollutant and by year, either in graphical or tabular format. At best, this should be accompanied by a detailed table showing the history of each monitoring site. Then each successive five-year assessment would simply append the most recent five-year history to the previous summary, maintaining a continuous record of the monitoring networks.

- **Step 3**: **Statistical Analyses** - Each assessment should include some level of statistical analysis. At a minimum, site intercorrelations would help identify redundant sites. Also, some comparisons to the NAAQS and trend analyses would help determine which sites are well below the NAAQS and are not trending upward. Such sites, from a purely statistical standpoint, could be candidates for divestment. Analyses can be more complex, at the discretion of the Regional Office. Examples include spatial and factor analyses, as well as innovative approaches using weighting schemes such as those used in the National Assessment. The more detailed analyses can be used as important tools for determining the adequacy of existing monitoring sites. Examples of the types of statistical analyses that should be conducted can be found at http://www.epa.gov/ttn/amtic/netamap.html.

- **Step 4**: **Situational Analysis** - Apart from the statistics, there are a myriad of other factors that have bearing on network changes. These include, but are not limited to:

  -- Value of maintaining long-term trends;
  -- Closeness to the NAAQS;
  -- Population changes (e.g., new areas of growth);
  -- Existing maintenance plan and SIP requirements;
  -- Sparseness of the existing network;
  -- Special local circumstances (e.g., political factors); and
  -- Needs of the scientific and health communities.

  These factors can be considered subjectively, or more objectively by first identifying the important factors and developing weighting schemes for each factor. The approach would be at the discretion of the Region.

- **Step 5**: **Suggested Changes** - Based on both the statistical and situational analyses, each Regional Office should prepare a recommended list of network changes, by pollutant and site, applicable to each state. Regional Office staff should engage in one or more workshops/meetings with state and local agencies for the purpose of sharing the results of the initial analyses and explaining the rationale for any suggested changes.

- **Step 6**: **Interactive Discussions** - State and local agencies should carefully review each of the changes suggested by the Regional Office. Deviations from the initially recommended changes are expected, but state and local agencies should present cogent rationale for the basis of any deviation. It is expected that state and local agencies will provide back to the Regional Offices their list of network changes, including those that agree with the Regional Office recommendations and those that differ. There may need to be one or more meetings between Regional Office staff and state and local agency staff to refine the changes that must ultimately be approved by the Regional Office.

- **Step 7**: **Final Recommendations** - Each Regional Office will provide a listing of the final changes to the air monitoring network within its jurisdiction. These are to be provided to OAQPS. The final listing should contain the following information:

  -- Parameter changes (additions/removals/relocations);

  -- Site changes (additions/removals/relocations);

  -- A justification statement explaining (briefly) the rationale for the change; and

  -- A timeline for implementation for each change.

## 8. Monitoring Technology Development and Transfer

This section of the Strategy focuses on the technologies that EPA, SLTs, and other partners will use to deliver timely ambient air monitoring data from the National Ambient Air Monitoring System. During the planning stages of the Strategy, the Technology Workgroup, with input from the Quality Assurance and Regulatory Review Workgroups, NMSC, CASAC, and SAMWG, identified three overall needs for technology investments. In addition to the new investments, the existing infrastructure for programs such as the ozone network will continue to be employed. Other technologies such as routine CO, $SO_2$, and $NO_2$ monitoring and filter-based PM monitors may be reduced depending on network assessments that take into account the new investments. While other technology investments will likely be made during implementation of the Strategy, most of those technologies will be supporting one of three major technology needs:

- Timely reporting of high quality, highly time-resolved ambient monitoring data;
- Collocated characterization of trace levels of CO, $SO_2$, NO and $NO_y$; and
- Highly time-resolved, spatially rich $PM_{2.5}$ data.

The timely reporting of high quality, highly time-resolved ambient monitoring data will require a coordinated effort to ensure that data management systems are meeting desired performance needs. These data management systems will need to provide validated data, to the extent possible, in near real-time to multiple clients within minutes of the ending of a sample period. To realize full potential of the nation's ambient air monitoring networks, the data management systems used will need to provide not only efficient processing and validation of data, but also proper communication of that data in a format appropriate and available to multiple users. The main impetus for improved data management systems is providing near real-time, high quality hourly data from all NCore continuous monitors, as well as ozone, trace level CO, NO, $NO_y$, $SO_2$, and $PM_{2.5}$ continuous data from other sites. By emphasizing the availability of data in near real-time, the networks will better serve their clients by providing data as episodes are occurring. This will allow technical and policy staff to better understand the exposure and interactions of air pollutants in the present atmosphere.

The characterization of trace level gases and $PM_{2.5}$ in near real-time is part of the monitoring technologies emphasized in the networks. The use of monitoring technologies in the networks is generally limited to reference and equivalent methods for gaseous criteria pollutants. However, for trace gas analyzers of CO, $SO_2$, NO, and $NO_y$, instrument manufacturers are expected to be utilizing their base reference or equivalent methods with modifications to improve their detection limit, and thus performance, at low concentrations relative to NAAQS levels. For PM criteria pollutants, EPA is moving toward a base network of reference or equivalent methods coupled with a larger network of *approved* continuous PM monitors that meet appropriate data quality objectives.

The challenge for implementation will be to produce a framework that encourages widespread adoption of the technologies described in this section, which some agencies already use. Specific technologies will not be required in most instances; however, the measurement of select parameters will be required at NCore sites, as appropriate. The concern with requiring specific technologies is that over time new technologies will become commercially available, making existing technologies obsolete. One of the main tenets of the Strategy is adopting Performance Based Measurement Systems (PBMS). Doing so for each parameter of interest in the network will allow future technologies to enter the market-place and gain acceptance over existing technologies if the data demonstrate that they are a better solution for the network. For parameters of interest that do not have reference methods, the strategy will be to use PBMS through a DQO process to identify both a relative standard approach to the method and acceptable error rates.

Despite the need to invest in many areas of the ambient air monitoring program, doing so indiscriminately may not lead to an improved system. The Technology Workgroup recommended focusing on the following issues in addressing these concerns:

- **Making the right choice for a technology:** For any one type of technology there may be several choices to consider. The most cost effective choice right now may be outdated in a year. Making the right choice requires careful consideration, and even then the choice may not be optimum.

- **Transition from current to new technology:** Important considerations in the transition to new technology include downtime in the system and the need for a contingency plan should the new system fail.

- **Training of Staff:** New technologies may require a higher level of expertise than those they are replacing.

- **Technical service:** What, if any, service plan would accompany a new technology? The need for a service plan may affect the true cost of the technology. Another important consideration is the responsiveness of technical service.

- **Use of proprietary software**: The use of software that is not in the public domain may arise as an issue.

- **Ability to transfer to new technologies at a future time**: Agencies must carefully select technologies that do not preclude the selection of newer technologies in the future.

- **Identification of appropriate technical specifications**: Appropriate technical specifications should be included on purchase requests so that air monitoring agencies make the right purchase of equipment. This is especially important where technologies may have similar features, but the lower cost product is actually inferior and leads to substantial problems to the end user. If purchasing agents are given an appropriate amount of detail in the technical specifications, they may better avoid selecting the inferior technology.

## 8.1 Monitoring Technology

The advancement in computing and communications technologies over the past fifteen years has significant implications for air quality monitoring. There is greater potential now than at any time in the past to improve monitoring methods, monitoring support capabilities, such as computer controlled instrument calibrations and quality assurance functions, and the transfer of information to the public. Yet, some components of the monitoring networks continue to function with less automation, efficiency, and speed than is necessary.

The technologies used in the ambient air monitoring program cover all hardware and software used in the measurement, calibration, logging, transfer, storage, validation, and reporting of data. Many of the areas identified are already using state of the art technologies. For instance, much of the gaseous criteria pollutants are measured using continuous monitors with automated features for calibration and data output. Other areas such as data transfer are relying on technologies that may be outmoded or antiquated. Yet, because it operates well and satisfies the needs of data users, it may not be an opportune area for investment.

Table 8-1 breaks down the major technology areas of the ambient air monitoring program into individual technology elements, summarizes the state of technology used in a typical ambient air monitoring program, provides recommendations for each technology element, and provides a statement of the expected benefit of moving to this element.

**Table 8-1**
**National Monitoring Strategy Technology Implementation Investments**

| Technology Element | State of Technologies used in Typical Program | Recommendations | Expected Benefit |
|---|---|---|---|
| Data Management Systems - recording of data from back of instrument to datalogger | Analog connection. | Move to digital capture of data. Could be RS232, Ethernet, FireWire, etc. | Allows tracking of instrument performance beyond just concentration. Allows for improved remote troubleshooting and two way communication directly to instrument. |
| Telemetry systems | Everything from low baud modems used on standard telephone lines to satellite, cable modem, DSL, and other high speed internet systems. | Focus on performance needs of moving low interval data very quickly to support real time reporting and other data uses. Choose most optimal telemetry system depending on availability in area of monitoring. | Improves timely reporting of data. In many cases, there may actually be a reduced cost for utilizing broadband over dial-up modems due to avoiding long distance charges. |

(cont.)

**Table 8-1**
**National Monitoring Strategy Technology Implementation Investments (cont.)**

| Technology Element | State of Technologies used in Typical Program | Recommendations | Expected Benefit |
|---|---|---|---|
| Data Validation | Limited range checks are used on most systems. | Move toward comprehensive automated QC systems with graphical display of data and point and click validation. | Reduced manual validation. Automated QC features improves quality of real-time reported data. |
| Data Reporting Format | For AQS reporting, bar delimited format is used. For AIRNow reporting, "Obs" file format is used. | Move to common "XML" schema that can serve both reporting needs. | XML is an open format that most applications will be able to read. By utilizing one format, data analyses tools that are developed for one system will be compatible with both systems. |
| Gas pollutants - CO, $SO_2$, $NO_2/NO_y$ | Approved Reference and Equivalent Methods. | Trace gas analyzers that are also approved as Reference and Equivalent Methods. | Allows for tracking of trends and signals that may be important. Allows for better model evaluation. |
| Gaseous criteria calibration systems | Mixed - Everything from fully automated to manual. | Move all agencies towards fully automated systems. | Improved data quality. |
| $PM_{2.5}$ monitoring | Approximately 1,000 filter-based FRMs and over 300 $PM_{2.5}$ continuous monitors. | Develop hybrid network of continuous and filter-based monitoring to reduce dependency on filter network and optimize resources. | Better spatial characterization of $PM_{2.5}$ for episodes. Improved temporal characterization. Reduced operating costs. |

### 8.1.1 Measurement Methods for Use at NCore Multipollutant Sites

This section considers the measurement methods to be implemented at NCore sites, with a focus on the additional measurement methods that are not currently part of the routine monitoring networks.

When possible, continuous methods should be implemented over manual methods. Most importantly, continuous methods deliver data with a high temporal resolution so that the atmosphere can be characterized on a time scale relevant to how it changes and how people are exposed. In addition, continuous instruments are usually much less resource intensive to operate, have a higher sample frequency, provide for greater precision due to reduced human intervention, are easier to automate with respect to data delivery, and provide data that are easier to validate.

However, EPA also recognizes that a mix of continuous and integrated (e.g., filter, canister, cartridge, denuder) systems in the networks will continue to be necessary for three important reasons:

- integrated samples allow for more extensive chemical and physical property analysis in the laboratory;

- due to uneven performance characteristics exhibited by continuous methods, collocated integrated measurements enable appropriate transformations of continuous data, thereby improving their quantification attributes (the basis for regional approved continuous $PM_{2.5}$ methods); and

- retention of integrated methods allows for a smooth transition to new continuous technologies with minimal compromise on the ability to construct air quality trends analyses.

Thus, the broad, longer-term goal is to transfer from a network that consists of nearly 80% integrated and 20% continuous methods to one where continuous methods are the dominant monitoring approach.

The minimum requirements for measurements at NCore sites are as follows:

- Continuous $PM_{10-2.5}$ and $PM_{2.5}$ mass
- Filter-based FRM $PM_{2.5}$ mass
- Continuous, trace level CO, $SO_2$
- Ozone
- Continuous NO and $NO_y$
- Nitric acid and ammonia characterization (methods and sampling frequency remains under consideration)
- Surface meteorology (temperature, relative humidity, wind speed, wind direction)

In addition, SLTs will continue to operate and maintain additional NAAQS-oriented sites. These sites will be used primarily for $PM_{2.5}$ and ozone, with continued operation of lead, CO, $SO_2$, and $PM_{10}$ sites only as needed.

The principal pieces of these sites are summarized in the following subsections.

**a. Trace Gas Monitoring.** One of the major areas of investment in the Strategy is for the use of trace gas analyzers to characterize CO, $SO_2$, $NO_2$ and $NO_y$ at NCore monitoring stations. These analyzers are basically the same instrumentation as approved reference and equivalent methods; however, modifications have been made to improve the sensitivity of the measurement. Utilizing trace gas analyzers instead of conventional gas analyzers, agencies can not only determine compliance with the NAAQS, they also can provide valid measurements at much lower detection limits. Providing data at lower detection limits will allow for better characterization of confounding factors associated with air pollution episodes given the collocation of trace gas measurements at NCore sites. In addition, improved gas monitoring data will result in reduced uncertainties in data sets used to model air pollution episodes and will enhance an array of multiple factor-based source apportionment analyses. The true measurement objective remains the characterization of actual levels of gases. Thus, in most cases, conversion to trace gas methods and associated calibration regimes will be necessary given the low levels of these gases in many "representative" NCore sites. For certain locations in urban areas where the levels of these gases remain in the more conventional ranges, it will not be necessary to convert to new trace gas monitors. Such situations will have to be addressed on a case-by-case basis.

The majority of ambient air gas analyzers operating across the United States were established to compare monitoring data to the NAAQS. Analysis of these data has shown that the majority of areas in the country are in attainment for the CO, $SO_2$, and $NO_2$ standards. For $NO_y$, for which there is no NAAQS, measurements are primarily used to characterize total reactive nitrogen. However, where concentrations of $NO_y$ are shown to be below those for the NAAQS for $NO_2$, it is reasonable to assume that the monitor is demonstrating attainment of $NO_2$.

**b. Ozone Monitoring.** The ozone monitoring network is expected to remain one of the spatially-rich monitoring programs implemented throughout the United States. Although there is a large network of ozone monitors in the United States, there may be opportunities through network assessments to make better use of this network. This could potentially involve areas of technology and planning associated with ozone monitoring identified below:

- Realigning monitors: divesting of some redundant urban monitors and relocating them from the high monitor density urban environment to areas of lower monitor density in order to detect the spatial gradient of ozone.

- Providing enhanced ozone QA, such as increased use of ozone calibrators.

- Operating a minimum number of ozone monitors at NCore sites on a year round basis to provide a better understanding of ozone seasonal differences and interactions with other pollutants.

**c. PM Continuous Mass Monitoring.** The Strategy emphasizes PM continuous methods as a major component. In response to requests from state and local agencies (specifically through SAMWG) and from the CASAC Subcommittee on PM monitoring, EPA has developed an ambitious continuous monitoring implementation plan. That plan is being proposed in the December 2005 regulatory proposal.

Major features of the PM continuous monitoring strategy include:

- Support for a hybrid network of several hundred PM continuous monitors with a lesser number of FRM samplers;
- Use of performance based criteria developed in a DQO process to determine the acceptability of PM continuous monitors in the individual networks where they are used; and
- Parallel DQO approach for approval and applicability of methods on a national basis.

The goal of the PM continuous monitoring strategy is to have a PM monitoring network that can meet multiple monitoring objectives at lower cost.

**d. Continuous Speciation Monitoring -- Generally.** With continuous or semi-continuous monitoring, networks can deliver data with a high temporal resolution that allows the atmosphere to be characterized on a timescale relevant to how it changes and to how people are exposed under dynamic processes. Excepting the 22 NATTS sites that include Aethalometer™ instruments to measure black carbon, sites need not operate continuous speciation samplers. Nevertheless, continuous sampler operations at NCore multipollutant and comparable sites should gradually evolve. To this end, EPA is committed to supporting a 10-site continuous speciation network to include carbon, sulfate, and nitrate. This commitment is rooted in discussions with the health effects community regarding recommendations made by the National Academy of Sciences in the late 1990s and continued by CASAC.

However, given findings from the Supersites and other programs that indicate mixed performance across a variety of monitors, EPA is cautiously approaching continuous speciation monitoring. EPA coordinated a pilot study of semi-continuous $PM_{2.5}$ speciation monitors at five Speciation Trends Network (STN) sites (see Table 8-2). The pilot study began in 2002. The goals of the pilot study were to assess the operational characteristics and performance of continuous carbon, nitrate, and sulfate monitors for routine application at STN sites, to work with the pilot participants and the vendors to improve the measurement technologies used, and to evaluate the use of an automated data collection and processing system for real time display and reporting. Results from this pilot work indicate operational issues with the effectiveness of the flash volatilization process and/or thermal and catalytic conversion efficiencies. EPA has worked with instrument vendors to discuss modifications and adjustments to the monitors for resolving these issues. As the monitoring technologies improve and new technologies are developed that are adequate for use in routine monitoring networks, EPA plans to support further expansion of the monitors to a minimum of 10 STN sites.

New research has focused on the application of coupling ion chromatography with aerosol collection and in parallel with criteria air pollutant sampling to provide complete gaseous and aerosol species monitoring. These methods may offer the advantage of freedom from artifacts, but they may also present design and operational challenges with adapting liquid media-based chemical analysis to routine field monitoring use.

**Table 8-2**
**Current Continuous Speciation Sites (Urban)**

| Site Location | Measurements |
|---|---|
| Deer Park, TX | $NO_3$, $SO_4$, C |
| Indianapolis, IN | $NO_3$, $SO_4$, C |
| Chicago, IL | $NO_3$, $SO_4$, C |
| Phoenix, AZ | $NO_3$, $SO_4$, C |
| Seattle, WA | $NO_3$, $SO_4$, C |

In addition, RPOs formed to assess regional haze have initiated continuous speciation monitoring in rural locations (Table 8-3). The typical suite of measurements at these sites includes:

- continuous [hourly] $PM_{2.5}$
- surface meteorology
- $PM_{2.5}$ speciation, trends or IMPROVE or "IMPROVE protocol" 3rd-day filter 24- hour average measurements for carbon, ions/elements, and $PM_{2.5}/PM_{10}$
- visuals (HazeCam)
- continuous sulfate
- hourly EC/OC
- light scattering [NGN-2 (wet) "IMPROVE-like" nephelometer]
- trace level sulfur dioxide
- ozone

**Table 8-3**
**Regional Planning Organization (RPO) Sites with a Subset of Continuous Speciation Monitors**

| Location | RPO/Site Type | Known or Expected Measurements Beyond the Standard Suite |
|---|---|---|
| Raleigh, NC (Milbrook) | VISTAS RPO/<br>suburban scale | standard suite |
| Look Rock, TN | VISTAS RPO/rural<br>Great Smokey Mountains NP (Class I) | standard suite |

(cont.)

**Table 8-3**
**Regional Planning Organization (RPO) Sites with a Subset of Continuous Speciation Monitors (cont.)**

| Location | RPO/Site Type | Known or Expected Measurements Beyond the Standard Suite |
|---|---|---|
| Cape Romaine, SC (Near Charleston, SC) | VISTAS RPO/rural<br>Cape Romain NWR (Class I area)<br>Southeast Coastline | standard suite |
| Frostburg, MD | Mane-VU/MARAMA/rural<br>Western Maryland | trace CO; $NO_y$; Profiler |
| Cornwall, CT | Mane-VU RPO/rural<br>Mohawk Mtn | standard suite |
| Bar Harbor, ME | Mane-VU RPO/rural<br>Acadia NP/(Class I) | trace CO |
| Bondville, IL | Midwest RPO/suburban | continuous ammonia, nitric acid, nitrous acid, sulfur dioxide |
| St Louis, MO | Midwest RPO, urban (original EPA funded supersite) | Sunset Lab continuous carbon monitor |

**e. Nitric Acid and Ammonia Monitoring.** Both nitric acid and ammonia are important precursor gases to the major aerosol components nitrate and sulfate. It is important that these measurements support air quality model and emission inventory evaluations, and that they track the long-term progress of emission reduction strategies targeting nitrogen species. Beyond their critical multimedia roles associated with watershed acidification and eutrophication, these compounds must be measured within the national networks. Specifics on the methods and sampling frequency for these two gases will be determined after EPA establishes appropriate DQOs.

***(i) Nitric acid***. In the past, time-integrated systems for sampling and collecting nitric acid have been widely used. These systems use either filter packs or a combination of coated diffusion tubes followed by filter packs for sampling at the monitoring site. The samples are then transported to a laboratory for analysis. These systems typically collect samples over several hours and are therefore limited in providing fine temporal concentration resolution. A major problem associated with nitric acid detection by point monitors is transport through the system inlet. Studies are needed to identify the best transport tubing for real-time measurements. EPA will not pursue semi-continuous measurements for nitric acid until the technology reaches a higher level of maturity and proven reliability. EPA expects research of technology issues to continue through a variety of federal and other efforts. Some of the technology developments in this area include:

- Thermal denuders with selective coating, such as tungstic acid, have been used for semi-continuous monitoring with data resolution of 30 minutes or less. The denuders are thermally desorbed and measured by a chemiluminescence detector. Several versions of parallel-operated denuder systems that are coupled to chemiluminescent detectors for semi-continuous measurement of nitric acid and ammonium nitrate by difference calculations have been developed. Commercial chemiluminescence monitors for NO have been modified to design real-time nitric acid detectors using two inlets, one with only a particle filter and another with a particle filter and a nylon filter. The difference signal is attributed to nitric acid.

- Wet denuders have been developed in which nitric acid is captured in an aqueous system using diffusion scrubbers or parallel-plate-wetted denuders and then analyzed by ion chromatographic or colorimetric means. Prototype instruments providing up to 10-minute resolution at a detection limit of 10 ppb have been field-tested.

- Real-time measurement of nitric acid has been possible using chemical ionization mass spectrometry with detection limits of less than 15 ppt for a one-second sample interval. Systems employing tunable diode laser absorption spectroscopy and open-path, multi-pass Fourier transform infrared spectroscopy have been successfully operated for monitoring nitric acid by interpretation of IR spectra. For nitric acid, the published detection limits are 4 ppb for the diode laser and 10ppb for the Fourier transform instrument.

***(ii) Ammonia Monitoring***. Similar to monitoring nitric acid, monitoring ambient ammonia can be conducted through a variety of time-integrated sampling methods and continuous, real-time, or near real-time measurements. The most prevalent time-integrated methods use acid scrubbers such as sulfuric, phosphoric, or boric acid to collect ammonia, which is then analyzed through ion chromatography. Although these methods are inexpensive and relatively simple to implement, their limitation is that temporal resolution is dictated by the sample collection time; thus, the concentrations are not known until after laboratory analysis. Other time-integrated methods involve the use of gas sorbent detector tubes or passive diffusion devices or denuders of various designs (annular or honeycomb) coated with boric, oxalic, phosphorous, and citric acids or sodium bisulfate.

Chemiluminescence monitors are widely used and are perhaps the most popular means of measuring ambient ammonia concentrations. These monitors do not actually measure ammonia directly. Instead, they determine the ammonia concentration by difference. To do this, a thermal converter must oxidize the ammonia to nitric oxide, which is then further oxidized using ozone to produce nitrogen dioxide, whose luminescence is measured. Two thermal converters operating at temperatures either oxidize all nitrogen species or all components excluding ammonia to produce a difference signal to represent the ammonia concentration. However, because organic nitrogen compounds and nitric acid are known interferences, ammonia specific scrubbers have been adapted to the monitors to adjust the measurements. These types of instruments can typically detect ammonia down to approximately 1 ppb.

Several optical systems have been adapted for use in real-time ammonia monitoring. These systems include differential optical absorption spectroscopy (DOAS), Fourier transform infrared spectroscopy (FTIR), tunable diode laser absorption spectroscopy (TDLAS), photoacoustic spectroscopy, and ion mobility spectroscopy. Several recent research field studies using photoacoustic spectrometers have monitored ammonia concentrations as low as 0.1 ppb, with good accuracy over a range from 1 ppb to 3 ppb.

**f. Aethalometers™.** The SAMWG Subcommittee recommended the use of Aethalometers at every urban site in the NATTS. These instruments were added to the network to measure black carbon, with the intent of developing an indicator for diesel emissions. However, EPA recognizes that all mobile sources emit black carbon, and that other potential urban sources, such as wood combustion, emit it as well. EPA continues to study the relationship between ambient levels of black carbon and diesel emissions to asses the effectiveness of this type of indicator monitoring. Technical guidance can be found in the NATTS document found at http://www.epa.gov/ttn/amtic/airtxfil.html.

Aerosol black carbon is a primary emission from combustion sources. Black carbon is ubiquitous and absorbs light. It can be found in diesel and gasoline exhaust, and is also emitted from all incomplete combustion sources together with other species such as toxic and carcinogenic organic compounds. The Aethalometer is a semi-continuous instrument that measures black carbon using a continuous filtration and optical transmission technique. The light attenuation through a sample spot and a blank reference are used to determine light absorption. The absorption is converted to black carbon using an absorption coefficient. The single beam Aethalometer (880 nm) is being used for the NATTS. An estimated detection limit of 0.05 $\mu g/m^3$ black carbon for a 5-minute average is expected. Because no black carbon or elemental carbon particulate standards are available for use in calibrating this monitor, only flow rate calibration using a NIST-traceable device is possible. Although the Aethalometer will not specifically measure diesel-related black carbon, it will be used in conjunction with other supportive information (e.g., meteorology, measurement of other toxic pollutants, and traffic patterns) to assess the impact of diesel emissions in the NATTS.

**g. Deployment of Continuous Speciation Monitors**. All of the identified monitoring technologies, whether under development or commercially available, offer the potential for providing either real-time or short time-averaged species data. These data will very likely aid the health effects research and model development communities, which are both in need of highly temporally-resolved monitoring data. However, given the limited practical field applications of emerging monitoring technologies, EPA strongly advises that these new systems be collocated with integrating methods for ensuring comparative assessments and eventual data transformation. Such technologies should be encouraged for use at NCore multipollutant sites, where there will be both time-integrated samplers and continuous gaseous monitors. This offers the ideal opportunity for both comparative assessments and data integration.

### 8.1.2 Organic Aerosol Speciation (Not Required)

EPA is working with technical experts in the field of molecular markers for organic carbon to develop a document on using molecular marker measurements to assess the origin of carbonaceous particulate matter. This document will be used to help educate and inform SLTs in the use of molecular markers or tracers for source attribution. The primary focus will be on the source attribution aspects, with a lesser focus on sampling and analysis. The document will review the current molecular markers and their sources, strategies to address unknown sources, new tracer species, the use of tracers in source apportionment modeling, strategies for atmospheric sampling, considerations for source sampling, and requirements for chemical analysis.

### 8.1.3 Implementation Products and Deliverables

Technical method guidance documents will be prepared to guide SLTs in the proper installation and operation of $NO_y$, and the trace level CO and $SO_2$ instruments. This method guidance will provide information on the setup, installation, configuration, operation and calibration of these instruments. This guidance is expected to be completed by the end of 2004. In addition, SOPs that are prepared for EPA's on-site operation of these types of equipment will be shared with SLT monitoring agencies.

The implementation of new measurement methods will require additional training. It is expected that training will be provided by EPA, equipment manufacturers, and SLT monitoring agencies. EPA's ambient methods training program will focus on instrument operations and procedures. EPA uses a variety of mechanisms for both formal and informal training, including workshops, satellite and video training, technical assistance, guidance documents, and EPA's Ambient Monitoring Technology Information Center website at http://www.epa.gov/ttn/amtic/. A public forum area allowing users to submit questions on monitoring is also available on this page. The overall monitoring Strategy training implementation program is discussed as part of the implementation plan outlined in Section 9.

### 8.1.4 PM Continuous Monitoring Implementation Plan Summary

An enlarged continuous PM monitoring network will improve public data reporting and mapping, support air pollution studies more fully by providing continuous (i.e., hourly) particulate measurements, and decrease the resource requirements of operating a large network of over 900 filter-based reference and equivalent particulate samplers. The continuous monitoring implementation plan provides recommended directional guidance to move forward in deploying a valued continuous PM monitoring program operated by SLT governments. The plan addresses a range of topics, including relationships between continuous and reference measurements, performance analyses of collocated continuous and filter-based samplers, recommended performance criteria, regulatory modifications, and identification of outstanding technical issues and actions to be taken in the near future.

The continuous monitoring implementation plan proposes a hybrid network of filter-based and continuous mass samplers. The hybrid network would include a reduced number of existing FRM samplers for direct comparison to the NAAQS, and continuous samplers that meet specified performance criteria related to their ability to produce sound comparisons to FRM data. The plan proposes two approaches for integrating continuous mass monitors to maximize flexibility: (1) FEMs, and (2) an expanded use of non-designated approved methods identified as Approved Regional Methods. For FEMs, new equivalency criteria will be derived based upon a data quality objective exercise that matches the required performance criteria with the needs of the data. Approved Regional Methods are analogous to the Regional Equivalent Monitors (REMs) described in the continuous monitoring implementation plan. These monitors will be approved in individual SLT networks where data quality meets specified criteria. EPA has proposed criteria for approval of regional methods in the December 2005 regulatory revisions.

Performance criteria for use on a national basis for FEMs have been derived using the DQO process. The major emphasis of the DQO process was to tie historical equivalency criteria that use slope, intercept, and correlation with network operation DQOs that use bias and precision. The major advantage, from a DQO perspective, of using $PM_{2.5}$ continuous monitors over filter-based FRMs is that they provide data daily. Many FRM sites operate on sample frequencies of once every third day or once very sixth day. Having a method that provides a daily sample will reduce the uncertainty of a decision with the data, as compared to a method on a lower sample frequency, all other inputs being equal.

## 8.2 Data Management Technology

Over the last several years, one of the most important emerging uses of ambient monitoring data has been public reporting of the Air Quality Index (AQI). This effort has expanded on EPA's AIRNow website from regional-based, near real-time ozone mapping products that are color coded to the AQI, to a national multipollutant mapping, forecasting, and data handling system of real-time data. Since ozone and $PM_{2.5}$ drive the highest reporting of the AQI in most areas, these two pollutants are the only two parameters currently reported from AIRNow. While other pollutants such as CO, $SO_2$, $NO_2$, and $PM_{10}$ may not drive the AQI, they are still important for forecasters and other data users to understand for model evaluation and tracking of air pollution episodes. Therefore, this Strategy seeks the following goals for sharing nationwide data in near real-time:

- share all continuous $O_3$, $PM_{2.5}$, and $PM_{10}$ data, where available; and

- for NCore sites, share all gaseous CO, $SO_2$, NO, and $NO_y$ data, and all base meteorological measurements.

# 9. Implementation Plan

The previous sections of this document provided the conceptual and design basis for moving forward with a national monitoring strategy. This section provides a summary of the actions that will allow transition from design to implementation. For many pieces of this Strategy, EPA is still exploring and detailing the design elements, and a specific implementation plan is premature. Section 9.1 discusses those elements. The implementation plan then incorporates action oriented components of the Strategy, including regulatory revisions [Section 9.2], grants [Section 9.3], and guidance and training [Section 9.4]. Section 9.5 then discusses research sites, 9.6 discusses RadNet implementation, and Section 9.7 discusses plans for implementing data capture, access, and analysis.

## 9.1 Continued Strategy Development

The CASAC Subcommittee's report recommended increasing integration with other organizations and networks outside of the traditional SLT monitoring programs that are funded through STAG resources. Opportunities exist to provide and receive reciprocal benefits from established networks and organizations that are more focused, for example, on ecosystem welfare or atmospheric processes, as compared to the NAAQS attainment emphasis in the traditional monitoring networks.

Effective integration practices that enhance network economies and overall value need to be pursued. However, the limits to full integration also need to be acknowledged. While the intent to integrate has merit, there is no clear, compelling program necessity for individual organizations to participate fully. In addition, no significant new funds to support full integration are available or foreseen at this time. Given this context, it is imperative to proceed along a fairly proactive pathway with modest and achievable objectives to maximize engagement. The following actions are designed to facilitate greater network integration, and may serve as a starting point for a more detailed plan governing integration of these monitoring networks:

- **Addition of Ecosystem Support as an Air Monitoring Strategy Objective**. Consistent with the CASAC Subcommittee, this Strategy adopts support for ecosystem welfare assessments as a key objective.

- **NCore Multipollutant Siting**. Numerous issues related to site selection and measurement needs will arise that will benefit from better communications across networks and organizations. For simplicity, three disciplines (ecosystems, health, and atmospheric processes) are separated, as they often are attributed with different objectives, participants, and perspectives yet share in some instances significant commonalities in data. Interaction on ecosystem assessment and atmospheric processes support will be solicited primarily through interactions with the Air Quality Research Subcommittee (AQRS) of CENR. Similar dialogue on health effects and exposure research support will utilize EPA's existing relationship with the Health Effects Institute (HEI). Internally, EPA's health effects, toxicological, and exposure scientists will be actively engaged in siting discussions. Within EPA, a design team consisting of OAQPS and ORD scientists will provide recommendations for siting criteria based on technical needs associated with national scale model evaluation and data analysis objectives. Actual siting recommendations are made by State and local agencies in cooperation with EPA Regional Offices. Approval of these sites are made by the EPA Administrator.

- **CASTNET**. EPA's Office of Air and Radiation manages the CASTNET network, which provides a conduit to the atmospheric deposition and ecosystem assessment community. With certain exceptions, there has been only limited coordination between the CASTNET and the national networks operated by SLTs. Over the last four years, integration with networks has been supported by the addition of IMPROVE $PM_{2.5}$ speciation monitors at eight CASTNET sites. Starting in late 2003, a pilot study was initiated to establish three advanced monitoring sites at CASTNET locations to test new continuous speciation technologies and trace gas instruments. These three sites may become rural NCore sites (or research-grade sites, as discussed in Section 9.5) and also may provide some minimal technology transfer support. Overall, developing a full strategy to integrate CASTNET with other national networks is a key area for strategy development in the near-term.

- **Increased Coordination with National Atmospheric Deposition Program (NADP)**. These positive steps taken to assimilate CASTNET measurements into the SLT national networks provide an important linkage to the NADP networks: NTN, MDN, and AIRMoN. Several CASTNET sites share locations with NADP sites. In addition, MDN will provide enormous value to the nation, as it is the only infrastructure in place to monitor mercury on a routine basis.

- **Increased Integration with the PBT Monitoring Strategy and Emerging Mercury Monitoring Needs**. EPA has developed a series of recommendations to increase our ability to characterize persistent and bioaccumulative toxics (PBT) that include mercury, dioxins, and persistent organic pollutants (POPs). In addition, in 2005 EPA promulgated CAIR and CAMR. To assess the effectiveness of those rules in reducing mercury, EPA will need ambient gaseous measurements in combination with precipitation and fish tissue mercury data. As discussed in Section 5.1.1, EPA has proposed a plan to develop a dry deposition mercury network.

- **Allocation of NCore Sites as Sentinel Sites for International Transport**. Recognizing the increasing importance of contributions from global scale interactions, the new NAAQS-oriented monitoring network should include an explicit measurement linkage that addresses international pollutant transport. Such a linkage can be established through integration with PBT measurements, which often are impacted by global scale transport phenomena, as well as through Sentinel sites located at key inflow and outflow locations near the coastlines and elsewhere. Some NCore multipollutant sites may be placed where they can serve as Sentinel sites.

  Also, EPA's evolving Strategy in this area will have to consider how best to work with NOAA and other workgroups on Sentinel sites. These groups can address the technical issues with an international perspective and would assist in the design and support of routinely operating Sentinel stations. The primary objectives of these sites would be characterizing fluxes of key pollutants into and out of the United States. The NCore parameter list could serve as a subset, or at least exhibit considerable overlap, of desired measurements from a transcontinental (and intra-continental) needs perspective.

- **Increased Communications with Exposure and Health Effects Research Community and HEI**. The PM Supersites program included support for health effects and exposure research as one of three primary program objectives. Continued efforts must be pursued to ensure that the networks are responsive to the needs of the health effects research community. While the NCore multipollutant design is based, in part, on supporting long-term epidemiological studies, there still needs to be an effective communications mechanism to increase support to this community. Recent efforts by HEI have incorporated the national networks as part of their ongoing agenda. EPA and HEI should continue to pursue opportunities for integration. More specifically, EPA should engage active researchers in the health effects community, and have a substantive meeting addressing important locations (e.g., those cities with planned long-term studies), to help prioritize NCore sites and comment on the parameter list. Additional attention also needs to be given to the proposed "daily" speciation sites, which EPA intends to evolve into approximately 10 continuous speciation sites as discussed in Section 8.

- **CENR/AQRS**. The AQRS of CENR is a multi-agency (EPA, NOAA, NPS, DOE, DOI, and USDA) group positioned to foster integration across a variety of air related topics. The AQRS has, in the past, pursued related inventorying of a variety of monitoring network efforts and generally is well positioned to offer guidance to EPA on effective approaches to integration. As of October 2005, AQRS had an ongoing project to develop a white paper on the status of existing monitoring systems that will include recommendations for improved use and integration of data from these systems. EPA will work with AQRS to consider these efforts in ongoing development of this Strategy.

In addition to the issues of integration discussed above, additional issues are fully expected to develop as the Strategy is implemented. As such issues arise, EPA will engage in dialogue with the appropriate entities (e.g., SLTs) and the appropriate staff (e.g., monitoring technical issues, funding issues, policy issues, etc.). EPA will engage in these discussions as soon as possible after the issues are raised, so that potential implementation delays can be avoided or at least substantially reduced.

In some cases, these types of issues have already been raised, and EPA has begun the dialogue process. These include:

- **Near Roadway Exposures.** EPA plans to discuss internally and with external partners and stakeholders how to address emerging concerns over exposure in near roadway microenvironments. This implementation plan will need to be updated as a design and course of action are developed through that process.

- **Satellite Monitoring.** Satellites present a new technology approach for ambient monitoring. How best to incorporate this technology into this Strategy is a key technology issue to address over the next few years.

## 9.2 Rule Changes

EPA has promulgated three sets of regulations to provide the framework for how SLTs conduct ambient air quality monitoring: 40 CFR Parts 50, 53, and 58. Part 50 applies to the NAAQS and the federal reference methods for each pollutant; Part 53 provides air quality monitoring equipment vendors with the application and testing requirements for federal reference and equivalency methods; and Part 58 applies to ambient air quality surveillance. Parts 53 and 58 are the primary focus for regulatory changes needed to implement this Strategy.

The regulations only set minimum requirements. State and local agencies can, and are encouraged to, exceed such minimums. Tribes, as separate sovereign entities, generally are not required to meet these regulations, unless they want to use monitoring data to document NAAQS compliance.

Monitoring regulation revisions are needed to remove potential obstacles in implementing the Strategy and to foster technically creative instrument approaches and measurement systems. The monitoring regulations remain the most authoritative guide for air agencies and will ultimately serve as the principal communications tool to convey many of the details of the Strategy to EPA's partners at the state and local levels. The specific topics targeted for regulation changes are:

- Reconfiguring the traditional NAMS/SLAMS monitoring components with reduced number of single pollutant sites and adoption of the NCore multipollutant site framework (40 CFR Part 58);

- Establishing new minimum requirements in criteria pollutant monitoring to enable action on results from the network assessments and the continuous PM monitoring implementation plan (40 CFR Part 58);

- Introducing new provisions for $PM_{2.5}$ monitoring, including new performance based criteria for Federal Equivalent Methods (FEMs) (40 CFR Parts 53) and Approved Regional Methods (ARMs) (40 CFR Part 58);

- Revising PAMS monitoring requirements to emphasize accountability as a primary objective and to reduce non-type-2 sites (40 CFR Part 58);

- Restructuring quality assurance requirements (40 CFR Part 58); and

- Revising national equivalency specifications for $PM_{2.5}$ and expected $PM_{10-2.5}$ that will be based on updated data quality objectives and structured to accommodate continuous technologies (40 CFR Part 53).

The development of these regulatory changes has been an ongoing effort since 2000. EPA has established a workgroup process between EPA and state and local agencies, as well as interaction with the NMSC. The workgroup has had many conference calls to identify: (1) those portions of the regulations needing review and revision; (2) initial suggestions for changes; (3) key issues and resolution of those issues; and (4) development of and comment on early draft language. While the final proposed regulation is entirely under EPA's purview, much of the necessary background effort was done in cooperation with the state and local agencies.

The specifics of the regulatory changes are not included in this document, as the regulatory process will govern these details. The proposed regulatory revisions will be issued by EPA in December 2005, with final changes to become effective after promulgation of final rules that address public comments. The following discussion highlights some of the key areas that the regulatory action will address.

### 9.2.1 Network Design and Criteria

Some of the fundamental changes to the regulations are to: remove the references to NAMS sites; broaden the scope of "SLAMS" to include all state and local monitors except special purpose monitors; and reconfigure the national monitoring program for NAAQS compliance around the NCore multipollutant sites and a streamlined set of additional SLT monitors (primarily for ozone and $PM_{2.5}$). The revised regulation would establish:

- Fundamental monitoring purposes and objectives.
- The minimum design criteria, including specific requirements for the number of NCore sites by State, and the minimum level of multipollutants to be monitored.
- Minimum requirements for $PM_{2.5}$, $PM_{10-2.5}$, and ozone monitoring.
- Minimum requirements for continuous $PM_{2.5}$ monitors and for $PM_{2.5}$ background, transport, and speciation sites.
- Requirements to monitor for lead, as part of a national lead trends site assessment, in at least one location in each of the 10 EPA Regions. A location could be within the largest CBSA within a Region, or alternatively, at one of the Urban Air Toxics Trends sites within the Region.
- Requirements for other pollutants including carbon monoxide (CO), oxides of nitrogen (to include total reactive nitrogen gases, $NO_y$), and sulfur dioxide ($SO_2$).
- Requirements to leverage other monitoring programs into the NCore site designs. These could include PAMS, air toxics monitoring sites, and $PM_{2.5}$ chemical speciation trends sites.

### 9.2.2 Changes to the PAMS Network

Consistent with the multipollutant objectives of NCore sites, the PAMS sites provide more comprehensive data pertinent to ozone air pollution in non-attainment areas classified as serious, severe, or extreme. There are four types of PAMS sites, but the primary focus under the proposed regulations would shift to the Type 2 PAMS sites: those areas where maximum ozone precursor emissions are expected.

### 9.2.3 Network Assessments

The proposed regulatory changes will include requirements for a network assessment every five years. (See Appendix B for a discussion of the current round of network assessments.) Along with this will be requirements for SLTs to develop a schedule for implementing the network changes consistent with the findings of the assessment. The final recommendations would have to be approved by the Regional Administrator prior to actually making the network changes. Where deemed necessary and appropriate, other network changes would be permitted in the years between network assessments.

### 9.2.4 Performance-Based Measurement Systems (PBMS)

As the move toward PBMS occurs, there will need to be some changes to the CFR. Instruments used for NAAQS comparison purposes will continue to meet performance specifications of the FRM/FEM criteria. For NCore objectives, instruments serving other objectives will need to meet minimum data quality requirements developed through the DQO process, and these will be defined in regulatory changes and guidance. More detailed discussions are presented in Section 7.

### 9.2.5 QA Related Changes to 40 CFR Part 58 Appendix A

The following regulatory changes are expected:

- Combine Appendices A and B into Appendix A
- Process for QMP and QAPP approval
- Responsibility for providing DQOs
- Graded approach to QA
- Quality assurance lead person
- Defining a reporting organization and primary quality assurance organization
- Removal of $SO_2$ and $NO_2$ manual audit checks
- Bi-weekly precision checks - changes in ranges
- Provide for quarterly data certifications
- Revise automated precision and bias statistics
- Responsibility to provide for adequate, independent evaluation audits

These QA elements are described in more detail in Section 7.

## 9.3 Funding

Funding for SLT monitoring programs comes from Section 103 and 105 STAG funds. EPA-led monitoring programs use a variety of EPA funding resources, including Science and Technology budget funds. Generally, this Strategy implies moving resources from programs of decreasing value to those of higher value, consistent with the principles presented in Section 1 (respecting the strong partnership across EPA and SLTs, retaining stability for the monitoring programs, and accommodating SLT flexibility). At this time, the Strategy assumes that resources will remain level, with no significant decrease in funding to support ambient monitoring initiatives. This "zero-sum" constraint implies a reconfiguration of monitoring networks. This approach contrasts with the process of expanding networks significantly with the deployment of the PAMS and $PM_{2.5}$ networks throughout the 1990s and early 2000s.

As EPA moves to finalize this Strategy by early 2007, these funding recommendations will be discussed with SLTs, and the 2007 final Strategy will address these issues based on those discussions.

### 9.3.1 General Funding Issues

One method of being able to accommodate improved monitoring with little additional funding will be to shift from labor-intensive integrated methods toward more technologically challenging continuous systems with enhanced data transmission and access capabilities. Attending this shift will be a short-term need for adequate resources devoted to retraining staff, quality assurance, and data analysis and interpretation.

The early Strategy discussions evoked a concern that any change in the networks, especially a thinning in monitoring sites, would result in a reduction in resources and serious degradation of monitoring agencies. This draft Strategy seeks to allay those concerns by stressing the importance of retaining stable funding as a basic operating principle, and by emphasizing a reallocation of skill mix (from labor to technical) and measurement approaches. Retaining a stable funding base for monitoring agencies and Tribes is of paramount importance among numerous resource concerns. Although many environmental assessment initiatives are based on short duration (1-3 years) efforts, effective ambient monitoring practice requires a longer, stable operation that can capture gradual signal changes in atmospheric concentrations over decades. Those operations must maintain and enhance a substantial infrastructure. Both the cost effectiveness and technical credibility of monitoring operations are compromised if operated in a cyclical ramp up, ramp down mode. As implementation of this Strategy occurs, funding and priority decisions must continuously balance the desire for network responsiveness and flexibility with maintaining the necessary stable operations needed for long-term ambient assessments.

Consistent with these goals and operating principles, the final implementation plan may need to include a variety of funding shifts within the current program structure. These shifts would require consensus building if there is no explicit pool of new resources. The basic shift of moving resources from filter-based methods to continuous and trace gas measurements is relatively straightforward, although it requires a substantial communications and training effort. To a lesser degree, there is a concern about the ability to reach consensus on funding sources for national level quality assurance and data analysis. While the final version of this Strategy scheduled for January 2007 will include details on these issues, the following discusses the general concept of funding for QA and data analysis.

Over the course of deploying the $PM_{2.5}$ network, EPA and states and local agencies reached agreement on utilizing Section 103 STAG funds to support the $PM_{2.5}$ performance evaluation program, the national level quality assurance program enabling EPA to develop estimates of FRM performance. The rationale for using STAG funds was predicated on the understanding that such QA was a required element of the program, and it was more efficient to manage the program nationally through EPA headquarters. Although consensus was reached on this approach, there always remained an underlying philosophical concern regarding whether such national QA should be funded through STAG or other EPA resources. From EPA's perspective, the STAG resources had a track record of stability that is a prerequisite to maintain support for quality assurance efforts; whereas, the availability of EPA internal resources can be volatile, as they are subject to a spectrum of changing priorities. This issue is brought to attention here, as the Strategy is recommending an increase in the portion of STAG resources used to support QA.

In addition to recommending a stable funding source for QA, the Strategy also recommends more explicit designation of STAG funds to support data analysis. This approach follows the model established early in the air toxics monitoring program. The same issues discussed under QA apply here in an attempt to address an important gap in the monitoring programs. The actual data analysis may be performed at the state level by state and local agencies or at a regional/national level. In the latter case, EPA, multistate organizations, and states would establish the mechanisms and resource commitments for allocating STAG funds to the analyses. Assuming consensus is generated to dedicate STAG funds to data analysis, a series of administrative questions remain regarding how such a program is carried out. Possible scenarios include establishing a management team of SLT/EPA members, or charging EPA or a multi-state organization with this task, with the possibility of rotational turns for lead responsibility.

### 9.3.2 Specific Funding Issues

**a. Section 103 versus 105 Funding.** Monitoring operations performed by SLTs are supported by Section 103 and 105 STAG funds. Generally speaking, the use of Section 103 allows for a more efficient tracking of resources, as agencies are not required to match Federal Grants. The sub units within state and local agencies responsible for conducting monitoring tend to favor the Section 103 funds, as they clearly are earmarked to support monitoring activities. Given the overall change implied by the Strategy, it is imperative that a solid base of Section 103 resources serve as a basis for supporting both the stability of monitoring agencies as well as the needed change in monitoring approaches. Consideration should be given to delineating more clearly the outputs and outcomes expected to be achieved with Section 105 resources allotted for monitoring activities to improve accountability.

**b. Training and Guidance.** Training and guidance documents will be required for new types of monitoring instruments, information management technology, and quality assurance techniques. Details of training and guidance development are found in Section 9.4.

**c. $PM_{2.5}$.** Section 103 STAG funds have supported the ongoing operations and maintenance of the $PM_{2.5}$ network. The majority of resources have supported $PM_{2.5}$ FRM measurements and the collection and analysis of chemical speciation data. The principal objectives of the FRM measurements and speciation data have been to support designations of attainment/nonattainment areas, and the development of national emission reduction strategies and SIPs. In large measure, these objectives have been attained as the Agency has made designations based on the FRM data collected from 2001 through 2003 (in some cases, 2002-2004), and has completed most of the technical analyses supporting major national programs such as CAIR. The SIP technical analyses will be based on the 2000-2002 time frame, attendant with the base emission inventory and air quality modeling analyses supporting attainment demonstrations.

As we move beyond this intensive period of analysis focusing on the current state of the environment, the networks need be more supportive of a longer range vision. The focus of the networks should evolve toward characterizing the air quality impacts of national air quality related programs and SIPs (i.e., measuring accountability), providing an infrastructure for public health advisories (AQI through AIRNow), and supporting health effects and exposure studies that feed into periodic evaluation of health standards. Accordingly, resources need to be shifted to assess the progress of implementation plans to ensure that the billions of dollars in resources required to reduce $PM_{2.5}$ levels are reaping observable benefits. And, in the event progress is not being achieved as planned, the networks must be able to support restructuring or "mid course" corrections over the next ten to twenty years.

Consequently, the funding base needs to be reconfigured consistent with that design, which will lead to divesting in areas of the current $PM_{2.5}$ monitoring system that have served their current primary objective. EPA's implementation approach will be to shift FRM and speciation program resources to continuous and multipollutant measurement systems. This proposed resource shift should address most resource requirements to reconfigure the SLAMS/NAMS networks. The current resources would be redirected to:

- add more continuous $PM_{2.5}$ monitors;

- support the NCore multipollutant sites;

- enhance the IT infrastructure in the networks and the capital expenditures for hardware and site improvements to accommodate additional samplers and NCore sites; and

- support training and QA needs arising from modification of network operations.

Note that, as of December 2005, EPA is proposing to revise the $PM_{2.5}$ NAAQS. If that proposal is finalized (a final decision is scheduled for September 2006), EPA would have to reconsider the divestment and change in direction for $PM_{2.5}$ monitoring.

**d. $PM_{10-2.5}$ monitoring.** EPA will be proposing new PM air quality standards that will include requirements to measure coarse particulate matter [$PM_{10-2.5}$]. The Agency expects that new continuous technologies will be used to measure $PM_{10-2.5}$ with attendant capital, operational, and training expenses. The bulk of new requested resources should be directed at initial equipment purchase and training. Divestment in operator time for related programs such as $PM_{10}$ should provide an available workforce for $PM_{10-2.5}$ monitoring. EPA anticipates that the projected sum of $PM_{10-2.5}$ and remaining $PM_{10}$ sampling costs will be equal to or less than the current $PM_{10}$ operational load. There will be recurring non-salaried costs for equipment repairs/upgrades and laboratory expenses for chemical speciation.

**e. Research-grade sites.** The CASAC NAMS Subcommittee and SLTs have advocated the need for high grade, research level sites to improve our ability to adopt advanced technologies and interface more effectively with the research community at a practical applications level. The STAG resources must remain within the SLT entities to provide the stable workforce for meeting monitoring needs. Less clear is a resource approach to fund these research sites, which are needed to provide the technology interface with advanced technologies and the research community. While some capable SLTs will operate sites that may closely resemble the research sites EPA envisions (e.g., the MANE-VU rural sites), the research program ideally would provide resources to academic institutions and firms that are leaders in methods development and associated leaders in analysis of data.

**f. PAMS.** PAMS requirements have been scaled down to allow for more specific special studies of interest by local area/region. There has been a wealth of data collected from the PAMS program, but analysis and interpretation of the data in some cases has been less frequent and systematic than EPA believes is appropriate. To address this gap and yield value from the PAMS databases, EPA has already proposed to set aside some of the PAMS-related funds to conduct data analysis. Ideally, this funding should be combined with additional data analysis resources set aside for air toxics and $PM_{2.5}$. EPA will be discussing this proposal with SLTs in more detail, for possible implementation in FY 2007 or later. A steering group of SLTs and EPA participants could establish a plan for this analysis that can include an allocation of these resources to SLTs or to other analytical groups.

**g. CASTNET.** While CASTNET provides an excellent framework to support EPA's overall national strategy, a number of technological and measurement upgrades would allow for CASTNET to provide greater benefits nationally. EPA has directed a one-time $3.5 million investment of FY 2006 STAG funds into CASTNET.

## 9.4 Guidance, Training, and Pilot Efforts

Implementation of this Strategy will require guidance and training for state and local agency staff. The primary areas for these outreach efforts will be to assist with new measurement methods, new QA and data analysis approaches, and pilot projects to support network deployment activities.

### 9.4.1 New Measurement, QA, and Data Analysis Technologies

The transition to the new network framework -- including expanded use of continuous monitors, new QA requirements, and new information technology to support data collection and analysis -- creates a significant need for training existing SLT staff. Areas where some type of training or a transfer of information on the Strategy will be useful include:

- **Programmatic Issues**
  - -- Monitoring Strategy - Overall concepts
  - -- Network Development/Assessment
- **Technical Issues**
  - -- Methods Implementation
  - -- Information Technology
  - -- QA

The majority of the resources allocated to training and guidance will be directed towards the technical areas. These areas lend themselves to the following variety of training mechanisms:

- **Satellite Broadcasts and Videos (DVDs)** - This can provide broad to semi-detailed information about a topic and is used to provide an initial exposure to the area, concepts and rationale for the direction or procedure, time line for implementation, and where one would get more detailed information and training. These formal presentations of the topic areas may be developed on DVD and distributed through the OAQPS Education Outreach Group.
- **Hands-on Sessions** - Formal detailed instruction on a particular area.
- **Guidance Documents** - Written guidance providing the necessary detail for an area when possible and generic guidance and suggestions when more than one alternative exits.
- **Vendor** - Training that particular vendors of instrumentation or information technology systems would provide.
- **Web-based training** - Training developed through software that can be posted on the internet.

- **Workshops** - National, Regional or local workshops where various training activities could be presented.

Table 9-5 provides the training mechanisms that can be developed for the programmatic and technical areas. Specific decisions on which training efforts will be undertaken will depend on SLT input and available EPA staff and budget resources.

**Table 9-5**
**Training Mechanisms**

| Area | Training Mechanisms | | | | | |
|---|---|---|---|---|---|---|
| | Satellite Broadcasts | Hands - On | Guidance Documents | Vendor | Web Based | Workshops |
| Monitoring Strategy | ✔ | | | | | ✔ |
| Network Development/Assessment | ✔ | | ✔ | | | ✔ |
| Methods | ✔ | ✔ | ✔ | ✔ | | ✔ |
| Information Technology | ✔ | ✔* | ✔ | ✔ | | ✔ |
| QA | ✔ | ✔* | ✔ | | ✔ | ✔ |

* Information technology and QA training would be incorporated as needed in methods hands-on training activities.

EPA has already distributed a technical assistance document on the precursor gas monitors that will be part of NCore multipollutant sites. (See Technical Assistance Document (TAD) for Precursor Gas Measurements in the NCore Multipollutant Monitoring Network. Version 4. U.S. Environmental Protection Agency. EPA-454/R-05-003. September 2005. Available at: http://www.epa.gov/ttn/amtic/pretecdoc.html.) EPA also has conducted three training workshops on these monitors. Additional guidance will be developed and provided on some other types of monitors with which many SLT staff are currently unfamiliar, and on network design, site selection, quality assurance, and other topics. While Tribes are not subject to the requirements of the proposed monitoring amendments, these technical resources will also be available to them directly from EPA and via grantees, such as the Institute for Tribal Environmental Professionals and the Tribal Air Monitoring Support Center.

### 9.4.2 Network Deployment

Deployment of a full NCore multipollutant network will be phased in over a multi-year period, preceded by pilot programs to develop practical experience and knowledge of issues. Three pilot programs were initiated in 2003:

- **Internal EPA-RTP methods facility**. As described above, EPA maintains a monitoring platform for training and to gain experience with various technologies. Currently, this in-house facility is focused on trace gas methods and associated operational and quality assurance issues.

- **Joint OAQPS-OAP CASTNET pilot study**. EPA OAQPS and Office of Atmospheric Program (OAP) staff are funding a pilot study at three CASTNET sites to explore new continuous technologies that would complement the existing filter pack techniques and to leverage the CASTNET infrastructure to establish rural NCore sites. In addition to testing continuous ion chromatography instrumentation for major aerosol ions, these sites will be outfitted with NCore trace gas monitors.

- **NATTS**. The NATTS will be adding trace level CO instruments at four locations to assess the use of CO as potential surrogate for mobile source hazardous air pollutants. Most of the NATTS will be NCore sites and eventually include CO measurements. These four sites are being treated as a pilot program to investigate both methodological issues and the ability to use CO as a surrogate for other measurements. The use of continuous CO data is attractive from a temporal perspective, as virtually all air toxics measurements are conducted through integrated techniques.

In addition to these pilot programs, there exist a handful of other studies being conducted by state and local agencies that will contribute to the knowledge base for addressing issues associated with trace gas measurements. The lessons learned from these pilot efforts can be communicated to SLTs and EPA staff as they move forward with NCore site network deployment.

## 9.5 Integration of Research Programs into this Strategy

The key element to implementing federal research monitoring efforts as part of this Strategy will be to coordinate those efforts with a small set (3-6 sites) of national network research monitoring sites. These national, research-grade sites would include the most comprehensive list of routine measurements (i.e., the most complete NCore multipollutant site with PAMS, PM speciation, and air toxics trends), research level measurements with potential for routine application (e.g., PM size distribution, continuous nitric acid and ammonia, and true $NO_2$), and additional measurements dependent on area specific priorities, available expertise, and resources. These sites would serve three needs: (1) a comprehensive suite of measurements providing the most insightful of all routine air monitoring networks; (2) a technology transfer mechanism to test emerging methods at a few locations with disparate conditions that eventually would find more mainstream application;[5] and (3) addressing a specific monitoring objective, such as providing a continental U.S. background or international trans-boundary transport site, or supporting ambient methods testing.

For implementation purposes, this Strategy calls for establishing three sites initially that focus on methods and technology transfer in different regions of the United States. These sites should be in locations that serve a critical spatial need, such as characterizing inflow or outflow of transcontinental transport, a true background location within the continental United States, or a major intra-continental transport location (note, however, that the NCore multipollutant sites may be more appropriate in addressing transport). Candidate locations include previously used PM Supersites and other well developed platforms capable of accommodating a large footprint for instruments, with adequate power and security, such as collocation at an agency-operated NCore site. Consideration should be given to developing a rural-based master site, to ensure that technologies tested today can meet future conditions as concentration levels continue to decline.

These research sites need not be considered as only fixed sites operating indefinitely at the same location. A small network of research sites should be instituted as a base component with stable funding for an indefinite period, recognizing the importance of the dynamic interaction between research grade and routine monitoring networks. However, it may be more prudent to view these sites as having a short-term or even a mobile role where, for example, dedicated, intensive measurements are conducted for a 1-3 year period in a particular location and perhaps rotated to another location with a built-in period assessment prior to each new deployment. Such an approach would be compatible with the joint NOAA-EPA proposed urban collaboration efforts that seek to conduct intensive studies linking sources to human welfare effects. This short-term siting approach is possible, because, unlike NCore multipollutant sites, these sites are not established to document long-term trends or provide long-term program accountability.

There is a clear need for these research sites to support a dedicated testing program. Over the last ten years, EPA has decreased its level of methods development and testing. Methods testing now is conducted through a rather loose collection of state sponsored trials (especially California's Air Resources Board), vendor sponsored initiatives, and miscellaneous research grants and agreements to universities (e.g., PM Supersites and health centers). These efforts have been combined with a skeleton level of internal EPA testing. The Supersites program has fulfilled some of the technology transfer needs, but it was designed to be a short duration program focused primarily on a broad array of particle characterization issues in addition to technology testing.

The new research sites would be one component to address this national level weakness. State agencies cannot continue to be burdened with being "trial" testers of new methods. More importantly, it is critical not to miss the benefits of greatly enhanced data value that emerging technologies present.

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[5] True nitrogen dioxide measurements should be part of routine operations; however, field testing and demonstration efforts must precede application in routine networks. Consideration for routine applications should be given to other measurements such as continuous ammonia, nitric acid, and particle size distributions.

As EPA and SLTs move forward with initial deployment of these research-grade sites, EPA needs to incorporate the knowledge and perspective of others engaged in research monitoring initiatives. For example, EPA's Office of Transportation and Air Quality has identified monitoring near roadways as one of the key urban air challenges. Over the next year, EPA intends to assess these issues further and develop an implementation plan for moving toward integration of monitoring near roadways with the core NAAQS urban air monitoring networks.

One issue EPA faces in the research monitoring area is that there is no assurance that resources will be available to support advanced monitoring sites that provide a necessary technology transfer mechanism across the research and applications communities. These sites begin to address a major weakness inherent in the national networks, which is the ability to capture adequate environmental measurements relevant to many evolving demands for air programs. Coordinating near roadway monitoring presents another key opportunity. However, resources for these measurements should not be extracted from the existing STAG resource pool because of the need for stable funding to state and local agencies and Tribes. In that regard, it may be best to site these stations at an NCore multipollutant site and operate the research station on a cooperative basis. In such situations, the NCore multipollutant site responsibilities would be assumed by a host agency, and the augmented monitoring to comprise a research-grade site stature would be assumed by the entity (e.g., EPA or an EPA contractor) responsible for that specific monitoring. Clearly, for such an arrangement to occur, there would need to be ample space, power, and security to accommodate both monitoring functions.

## 9.6 Ongoing Implementation of Major Federal Networks

One priority of this Strategy is to maintain major federal networks, such as CASTNET, NADP, IMPROVE, and RadNet. In addition to a commitment to maintain those programs, both CASTNET and RadNet have specific improvements that EPA intends to implement over the short-term.

### 9.6.1 General Implementation Plan for CASTNET Improvements and Opportunities

Except for RadNet, CASTNET is the only routinely operating air monitoring network directly managed by EPA headquarters. CASTNET was designed to assess deposition impacts associated with major power production facilities located in the midwestern and eastern portions of the U.S. CASTNET is a model network that successfully tracks national air quality program progress in the rural Eastern United States, where siting conditions are relatively free of urban "noise" that can compromise trends analyses. CASTNET has been expanded over time to include about 30 sites in the western U.S. In addition, CASTNET provides a more science-oriented approach than some networks, and has taken important strides toward integrating with other science based networks, including AIRMoN, NADP, and IMPROVE.

To take full advantage of CASTNET, EPA is committed to developing further specific methods of integrating it with the other national networks (see Section 9.1). In addition, the EPA intends that the following specific implementation action steps occur under this Strategy:

- A subset of CASTNET sites should be assigned NCore multipollutant status to address gaps in rural multipollutant monitoring stations.

- A subset of CASTNET sites should be elevated to serve as a test bed of special studies that evaluate emerging technologies that have potential for routine use in network operations, thus meeting some research site objectives. The focus of such technologies would be on those measurements (e.g., ammonia, nitric acid, major aerosol ions, and trace gases) that support accountability and model evaluation analyses. This aspect is especially important, as the desire to accommodate new technologies must be achieved carefully and in balance with historical techniques so as to maintain a credible record of pollutant trends that reflects shifts in atmospheric conditions and not in technologies. In this area, CASTNET already has embarked on determining the feasibility of a semi-continuous (hourly) multi-pollutant monitoring system as next generation monitoring instrumentation to perhaps move beyond the current integrated filter-based methodology. The pilot systems are capable of measuring both gaseous and particle ($SO_2$, $NH_3$, $HNO_3$, $NH_4$, $SO_4$, $NO_3$, and major base cations) constituents with on-line Ion Chromatography analysis.

- The existing contacts and user groups associated with CASTNET should be utilized as a larger integrating vehicle that promotes greater communication and coordination across networks focused on ecosystem and public welfare. The NADP-CASTNET sponsored workshop on ammonia (Washington, D.C., October 2003) provides an example of bringing together those responsible for managing ecosystem-based and public exposure networks.

### 9.6.2 RadNet Implementation Status and Plan

The RadNet project currently is in the early implementation phase. Table 4-5 reflects major milestones accomplished and status of work in progress as of October 2005.

**Table 9-6**
**Milestones Accomplished and Status of RadNet Air Monitoring Project**

| Item | Comment |
|---|---|
| Fixed monitor acquisition | Contract let; prototype received, tested, and installed in Montgomery |
| National siting of fixed monitors | 60 most populated cities—15 locations ready to receive; 20 locations with operator, but site improvements needed |
| Local siting of fixed monitors | Local siting criteria established |
| Deployable monitor acquisition | 40 deployable monitors built and delivered to ORIA laboratories in August 2005 (20 to Montgomery, 20 to Las Vegas) |
| SOPs for monitor operation | Identified and being developed/drafted |

(cont.)

**Table 9-6**
**Milestones Accomplished and Status of RadNet Air Monitoring Project (cont.)**

| Item | Comment |
|---|---|
| Quality Assurance Project Plans | Developed for both fixed and deployable monitors |
| Data repository for receiving and storing real-time data | Established at NAREL; OEI approved IT security plan for RadNet system |
| Status of original RadNet non-real-time monitoring stations | All remain in operation, but some will be replaced by new equipment in priority order |

Although equipment for the fixed and deployable monitors has been purchased, relationships with potential station operator groups are fairly well established for the first purchase batch, and the information technology infrastructure is in place for handling real-time data, the following implementation areas will require careful attention as the project moves forward:

- National sampling/siting plan.
- Logistics for emergency distribution and operation of deployable monitors.
- Best protocols for distribution/dissemination of verified RadNet data during emergencies.

The effective placement of approximately 180 fixed monitors that provide near-real-time ambient air radiation data across the United States by Fiscal Year 2012 requires that the working approach for siting address major population areas, geographical coverage, and the concerns of partners (states and regions).

The logistics for rapidly and effectively distributing deployable stations during an emergency can be daunting. Ideally, the stations (as many as 40) should be in place and transmitting data within two days of the beginning of a major nuclear or radiological event. Given the realities of not knowing where an event might occur, delivery by someone other than EPA personnel, i.e., commercial carrier, is likely to add problems and delays. In addition, securing appropriate operators/set-up and maintenance staff quickly, in the two-day window for delivery, is another obvious area of potential difficulty and delay. Answering these questions is and will remain high on the project team's agenda. The exercises that are planned to test the RadNet air network are expected to help address and suggest solutions for the logistics issues.

Finally, protocols and practices for data dissemination during an emergency will require ongoing work. Even though the ultimate control of radiation emergency data will reside with the Department of Homeland Security or the coordinating agency (see the Nuclear Rad Annex to the *Homeland Security National Response Plan*), the ways in which this data will be communicated and the development of protocols to accomplish that are likely to develop and change as exercises and new knowledge are acquired in the future.

## 9.7 Information Technology Implementation Plans

EPA is addressing these issues with a variety of approaches emerging from a long range "Data Warehouse" OAQPS planning effort as well inter office collaboration with the Office of Environmental Information (OEI). EPA is in the process of conducting several pilot projects to gauge the usefulness of new data products and access methods over the short-term planning horizon (1-5 years). These projects are discussed in Section 2.5.4. The implementation plan for these activities is to continue to explore pilots and plan possible upgrades. In the 2007 final Strategy document, EPA anticipates including more specific milestones in this area.

In addition, EPA is at the early scoping stages for evaluating which data analysis commitments and objectives ought to be minimum elements of this Strategy. There are a number of examples of data analysis capacity building EPA wants to promote through this Strategy, and the 2007 Final Strategy will include more details on the plan for implementing this capacity building. The general types of analysis include:

***(i) Regular analysis for status and trends of criteria and air toxics air quality***. The large amount of data being collected in the monitoring networks, along with important supplementary data (e.g., meteorological, remote sensing, and QA data), will allow air program managers to adjust ongoing activities/decisions and explore new aspects of air pollution as they occur. For these data to be useful for managers, they must be analyzed on a regular basis for a complete set of measures, including detailed characterizations and specific progress or trend measures. In parallel, and perhaps more importantly, a "tool set" to facilitate analysis should be developed to deliver data on annual, seasonal, near-term, and real-time bases appropriately for various air pollutants across various spatial domains. The products would be based on a variety of techniques, from simple temporal trends to complex spatial interpolation, and would be useful at the national, regional, state, and local levels. This approach would develop, for the entire air program, a set of analytical products analogous to those developed for the visibility program (e.g., VIEWS website *http://vista.cira.colostate.edu/views/* developed under the Regional Planning Organizations). A "dashboard" website would be needed for viewing regular updates and access to useable products; thus the need for automation of the basic tool set. In addition to the basic tool set, this approach would expand the tool set to new tools, as special studies produce operational techniques, and would work to identify unusual air quality events to study or address in the context of public health tracking.

***(ii) Special studies on technical and policy relevant topics***. Monitoring and air quality data (technical and analytical) uncertainties and limitations may affect policy decisions. These topics should be investigated through special studies that rely on ambient monitoring data. These studies would include a number of topics. An assessment of major programs (and their effectiveness), such as the $NO_x$ SIP call, the 2005 Clean Air Interstate Rule, and other various approaches to reduce ozone concentrations, would be undertaken to provide insights into these programs, with the potential to adjust those programs periodically. An investigation of multiple pollutants affected by independent control program elements (PM, ozone, air toxics) would advance the ability to "co-control" pollutants and avoid shifting air quality problems across programs (e.g., increasing air toxic emissions in response to VOC controls). A thorough study of "exceptional" and "natural" events is needed to provide a factual basis for the proper exclusion of data from program decisions. Along these lines, source attribution studies would be undertaken to inform regional and specific issue decisions. In addition, studies to evaluate the quality and uncertainties associated with collected data and special characterization of monitoring sites would be undertaken, and the collective information would provide a dynamic feedback into network design.

***(iii) Building air quality data analysis tools and capacity***. Broadening the capacity for analyzing air quality data facilitates greater engagement, and adds analytical and quality assurance power to the entire network measurement and design process. With expanding detail in monitoring data and the need to understand air quality issues better, analytical tools have become complicated and complex to use. Techniques such as back trajectory; source apportionment; and assimilation of satellite, monitoring, and monitoring data have great potential to advance the ability to understand the progress of the Nation's efforts to address air quality problems. Guidance is needed for a range of applications including network assessments and design, emissions inventory and model evaluation, conceptual model building (e.g., genesis and attributes of air quality problems), and observational models (source attribution and emissions strategy tools), as well as a spectrum of more direct regulatory problems. As special studies are completed by EPA, SLT, and regional analysts, there will be a need to develop new operational tools for the analytical techniques developed within the study. Accordingly, "how-to" instructions to aid in the use of existing and new tools would be developed and distributed. Specific special tools would be developed, evaluated and otherwise made available, as the need arises, to provide the analytical capacity needed to implement air programs. Efforts to bring knowledge developed within the research communities to practicing analysts would be undertaken. For example, an annual conference and a virtual homepage for the Nation's air quality data analysts could be developed to facilitate communication among analysts for expanded understanding of tools and exchange of ideas on monitoring and data analysis topics.

# Appendix A: Acronyms and Terms

**AIRS** – Aerometric Information Retrieval System
**AIRMoN** – Atmospheric Integrated Research Monitoring Network
**ALAPCO** – Association of Local Air Pollution Control Officials
**AMTIC** – Air Monitoring Technology Information Center
**APTI** – Air Pollution Training Institute
**AQI** – Air Quality Index
**AQS** – Air Quality (data) System
**ARM** – Approved Regional Method
**BAM** – Beta Attenuation Monitor
**CAA** – (Federal) Clean Air Act
**CAC** – Correlating Acceptable Continuous (monitor)
**CAIR** – Clean Air Interstate Rule
**CASAC** – Clean Air Science Advisory Committee
**CASTNET** – Clean Air Status and Trends Network
**CBSA** – Core Based Statistical Area
**CENR** – Committee for Environment and Natural Resources
**CEU** – Continuing Education Unit
**CFR** – Code of Federal Regulations
**CMAQ** – Community Model Air Quality (system)
**CO** – Carbon Monoxide
**CRPAQS** – Central Valley (California) Regional Particulate Air Quality Study
**CV** – Coefficient of Variance
**CY** – Calendar Year
**DC** – Direct Current
**DHS** – Department of Homeland Security
**DMC** – Data Management Center
**DOE** – Department of Energy
**DOI** – Department of Interior
**DQA** – Data Quality Assessment
**DQI** – Data Quality Indicator
**DQO** – Data Quality Objectives
**EC** – Elemental Carbon
**EPA** – Environmental Protection Agency
**ESAT** – Environmental Services Assistance Team
**FEM** – Federal Equivalent Method
**FLM** – Federal Land Manager
**FRM** – Federal Reference Method
**FY** – Fiscal Year
**GAO** – General Accounting Office
**GC** – Gas Chromatograph
**GIS** – Geographical Information System
**HAP** – Hazardous Air Pollutants
**HEI** – Health Effects Institute
**IACET** – International Association for Continuing Education and Training
**IADN** – Interagency Deposition Network
**IC** – Ion Chromatography
**IMPROVE** – Interagency Monitoring of Protected Visual Environments
**ITEP** – Institute of Tribal Environmental Professionals
**ITT** – Information Transfer Technology
**K** – thousand
**M** – million
**MANE-VU** – Mid-Atlantic/Northeast Visibility Union
**MDN** – Mercury Deposition Network
**NAAMS** – National Ambient Air Monitoring System
**NADP** – National Atmospheric Deposition Program
**NAAQS** – National Ambient Air Quality Standards
**NAMS** – National Air Monitoring Stations
**NAPAP** – National Acid Precipitation Assessment Program
**NARSTO** – North American Research Strategy for Tropospheric Ozone
**NAS** – National Academy of Science
**NASA** – National Aeronautics and Space Agency
**NATTS** – National Air Toxics Trends Stations
**NAU** – Northern Arizona University
**NCore** – The National Core Monitoring Network
**NMHC** – Non-Methane Hydrocarbons
**NMSC** – National Monitoring Strategy (or Steering) Committee
**NO** – Nitric Oxide
**$NO_2$** – Nitrogen Dioxide
**NOAA** – National Oceanic and Atmospheric Administration
**$NO_x$** – Oxides of Nitrogen
**$NO_y$** – Reactive Nitrogen Compounds
**NPEP** – National Performance Evaluation Program
**NPS** – National Parks Service
**NTN** – National Trends Network
**$O_3$** – Ozone
**OAP** – Office of Atmospheric Programs
**OAQPS** – Office of Air Quality Planning and Standards
**OC** – Organic Carbon
**OEI** – Office of Environmental Information
**ORD** – Office of Research and Development
**ORIA** – Office of Radiation and Indoor Air
**PAMS** – Photochemical Assessment Measurement Stations
**Pb** – Lead
**PBT** – Persistent Bioaccumulative Toxics
**PBMS** – Performance Based Measurement System

**PE** – Performance Evaluation
**PEP** – Performance Evaluation Program
**PM** – Particulate Matter
**$PM_{10}$** – Particulate Matter with aerodynamic diameter less than 10 micrometers
**$PM_{2.5}$** – Particulate Matter with aerodynamic diameter less than 2.5 micrometers
**$PM_{10-2.5}$** – PM10 minus PM2.5
**POP** – Persistent Organic pollutants
**ppb** – parts per billion
**PSD** – Prevention of Significant Deterioration
**QA** – Quality Assurance
**QAPP** – Quality Assurance Program Plan
**QC** – Quality Control
**QMP** – Quality Management Plan
**RADM** – Regional Acid Deposition Model
**REM** – Regional Equivalent Monitor
**RO** – EPA Regional Office
**ROM** – Regional Oxidant Model
**RPO** – Regional Planning Organization
**RTP** – Research Triangle Park (North Carolina)
**S & T** – Science and Technology
**SAMWG** – Standing Air Monitoring Working Group
**SIP** – State Implementation Plan
**SLAMS** – State and Local Air Monitoring Stations
**SLTs** – State and Local Agencies and Tribes
**$SO_2$** – Sulfur Dioxide
**SOP** – Standard Operating Procedure
**SPM** – Special Purpose Monitor
**SRP** – Standard Reference Photometer
**SS** – Supersite
**STAG** – State and Tribal Air Grant
**STAPPA** – State and Territorial Air Pollution Program Administrators
**STN** – Speciation Trend Network
**Strategy** – The National Air Monitoring Strategy
**SVOC** – Semi-Volatile Organic Compound
**TAMS** – Tribal Air Monitoring Support (Center)
**TAR** – Tribal Authority Rule
**TBD** – To Be Determined
**TEOM** – Tapered Element Oscillation Monitor
**TIP** – Tribal Implementation Plan
**TNMOC** – Total Non-Methane Organic Compound
**TSA** – Technical Systems Audits
**TSP** – Total Suspended Particulates
**USB** – Universal Serial Bus
**VOC** – Volatile Organic Compound
**XML** – Extensible Markup Language

# Appendix B: 2000 and 2003 Network Assessments

## A. FY 2000 National Assessment

An example national assessment of the criteria pollutant networks was conducted in 2000 to catalyze subsequent regional level assessments. This assessment considered concentration level, site representation of area and population, and error uncertainty created by site removal as weighting parameters used to determine relative "value" of individual sites. The most widely applied factor inherent in most assessment approaches is related to site redundancy and can be estimated in a variety of ways. The national assessment calculated error uncertainty by modeling (i.e., interpolating between measurement sites) surface concentrations with and without a specific monitor with the difference reflecting uncertainty (Figure B-1). Areas of low uncertainty (e.g., less than 5 ppb error difference for ozone) suggest that removal of a monitor would not compromise the ability to estimate air quality in the region of that monitor as nearby stations would provide adequate acceptable predictions.

The assessment approach was expanded to include additional weighting factors beyond error. Typical outputs for ozone networks (Figure B-2) suggest that ozone sites clustered in urban areas yield less powerful information than sites located in sparsely monitored areas, especially in high growth regions like the southeast. However, this conclusion is more applicable to urban areas with more homogeneous conditions. This methodology was applied to all criteria pollutants with a variety of weighting schemes to provide a resource for more detailed regionalized assessments.

The key findings of the national network assessment were as follows:

- **Investment Needs**: New monitoring efforts are needed to support new air quality challenges, including monitoring for air toxics and new technology for criteria pollutants and precursor species. Air toxics have emerged as a top public health concern in many parts of the country, and a national air toxics monitoring network is currently under development under special funding for air toxics monitoring. New technology, especially continuous measurement methods for pollutants, such as fine particles, are needed to provide more complete, reliable, and timely air quality information, and to relieve the burden of manual sampling. Resources and guidance are needed for this activity.

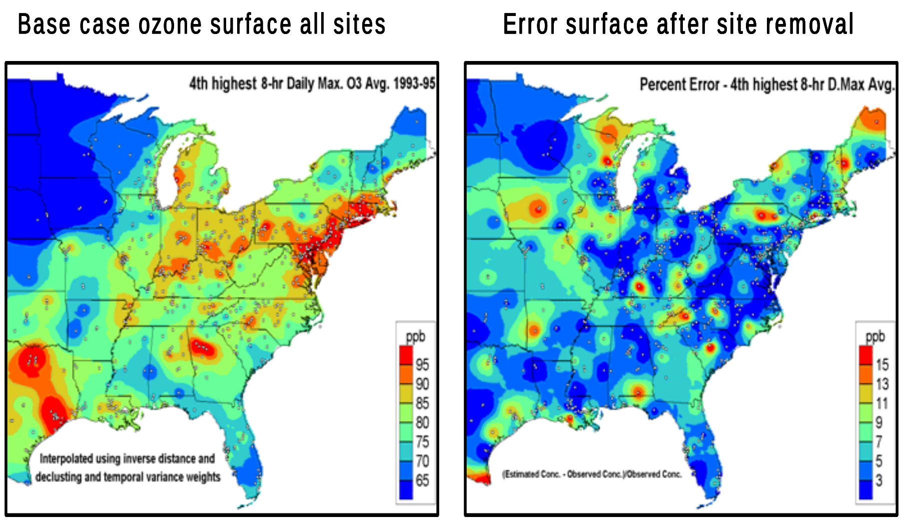


**Figure B-1:** Surface depiction of estimated absolute errors (right) in ozone concentrations produced by removing existing monitors on a site by site basis, relative to base case (left). Areas showing low errors (<5 ppb) suggest neighboring monitors could accurately predict ozone in area of a removed site. Areas of high error suggest necessity to retain existing monitors and perhaps increase monitoring.

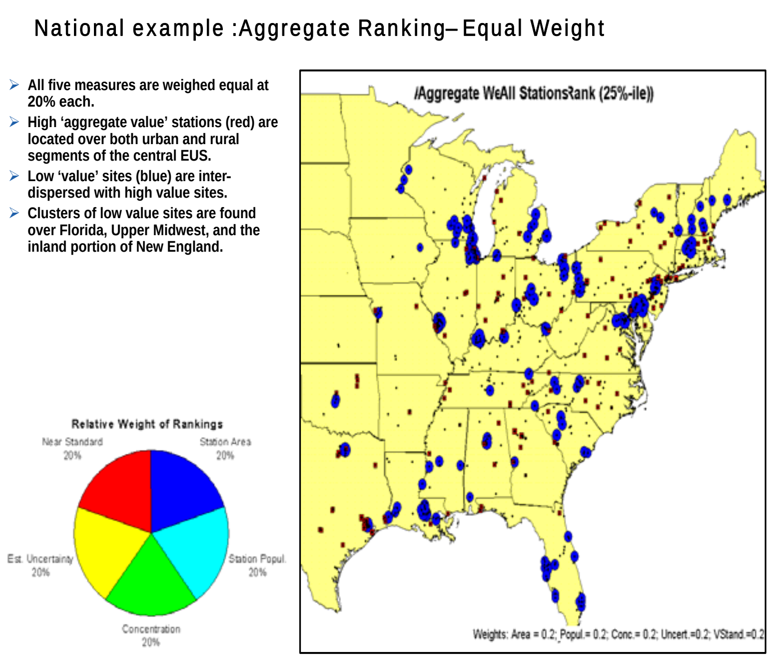


**Figure B-2:** Aggregate assessment of 5 evenly weighted factors. Blue circles and red squares indicate the lowest and highest valued sites, respectively

- **Divestment Opportunities**: To make more efficient use of existing monitoring resources and to help pay for (and justify additional resources) the new monitoring initiatives noted above, opportunities exist to reduce existing monitors. Two areas of potential divestment are suggested. First, many historical criteria pollutant monitoring networks have achieved their objective and demonstrate that there are no national (and, in most cases, regional) air quality problems for certain pollutants, including $PM_{10}$, $SO_2$, $NO_2$, CO and Pb. A substantial reduction in the number of monitors for these pollutants should be considered. (However, considerations need to be made to retain a certain number of trace level monitors especially for $SO_2$ and CO because of their utility as tracers for certain sources of emissions.) As part of this adjustment, it may be desirable to relocate some of these sites to rural areas to provide regional air quality data. Second, there are many monitoring sites with only one (or a few) pollutants. To the extent possible, sites should be combined to form multi-pollutant monitoring stations. Any resource savings from such divestments must remain in the monitoring program for identified investment needs. A reasonable period of time is required to smoothly transition from established to new monitoring activities.

- **Importance of Regional Input**: National analyses provide broad directional information about potential network changes. Regional/local analyses are a critical complement to the national analyses, and are necessary to develop specific monitoring site recommendations. To this end, EPA must allow States and regional organizations sufficient time (e.g., at least six months) to conduct adequate regional/local analyses.

A copy of the FY 2000 national assessment can be found on the web at: www.epa.gov/ttn/amtic/netamap.

### B. FY 2003 Regional Assessments

Each of the 10 EPA ROs was tasked with performing a regional network assessment in conjunction with its SLT partners. Although a framework was suggested, each RO undertook the assessment process differently, ranging from complex statistical functions to subjective site-by-site considerations. Some ROs have gone through the process of approving SLT network changes, while other ROs are awaiting finalization of the network assessment process before approving changes. This lack of consistency points strongly to the need for network assessment guidance. Such guidance was deemed to be important by the CASAC Subcommittee on Monitoring at its July 2003 meeting. Because the regional assessment process is so far along at this point, there will not be a guidance structure in place for this initial round of assessments; however, a guidance document is now being developed which will help provide national consistency for subsequent assessments.

Though not necessarily final, the following summary of recommended network changes is intended to show the progress made by each of the Regional Offices:

| | | |
|---|---|---|
| **Region 1:** | Reductions: | $PM_{10}$ FRM monitors, CO, and $SO_2$ |
| | Additions: | $PM_{2.5}$ continuous monitors and air toxic monitoring |
| | Modifications: | $PM_{2.5}$ FRMs to support PM-coarse monitoring |
| | Approach: | Site-by-site situational analysis |
| **Region 2:** | Reductions: | $PM_{10}$ and CO |
| | Additions: | $PM_{2.5}$ continuous monitors |
| | Approach: | Site-by-site situational analysis |
| **Region 3:** | Reductions: | $SO_2$, $NO_2$, CO, Pb, and $PM_{10}$ |
| | Additions: | Yet to be determined |
| | Approach: | Optimum network design function using 6 design considerations |
| **Region 4:** | Reductions: | CO, $PM_{10}$, $NO_2$, lead, and $SO_2$ |
| | Additions: | Yet to be determined |
| | Approach: | Statistical spatial analyses with considerations for population exposure, a real extent of violations, and sensitivity analyses |
| **Region 5:** | Reductions: | Ozone, CO, $PM_{10}$, $PM_{2.5}$, lead, CO, $SO_2$, and $NO_2$ |
| | Additions: | Yet to be determined |
| | Approach: | Statistical analyses for identifying high/low value sites; use of positive matrix factorization |
| **Region 6:** | Reductions: | $PM_{10}$, $PM_{2.5}$, CO, $SO_2$, $NO_x$, lead, and ozone |
| | Additions: | Continuous $PM_{2.5}$, $NO_y$, and ozone |
| | Relocations: | $PM_{2.5}$ FRM, $SO_2$, $PM_{10}$ FRM sites |
| | Approach: | State-by-state changes in consultation with each state |
| **Region 7:** | Reductions: | Pb, $PM_{10}$, CO, and $PM_{2.5}$ |
| | Additions: | 8 hour ozone sites, further additions considered |
| | Relocations: | 1 hour ozone sites |
| | Approach: | Statistical approach and consultation with State/Local agencies |
| **Region 8:** | Reductions: | Yet to be determined |
| | Additions: | Yet to be determined |
| | Approach: | Paired correlation rankings; comparisons to NAAQS; input and feedback from individual states |

| | | |
|---|---|---|
| **Region 9:** | Reductions: | Yet to be determined |
| | Additions: | Yet to be determined |
| | Approach: | Statistical process similar to national assessment |
| **Region 10:** | Reductions: | $PM_{10}$ and $PM_{2.5}$ FRM monitors, CO, and $NO_2$ |
| | Additions: | Continuous $PM_{2.5}$ monitors |
| | Approach: | Correlation analyses; NAAQS comparisons; NCore design criteria |

It should be noted that the above summary represents work-in-progress, but is intended to provide a sense of the progress and types of approaches being taken by the various EPA Regions.