Chapter 10

National Ambient Air Monitoring Programs

Introduction

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. As depicted in Figure 10-1, 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 non-criteria 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.

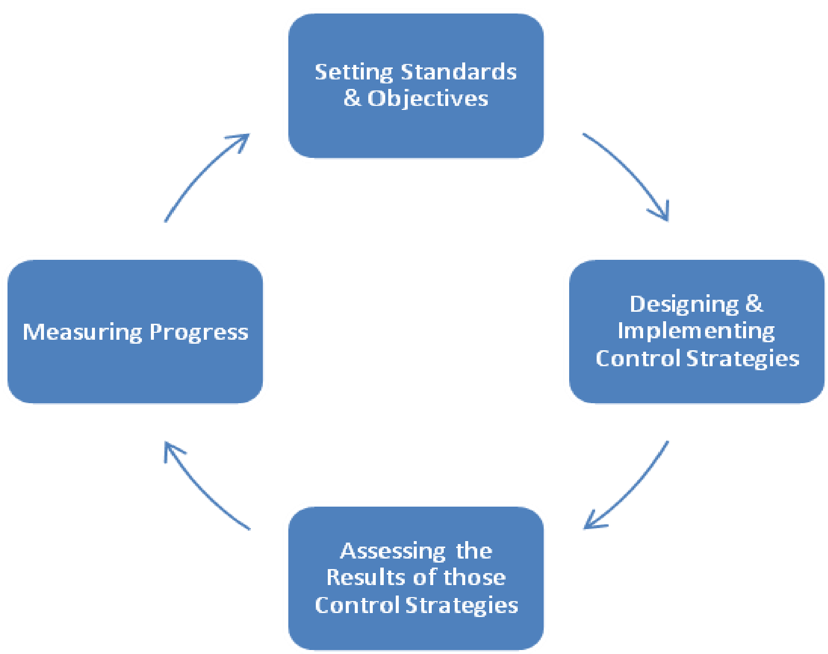

Figure 10-1. Process of associated with assessing an air quality management program.

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.

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.

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 the recently adopted (2006) National Ambient Air Monitoring Strategy (NAAMS) 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.

Overview of Ambient Air Monitoring

NAAQS Monitoring

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. 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 10-2). 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.

[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.

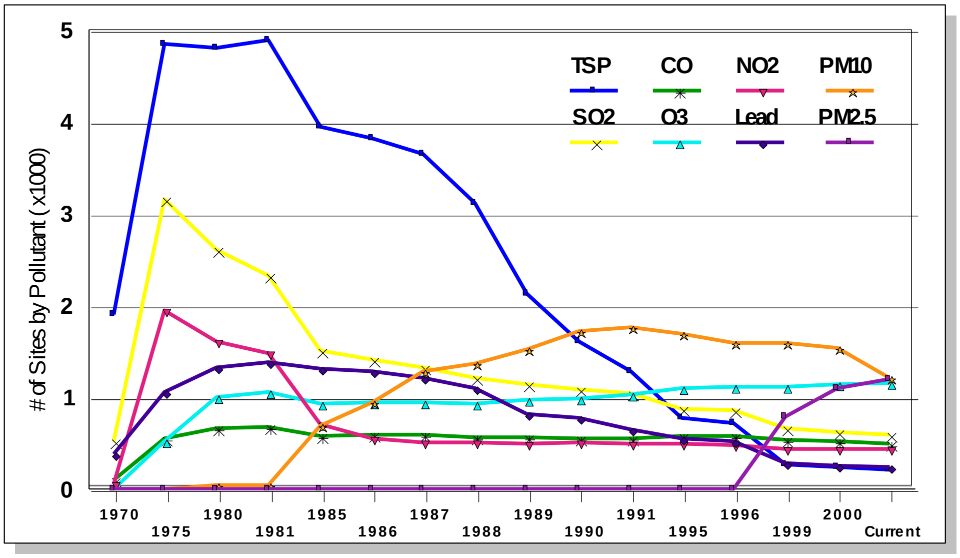

Figure 10-2: Growth and decline of criteria pollutant networks.

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 10-3). 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).

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. These sites also provide $PM_{2.5}$ speciation data, as noted above.

CASTNET Site Locations

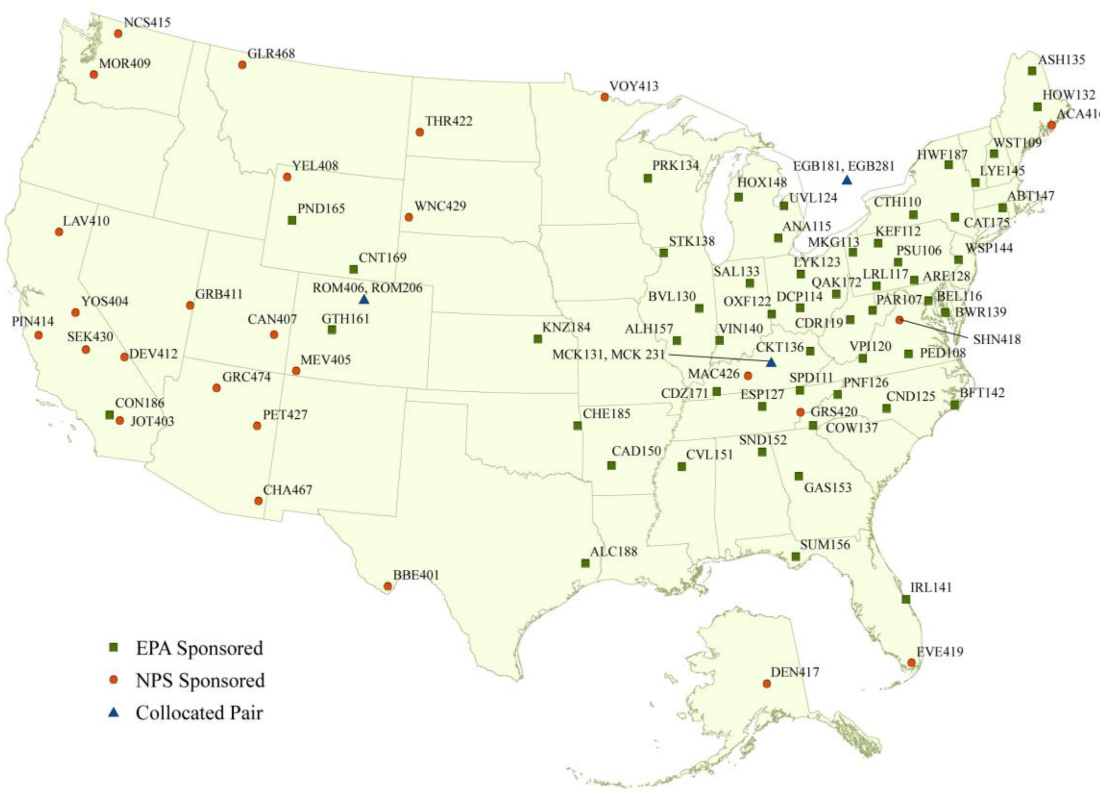

Figure 10-3: Clean Air Status and Trends Network (CASTNET)

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, the NAAMS 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, and expanded mercury monitoring.

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.

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 10-4).

As Figure 10-4 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.

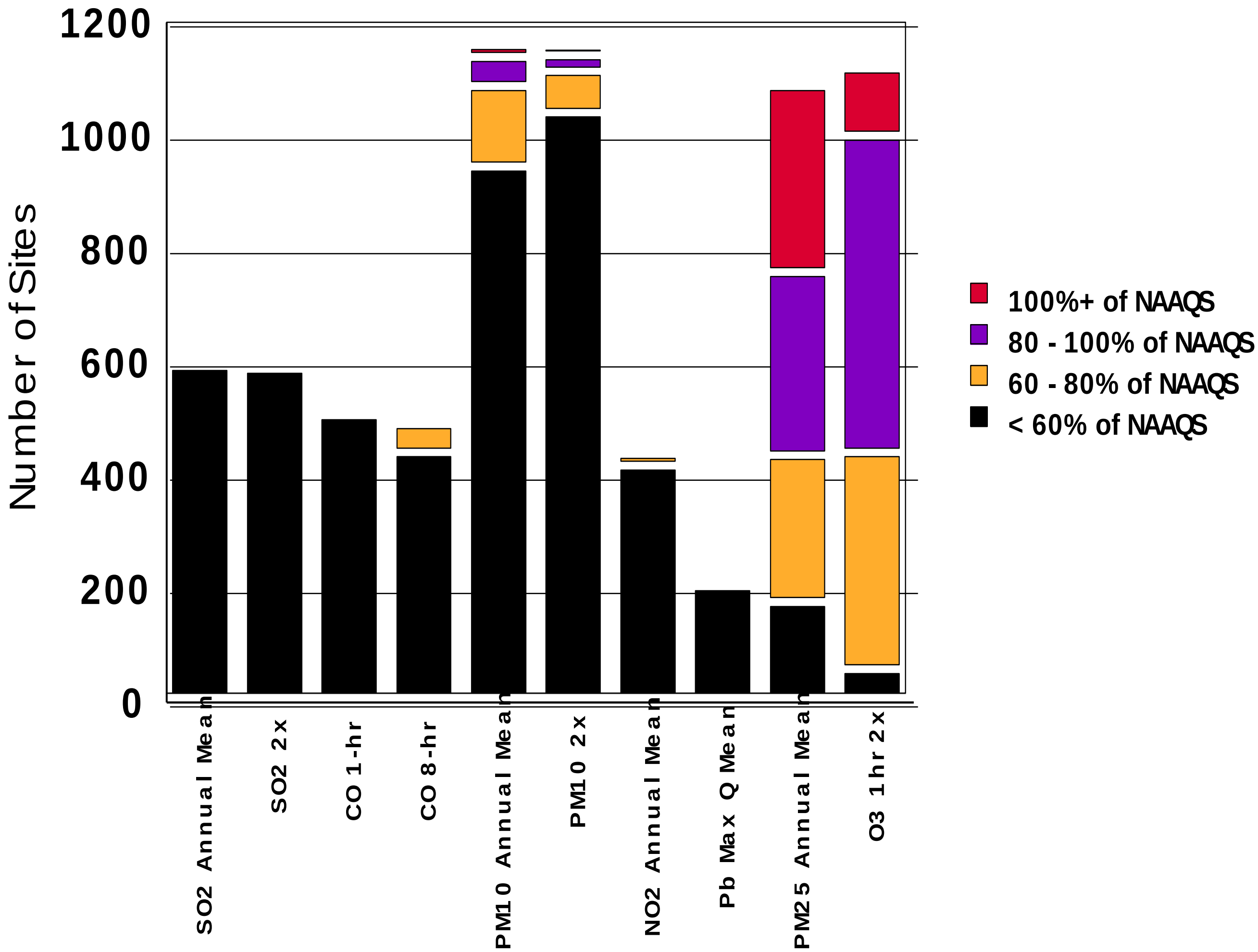

Figure 10-4. Number of monitors measuring values relative to the National Ambient Air Quality Standards based on AIRS data through 1999. Great progress has been made in reducing ambient concentrations of most criteria measurements. Ozone and $PM_{2.5}$ dominate the nonattainment picture on a national 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. The NAAMS 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.

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 $PM_{10-2.5}$ (see subsequent section on PM Coarse). 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.

Strategy Development

A National Monitoring Steering Committee (NMSC) was developed to provide oversight and guidance to develop the NAAMS.[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. The December 2005 draft updated 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 10-5). 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.

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

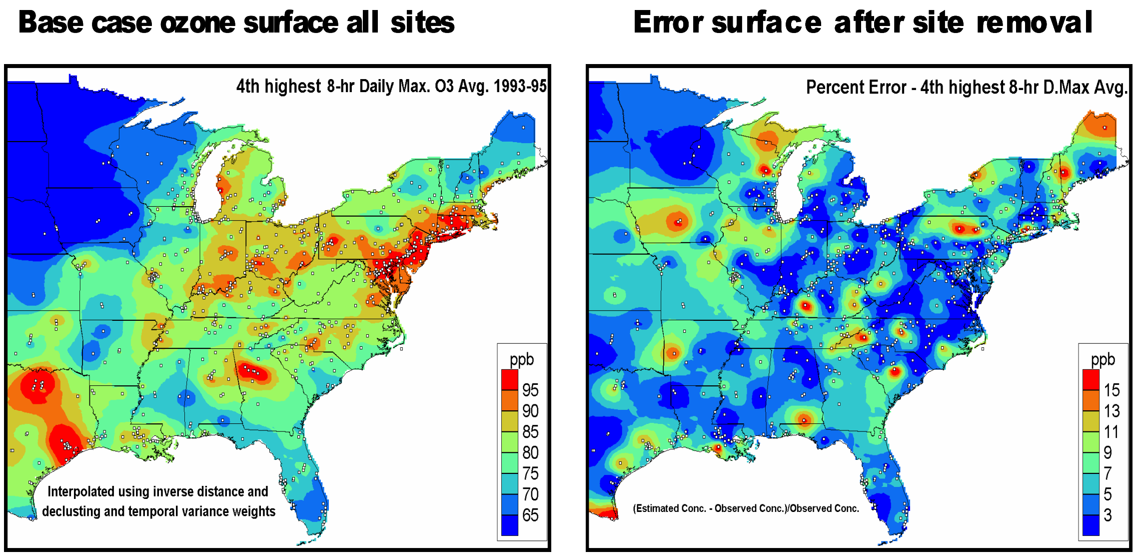

Figure 10-5: Surface depiction of estimated absolute errors (right) in ozone concentrations produced by removing existing monitors on a site by site basis, relative to base case (left). Areas showing low errors (<5 ppb) suggest neighboring monitors could accurately predict ozone in area of a removed site. Areas of high error suggest necessity to retain existing monitors and perhaps increase monitoring.

National Strategy

Overview

The National Ambient Air Monitoring Strategy (NAAMS) which was promulgated in 2006 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; and

- 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 applied to specific monitoring programs in the following sections entitled, Strategy for Urban Areas and Strategy for Rural Areas.

Strategy for Urban Areas

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 $PM_{2.5}$, $PM_{10-2.5}$), 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. 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.

Rationalization of NAAQS Pollutants Networks

In shifting to the new framework outlined above, 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 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 $PM_{2.5}$.

Coarse PM

Prior to the adoption of the fine-particle fraction NAAQS in 1997, EPA determined that the fine and coarse fractions of PM_{10} should be considered separately. At this time, EPA added new standards, using $PM_{2.5}$ as the indicator for fine particles (with $PM_{2.5}$ referring to particles with a nominal aerodynamic diameter less than or equal to 2.5 μm), and using PM_{10} as the indicator for purposes of regulating the coarse fraction of PM_{10} (referred to as thoracic coarse particles or coarse-fraction particles; generally including particles with a nominal aerodynamic less than or equal to 10 μm).

In the more recent review and adoption (October 17, 2006) of revised PM NAAQS, some consideration had been given to a more narrowly defined indicator that did not include fine particles (*e.g.*, $PM_{10-2.5}$); however, EPA decided that it was more appropriate to continue to use PM_{10} as the indicator for standards to control thoracic coarse particles.

Although NAAQS for $PM_{10-2.5}$ have not been established, EPA is promulgating a new reference method (FRM) for measurement of mass concentrations of $PM_{10-2.5}$ in the atmosphere. This new FRM will be defined as the standard of reference for measurements of $PM_{10-2.5}$ concentrations in ambient air. This should provide a basis for approving Federal Equivalent Methods (FEMs) and promote the gathering of scientific data to support future reviews of the PM NAAQS. One of the reasons for not finalizing a $PM_{10-2.5}$ standard was the limited body of evidence on health effects associated with thoracic coarse particles from studies that use $PM_{10-2.5}$ measurements of ambient thoracic coarse particle concentrations. If an FRM is available, researchers will likely include $PM_{10-2.5}$ measurements of thoracic coarse particles in health studies either by directly using the FRM or by utilizing approved equivalent methods based on the FRM.

The NAAMS, promulgated on the same day (October 17, 2006) as the revised PM NAAQS, has a requirement for a new multi-pollutant monitoring network that takes an integrated approach to air quality measurements. One of the required measurements at these multi-pollutant monitoring stations is $PM_{10-2.5}$. The availability of an FRM, and subsequently approved equivalent methods for $PM_{10-2.5}$, will support State and local agencies' efforts to deploy robust methods at these monitoring stations for the measurement of thoracic coarse particles that do not include fine particles. These multi-pollutant monitoring stations will provide a readily available dataset at approximately 75 urban and rural locations for atmospheric and health researchers to compare particle and gaseous air pollutants.
Finally, the $PM_{10-2.5}$ FRM, by definition, provides a reference measurement. Because it is a filter based system, this method can itself be used to provide speciated data and EPA will be issuing guidance to ensure the use of a consistent national approach for speciated coarse particle monitors as soon as possible. The reference measurement from this instrument is also important in the development of alternative $PM_{10-2.5}$ speciation samplers.

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 10-1, 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).

- Precursor gas (trace level) CO would be required at Type 2 sites.

Table 10-1. 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: • hourly auto GC • (8) 3-hr canisters • 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

See Chapter 7, Ozone Precursors, in this Manual, for further discussions of PAMS monitoring.

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 10-6).[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.

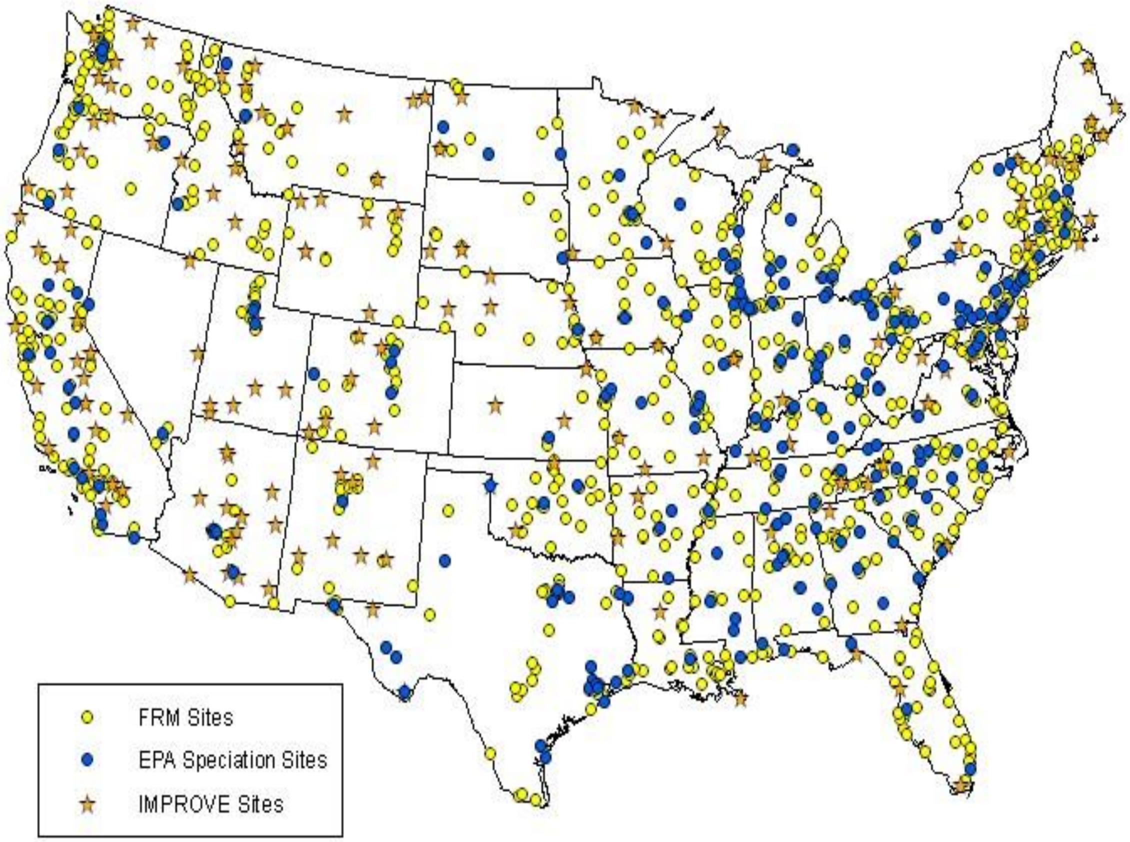

Figure 10-6. $PM_{2.5}$ Monitoring Sites, Including Chemical Speciation Sites.

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 (for more discussion on Aethalometers see EPA Course 435, Atmospheric Sampling). 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

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[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.

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.

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.

The NAAMS 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 persistent bioaccumulative toxics (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 the NAAMS 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 "Strategy for Rural Area," below, for further discussion).

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 (scheduled for release in January 2007).

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 Prevention of Significant Deterioration (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).

For mercury monitoring, EPA has proposed 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 Mercury Deposition Network (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.

Common Elements Applicable to All Monitoring

Quality System

Quality assurance is a major component of the air monitoring programs. The goal of the NAAMS is that all of the ambient monitoring networks 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 include:

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

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

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 in recent years than at any time in the past. However, 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 the NAAMS, and funding/training issues will be addressed as part of the implementation plan.

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 geographic 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 the NAAMS reflects many of the findings of these assessments and the 2000 national assessment. As part of EPA's commitment to maintaining the NAAMS 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 the NAAMS, 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.

Data Access

A primary objective of the NAAMS 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.