National Park Service
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Natural Resource Program Center

Air Quality Monitoring Strategy for the National Park Service 2010

Natural Resource Report NPS/HTLN/NRR—2010/001

A new day. Photograph by: Leland Tarnay

ON THE COVER
View of Yosemite Valley. A layered haze hangs in the valley.
Photograph by: Leland Tarnay

Air Quality Monitoring Strategy for the National Park Service 2010

Natural Resource Report NPS/HTLN/NRR—2010/001

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Contents

Page

List of tables and figures iv

Summary..……. iv

Introduction to NPS Air Quality Monitoring 2

Program Objectives 6

Visibility Monitoring 7

Gaseous Pollutant Monitoring 9

Current Monitoring Programs 10

Visibility Monitoring Program 10

Network Design 10

Particulate Monitoring 12

Optical Sampling 12

VIEW Shed Monitoring 13

Gaseous Pollutant Monitoring Program 13

Deposition Monitoring Program 16

Partnership Monitoring 17

Targeted Monitoring 22

Using New Technology and Shared Resources 25

Connections to Climate Change 27

Closing the Loop with Analysis 28

Reporting and Presenting Results 29

Influencing Policy and Making Positive Changes .....

References.....1

Tables and Figures

Page

Figure 1. The Air Resources Division statements of mission and vision and some key statements about the monitoring strategy ……...2

Figure 2. Timelines for the various monitoring activities by the Air Resources Division. 3

Figure 3. Types of monitoring at park locations in 2006……4

Figure 4. The locations of IMPROVE and IMPROVE protocol sites are shown for all discontinued and current sites as of December 2004…….……5

Figure 5. Location of the now discontinued nephelometer monitoring stations……..

Figure 6. Map showing the location of gaseous pollutant monitoring.

Figure 7. Location map of NPS AMoN ammonia measurements.

Figure 8. Location map of IMPROVE NHx sampling.

Figure 9. Examples of the satellite air quality data currently available for the troposphere.

Figure 10.

Summary

A revised air quality monitoring strategy was developed by the Air Resources Division. Key points and changes are:

- All the air quality monitoring programs are united under a common set of objectives

- The design and purpose of each monitoring program is described. Network assessments were used to assign priorities and suitability of each monitoring station. Separate purposes are assigned to the different monitoring programs that relate to the objectives, the time frames for monitoring, and relationships to air pollution laws and regulations.

- Extensive use of partnerships and common resources will continue to be used and expanded.

- New analysis tools, such as the GIS Air Atlas, extended model outputs and satellite data, will be used along with new monitoring information satellites and networks that have developed since NPS air quality monitoring began.

- A greater emphasis will be placed on bringing information together, analysis of data, and technical reporting so as to complete and fulfill the objectives and to communicate results to the Park Service and the public.

- Short-term projects, referred to as "targeted monitoring" will be used to answer narrowly defined questions such as method development, source attribution, transport and formation uncertainties, and effects on natural resources.

- New types of monitoring and addition of more pollutant parameters, such as ammonia and mercury, are recommended. The aging of equipment and the need to update network monitoring is acknowledged in the budget planning.

- Existing monitoring by states and other national networks is an extremely important component our overall ability to assess the amount of air pollution in the parks. ARD will encourage and work with other groups and agencies to assure the continuing availability of that data resource.

Introduction to NPS Air Quality Monitoring

To meet its general responsibilities with respect to air resource management, the National Park Service (NPS) has established an air quality monitoring program. The service-wide air quality monitoring strategy is to help ensure NPS compliance with the Clean Air Act and associated regulations, the Regional Haze Regulation, the NPS Organic Act, and the Government Performance and Results Act (GPRA) by developing the comprehensive scientific information that is essential to understand and document air quality conditions in parks. The monitoring strategy is outgrowth of the Air Resources Division's (ARD) mission and vision, as given in Figure 1, which provides the needed information and feedback on the effectiveness of our actions in achieving our goals.

Figure 1. The Air Resources Division statements of mission and vision and some key statements about the monitoring strategy.

An air quality monitoring program can be organized in a number of different ways. It might be organized around the monitoring of atmospheric gases, particles, and wet deposition, the effects of atmospheric aerosols such as visibility and ecosystem changes, or around the myriad of regulations seeking to control the emissions of the various aerosols or the effects of the aerosols. Currently, the monitoring networks are organized as an ad hoc mixture of regulatory and programmatic objectives. The visibility monitoring program was and is designed to meet the

needs of assessing visibility effects as well as being responsive to the Environmental Protection Agency's (EPA) regional haze regulation, while the National Atmospheric Deposition Program (NADP) was originally designed to track changes in wet deposition chemistry as sulfur dioxide emissions were reduced and relate those changes to ecosystem effects. Similarly, the Clean Air Status and Trends Network (CASTNet) was designed to measure concentrations of those atmospheric gases and particles that deposit and cause ecosystem effects and to monitor depositional changes as emissions were reduced. The gaseous pollutant monitoring program was originally designed to determine compliance with national ambient air quality standards and to provide data that could be linked to ecological effects. Other shorter term programs, such as PRIMENET were implemented to assess the effects of solar UV radiation and toxics, such as pesticides, herbicides, and mercury, on park ecosystems. Although the monitoring networks are administered nationally and the results often presented nationally, the measurements are inherently local or regional and apply to the specific parks in which they are made.

Summary of Current Monitoring Program

The evolution of the NPS's various monitoring programs is summarized in Figure 2 for all the air quality monitoring programs. Several programs such as the visibility cameras, passive ozone monitoring, and PRIMENET have run for a while and been shut down. The newest programs include mercury monitoring, continuous PM2.5, portable ozone (POMS), and web cameras. Over the years the ARD monitoring programs had adapted to changing needs, technologies, partnerships, and available funding. Table 1 lists those variables that are currently being measured in each monitoring program. Selected species that would be desirable to measure are in bold. More discussion of future monitoring needs can be found in the summary section of this document.

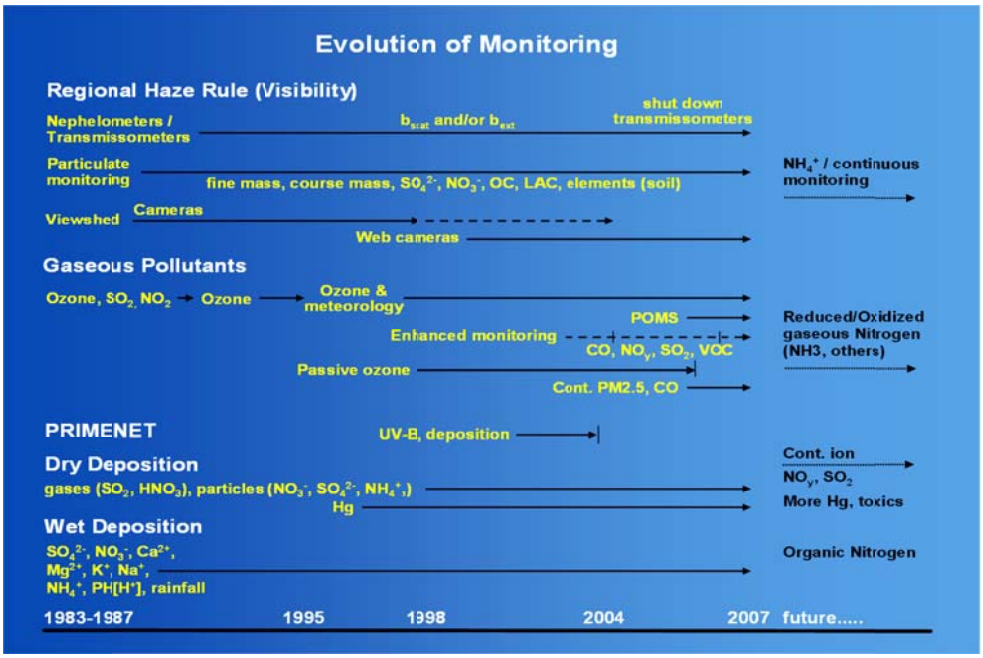

Figure 2. Timelines for the various monitoring activities by the Air Resources Division.

Of the 390 park units, about 70 have some time of air quality monitoring in them currently (figure 3). The visibility program have filter pack monitoring in 51 parks, ozone in 33, dry deposition in 27, and wet deposition in 40. The states run monitors that are near (within 10 miles) of about 90 units. Locations of the various monitors are covered by network in the assessment sections of the implementation plan appendix.

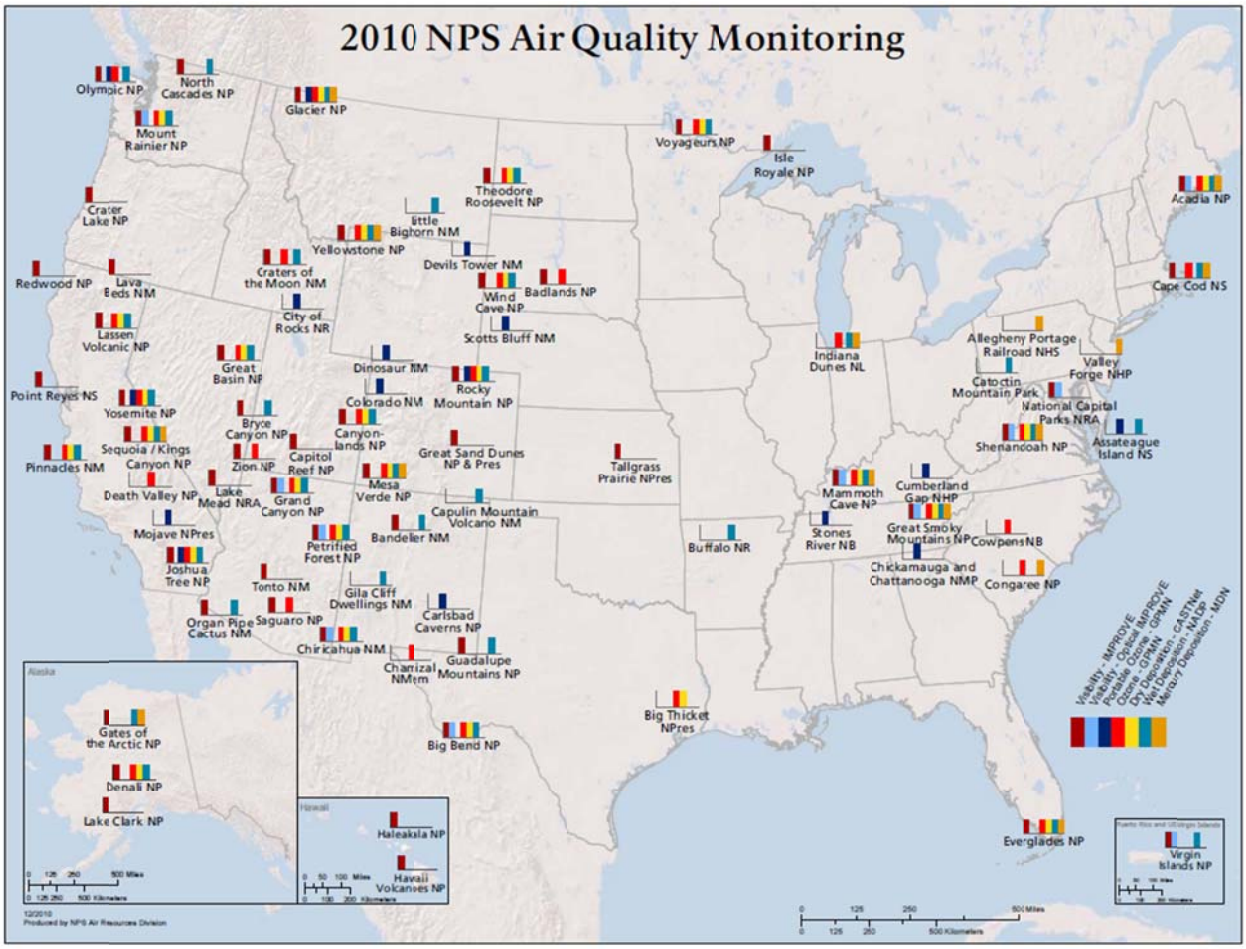

Figure 3. Types of monitoring at park locations in 2010. Some monitoring in or very near the parks are operated by other agencies

Description of NPS Monitoring Programs

The NPS **visibility program** mostly deals with aerosols that reduce clarity, color, and distance of visual observations near and in the Class I protected areas. The degradation of visibility or visibility impairment is probably the most easily recognizable effect of air pollution in the atmosphere. It is caused by the scattering and absorption of light by particles and gases in the air. Under the Clean Air Act (Act), Congress recognized that good visibility is a resource to be valued and preserved, now and for future generations. In section 169A of the Act, Congress set forth a national goal that calls for "the prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas in which impairment results

from manmade air pollution." The EPA is responsible for establishing regulations ensuring that "reasonable progress" toward the national goal is achieved in the 156 mandatory Class I federal areas (primarily national parks and wilderness areas) identified under the Act. Visibility is also protected under section 109 (relating to the National Ambient Air Quality Standards, or NAAQS) and section 165 (requirements for new or reconstructed sources) of the Act. The IMPROVE (Interagency Monitoring of PROtected Visual Environments) program is the primary monitoring network. Aerosol monitoring is conducted at 165 sites using four filter-collection modules. Other visibility sampling in park units make use of transmissometers, nephelometers, or cameras. With the advent of the Regional Haze Rule (RHR), the IMPROVE partnership has expanded to federal land management agencies, states, tribes, regional air partnerships, and other agencies that jointly operate the network to meet the haze regulations concerning tracking progress and estimating natural backgrounds. The visibility program has historically carried out special studies and intensive field programs to resolve specific issues and scientific problems related to visibility, aerosol transport, and source attribution.

The **gaseous pollutant monitoring program** (GPMP) has historically concentrated on determining the levels of two air pollutants, ozone and sulfur dioxide, but also includes the gaseous portion of deposition. Approximately 33 monitoring sites are operated by the NPS in the regular GPMP network and another 15 plus sites have "portable" systems. Ozone and sulfur dioxide pollutants are unhealthy for both people and native vegetative species found in NPS units at levels above the NAAQS established by the EPA. Other gaseous pollutants (e.g., other photochemical oxidants, nitrogen compounds, and toxic organic compounds) are also of interest to the NPS because they relate to the formation and transport of ozone and to physiological, morphological, or histological injury to park biological resources. Currently, only selected, limited studies measure other gaseous pollutants within the national park system primarily through the enhanced monitoring, the passive ozone sampling program or the portable ozone monitoring program. The determination of current conditions relative to the NAAQS and the analysis of trends are used to assess the threat to resources.

The **deposition monitoring program** includes wet, dry, and cloud water monitoring to determine both atmospheric concentrations and the amount of deposition. Sulfur and nitrogen species are the primary concerns, but other toxic materials such as mercury, pesticides, PCBs, etc., that have an airborne deposition component are also of interest. The primary national networks that the NPS participates in to make these measurements are the NADP, the CASTNet, and the Mercury Monitoring Network. The CASTNet dry deposition portion is operated as part of the NPS gaseous pollutant monitoring program since ozone is included in the CASTNet measurements. Air toxics and persistent toxic components have been measured in survey and research projects in cooperation with other agencies. These have generally been non-routine monitoring and of only a few years duration.

Deposition monitoring has focused mostly on trends that might result from source emission reductions, rather than on a standard or threshold that might relate to resource (AQRV) injury. Recent attempts to develop critical and target loads may help tie the quantification of pollutants from monitoring to the extent of harm or potential injury to the resources.

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Air Quality Monitoring Objectives

ARD proposes to continue as a leader in air quality issues, natural area monitoring, effects on resources, and the connection of harmful deposition to anthropogenic emissions. There are two aspects to the monitoring:

1. Determination of baselines and trends
2. Establishing relationships of transport and source attribution to park receptors

Possible or measured harmful effects on resources (air-quality-related values) are the key reasons to monitor air pollutants, while recognizing possible resource effects and mitigating or controlling emissions that lead to air pollution in the parks are resource management actions to be taken. To fully utilize the monitoring data, there needs to be more connection between policy issues, modeling, effects research, and the reporting of analysis.

There are specific reasons for doing monitoring within the park units rather than depending on data from other networks and locations. Only by getting the measurements in the parks can we get data that is location specific, consistent, covers extended periods, and gets the data of most significance to park resources. The air quality monitoring objectives for NPS are:

- Provide data to make pollutant risk assessments of adverse effects to natural resources (AQRVs).
- Provide data related to NAAQS standards, and base information for new source review and PSD
- Determine trends that assist in compliance predictions, policy objectives, and regional assessments at non-urban parks.
- Provide specific answers from special studies that assist modeling, regional pollution transport issues, State Implementation Plan (SIP) development, and national control strategies.
- Provide timely information to the public and researchers to assess current conditions in parks.

The Clean Air Act and amendments provided many tools to assist in protection of air quality in the parks. The break down into Class I and Class II provides mechanisms for protection, but does not really take into account the resources in the parks or the threat to resources. It is therefore proposed that the monitoring focus on the 48 Class I parks be dropped in favor of broader coverage and the use of risk analysis tools such as those provided by the GIS-based Air Atlas, vegetation injury assessments, and the air quality (AQ) scorecard. In general, the 270+ parks determined by the inventory and monitoring program to have significant natural resources

will now be the pool of parks considered for monitoring. The goal should be then to monitor in a selection of park units to test the reliability of the risk analysis tools. Ideally each of the 32 inventory and monitoring networks would have several monitoring stations in or near park units, though not necessarily provided by the Air Resources Division alone.

In all monitoring, we propose to collect high quality data that uses scientifically valid methods, that meets data quality objectives stated in our quality management plan, quality assurance plan, and standard operating procedures, and that covers the temporal periods and spatial needs. The data will be carefully validated and stored in databases accessible to park service staff and the public. Periodic summaries and analysis will be reported that focus on the monitoring objectives. More in-depth analysis would be provided by special reports and articles in peer-reviewed journals.

In general, each monitoring station has specific products and projected outcomes that are associated with data collected at that monitoring site. A layered structure to the network can provide the predictability, stability, and outcomes that are needed for various objectives. Table 1 illustrates a three-layered concept designed to meet specific air quality related objectives listed above. Each monitoring station will be assigned a layer which defines its priority and purpose. A set of core monitoring stations will have the highest priority and get the most complete parameter coverage. See table 6 for park listings.

Table 1. Different layers to monitoring.

Monitoring layer	Purpose	Characteristics	Time frame	Monitoring networks
1. Trend	Long-term trends for rural regions. Allows for assessment of whether emissions changes (increase or decrease) are reflected in changing pollutant levels in park units.	Stable sites that have regional presentation and are not near significant sources; multiple measurements and network monitors collocated; strong park support with an active AQ program	Several decades	IMPROVE; NADP/NTN; CASTNet
2. Compliance	Determine exceedances of the NAAQS and nonattainment status; assess whether a park unit is being represented by other monitors, supporting information on critical loads.	Minimum of 3 years of data needed after an area is designated nonattainment. When concentrations are less than 80% of the NAAQS ,then compliance concern decreases.	4–10 years	CASTNet GPMP SLAMS/NAMS

3. Targeted monitoring	Provide information that supports policies, decisions, plans, or actions that lead to improved air quality.	Multiple pollutant monitoring that investigates issues of source apportionment, transport, response to emission control changes, and other policy-relevant issues; survey monitoring to provide baseline pollutant data and to challenge model estimates.	Less than 5 years	POMS Special studies NCORE Enhanced

Table 2**.** Current measurements in the NPS monitoring program. *Desired additional measurements are in bold*.

Pollutants to monitor	The most important pollutants to monitor at this time are: **Visibility:** PM: fine and coarse mass, elements (soil), SO_4, NO_3, organic and elemental carbon. **NH_4 OC markers.** Optical: nephelometer, extinction. **View shed**: digital cameras or webcams. **Gaseous:** O_3, SO_2, $PM_{2.5}$, extended: NOx, NO, NO_2, CO, SO_2, **VOC** **Deposition:** wet: NO_3, SO_4, NH_4, **ON**, Hg: dry: NO_3, SO_4, NH_4, **OCN**, HNO_3, SO_2, **NH_3, reduced and oxidized organic gases (OGN)** **Toxics:** Hg, ?? others *Only ozone, sulfur dioxide, and $PM_{2.5}$ are criteria pollutants that have standards set by the EPA. Visibility is more broadly defined and has targets under the Regional Haze Rule. The other pollutants fall either under acid rain, hazardous air pollutants (HAPS), or are used as tracers and trend indicators.*
Time resolution	In general, hourly average data are of the most use to modelers and for doing transport and source-receptor analysis. In some cases, 5-minute or 1-minute data can greatly improve the understanding of transport issues. Most deposition samples are currently taken weekly, but new continuous ion analyzers make the possibility of hourly values likely for a small subset of monitoring sites. Visibility is measured 3 times per week for 24 hours each. This time resolution can also be improved with semicontinuous analyzers. *For locations where exceedances of the NAAQS are unlikely, hourly values may not be needed to determine trends or the risk of resource injury. When possible, simpler, less expensive sampling should be substituted, even at the loss of time resolution.*

Strategy 1 Partnership monitoring with national networks in support of ARD objectives

Air quality monitoring done in cooperation with national leverages NPS funds, expertise, and spatial coverage. The NPS monitoring will be designed around the following national networks to effectively provide data for the Air Resource Division programs and for park resource management decisions.

IMPROVE Program - Visibility Monitoring

The purpose of visibility monitoring is to collect high quality data that can be used in analyses to assess whether or not progress is being made toward meeting the national visibility goals. Without measurements there is no quantifiable method of tracking progress. The data is needed for new source review (NSR) and for prevention of significant deterioration (PSD) analyses. Each mandatory Class I area is covered by an IMPROVE monitoring station using modules that speciate the particular matter and reconstruct the visibility extinction coefficient. Visibility data is used for tracking process towards natural conditions as required by the Regional Haze Regulation. Data access is provided at the IMPROVE and the VIEWS web sites.

CASTNet network - Gaseous Pollutant Monitoring

Both ozone and dry deposition monitoring are conducted together using continuous analyzers and weekly filter-pack systems. NPS ozone monitors were previous focused on Class I parks, but a broad range Class II parks are now been included. Ozone monitoring may be with EPA-certified analyzers or with portable systems or passive samplers. Areas found to have ozone concentrations near or above the NAAQS will use EPA-certified monitors and the data will be entered into the EPA Air Quality System (AQS) database. Most of the NPS operated gaseous monitoring stations run as part of the CASTNet network and meet all quality assurance and data quality objectives of that network. Several additional stations use the CASTNet filter-packs and laboratory to obtain concentration data. Only locations meeting the CASTNet siting criteria can be included in the dry deposition network. Co-location with NADP wet deposition monitoring stations is highly stressed.

NADP/NTN and MDN - Deposition and Toxics Monitoring

Deposition monitoring is handled by participation in several national monitoring networks (NADP/NTN, CASTNet, MDN) that have objectives consistent with NPS needs. The networks have detailed quality assurance plans and provide assess to the data and some analysis. Participants in these networks often publish analysis and annual maps of spatial concentrations and deposition are reported by the networks. Where the national networks have not have done monitoring specific to a park, ARD has sponsored monitors to fill in the gaps. The spatial and temporal variability is the primary concern of these networks as the deposition relates to mandated emission reductions from point and mobile sources. ARD has also sponsored additional studies of toxics measurements in soils, fish, and snow and the measurement of acidic species in cloud water.

Details on Current Monitoring Programs

Visibility Monitoring Program

Visibility-related measurements are partitioned into three groups of measurements that capture the impairment of scenic features as well as collect aspects of the atmosphere that allow for identifying the emissions that cause the visibility impairment.

Scene monitoring: the appearance of a scenic landscape viewed through the atmosphere. Scene characteristics are more in line with the simple definition of visibility than aerosol or optical characteristics. Scene characteristics include observer visual range, scene contrast, color, texture, clarity, and other descriptive terms. Scene characteristics change with illumination and composition of atmospheric aerosols.

Optical properties: the ability of the atmosphere to scatter or absorb light passing through it. The physical properties of the atmosphere are described by extinction, scattering, and absorption coefficients, plus an angular dependence of the scattering known as the scattering phase function. Optical characteristics reflect the effects of atmospheric aerosols and gases on visibility.

Aerosol concentrations: the physical and chemical properties of the ambient atmospheric particles (size, shape, chemical composition, concentration, temporal and spatial distribution, and other physical properties) through which a scene is viewed.

Atmospheric aerosol and optical characteristics depend only on the aerosol physical and chemical characteristics; however, scene characteristics are also dependent on scene and lighting conditions.

Network Design

The principle considerations in network design are the following:

1) Each site must be selected to represent visual air quality within the air mass of interest.
2) The spatial and temporal aspects of a monitoring network must be designed to meet the monitoring goals and objectives of the network.
3) “Representative” sites should be determined on a case-by-case basis. Important considerations should include common elevation, common source region of emissions, and similar location relative to major topographic features.
4) Year-round monitoring may not be practical at certain national parks due to geographic or safety limitations, such as the extremely remote location of a park area.
5) Visibility site and network designs may vary due to cost, logistical, or historical data considerations, but an ideal site design would include the full complement of aerosol, optical, and scene monitoring.

Table 2 summarizes appropriate configuration sites designed to meet a number of common monitoring objectives, including

- sites to determine existing conditions, track long-term trends, and source attribution;

- monitoring for PSD and NSR where only total light extinction measurements or visual range are required; and
- short-term pilot study options for initial evaluations or spatial representativeness tests.

The table highlights several approaches for each common objective.

Table 2. A summary of appropriate site configurations for common monitoring objectives.

Common Applications (to meet monitoring objectives)	**Monitoring Approach**	**Aerosol**							**Optical**		**Scene**		**Meteorology**
		$PM_{2.5}$				**PM_{10}**		**b_{sg}**	**Trans**	**Neph**	**Still Frame**	**Time Lapse**	
		Mass	**Elements**	**Ions**	**b_{sp}**	**Mass**	**Elements**	**NO_2 Gas**	**b_{ext}**	**b_{scat}**	**Instantaneous**	**Dynamic**	**AT/RH**
Determine existing conditions, track long-term trends and source attributes	Most scientifically sound – Aerosol, optical (transmissometer), and Scene	✓	✓	✓	✓	✓	AN	AN	✓		✓		✓
	Aerosol, optical (nephelometer), and Scene	✓	✓	✓	✓	✓	AN	AN		✓	✓		✓
	No optical possible. Aerosol-based (reconstructed extinction)	✓	✓	✓	✓	✓	AN	AN			✓		✓
PSD or NSR when only extinction measurements are required	Most scientifically sound – Optical (transmissometer based)								✓				✓
	Optical (nephelometer based)							AN		✓			✓
	No optical possible – Aerosol based (reconstructed extinction)	✓	✓	✓	✓			AN					✓
	Scene only (elevated layer characterization or visible plume attribution)										✓	AN	
Short-term pilot study options for initial evaluations of spatial representativeness tests	Aerosol based	✓	✓		✓								
	Optical (nephelometer based)									✓			✓
	Scene based										✓	AN	

✓ = Recommended
AN = As needed

Particulate Monitoring

The IMPROVE network initially was funded by the NPS and consisted of 30 monitoring sites primarily located in national parks, 20 of which began operation in 1987, with the others starting in the early 1990s. Many of the sites also included optical monitoring with a nephelometer, a transmissometer, and/or color photography to document scenic appearance.

Beginning in 1998, the EPA provided support to IMPROVE to expand the network in order to provide the representative speciated particle monitoring required under the Regional Haze Rule for each of the 156 mandatory federal Class I areas where it was practical to do so. The expansion was carried out, consistent with the monitoring design discussed above. The current monitoring configuration is shown in Figure 4 with monitoring sites grouped into regions that tend to have similar levels of aerosol concentrations. These monitoring sites provide data that aid in understanding spatial patterns and are often installed to assist the sponsoring agency, such as a state, tribe, or the EPA, in meeting planning or quality assurance responsibilities.

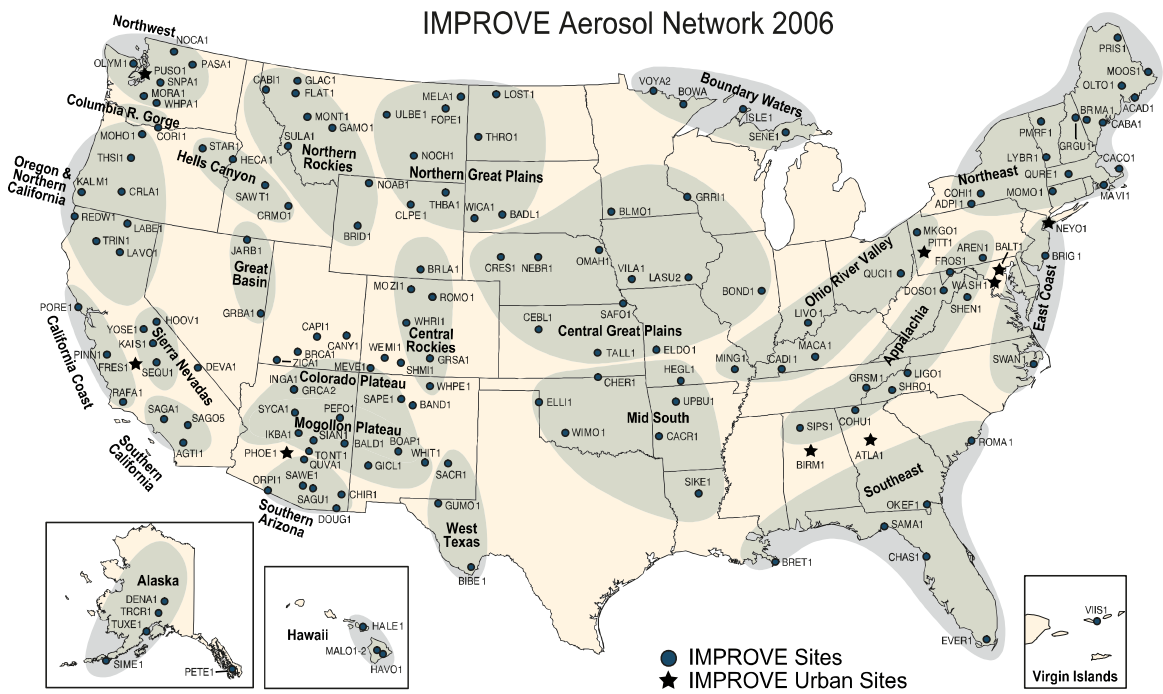

Figure 4. The locations of IMPROVE and IMPROVE protocol sites are shown for all discontinued and current sites as of December 2004. The IMPROVE regions used for grouping the sites in some analyses in this report are indicated by green shading and bold text. Urban sites included in the IMPROVE network for quality assurance purposes are identified by stars.

Optical Sampling

Because of funding shortfalls, seven transmissometer monitors were discontinued in 2006. The location of nephelometers used to measure atmospheric scattering, operated by the NPS, the United States Forest Service (USFS), and other cooperating partners are shown in Figure 5. Two transmissometers, used to measure atmospheric extinction, are also operated in Grand Canyon

National Park. The NPS operates 12 out of 37 nephelometer sites (figure 5). With the closure of the transmissometer sites there are some areas of the country that are left without representative optical monitoring. Some consideration should be given to relocating a few of the existing nephelometer to fill these gaps.

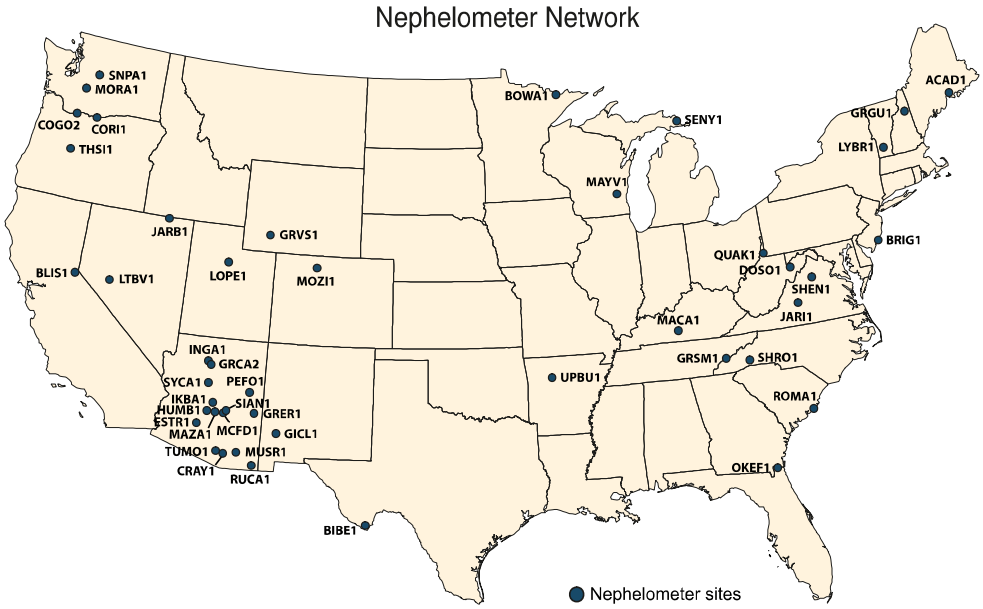

Figure 5. Location of the now discontinued nephelometer monitoring stations.

VIEW Shed Monitoring

A network of film cameras was deployed at one point to get qualitative measures of visibility and haze. Comparisons of clean and hazy day images have been very useful in showing the effects of air pollution on the scenery. The Webcam program using new digital cameras that post images to a web site has replaced the film cameras and has been extremely popular with the public. Images are now collected for approximately 15 parks and updated every 15 minutes on the web site. Real-time data for visual range, weather, ozone, and PM have been added to provide overall air quality. Several parks now issue public advisories when the air quality is poor .

Gaseous Pollutant Monitoring Program

The NPS gaseous pollutant monitoring network, along with state supported sites, is shown in Figure 6. The original monitoring strategy (1991) was to establish baseline conditions in nearly all 48 NPS Class I areas by the year 2000 and to reactivate each of the baseline sites at 5–10 year intervals to determine whether air quality levels have changed from those measured when the area was monitored previously. The baseline monitoring concept was never fully implemented because of cost; that structure is being dropped and replaced by core monitoring and spatial interpolations using Geological Information System (GIS) mapping. All parks with significant

natural resources, as determined by the inventory and monitoring program, will be considered for monitoring. Short-term survey monitoring will replace the baseline monitoring concept and there is no presumption of returning to a site later. A three-layer concept will be applied to all monitoring. Selected sites will be core stations with the highest priority and most measurement parameters.

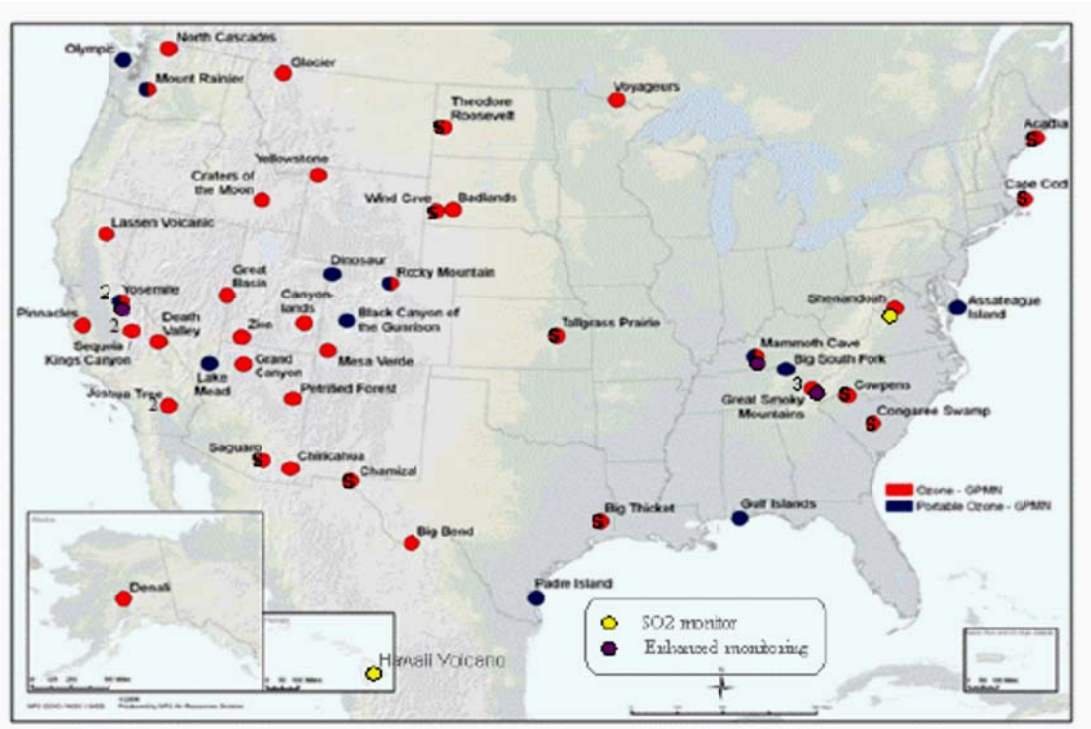

Figure 6. Map showing the location of gaseous pollutant monitoring. Some sites are operated by ARD (red symbols), some by states (red with S), and the remaining stations are portable units in the POMS network (blue).

Several factors are considered about a monitoring station to determine its layer, priority, and need. A large number of GPMP ozone monitoring stations now have 15–23 years of trend data. Most of the monitoring sites follow regional changes in air quality, but in some cases more local emissions dominate. In table 3 parks with monitoring are assessed for the representativeness of the monitoring categories.

Background sites	➔	very long range transport
Regional sites	➔	synoptic scale transport
Urban influenced sites	➔	regional transport; major urban or point sources are nearby

Table 3. Categorization of the NPS ozone monitoring stations.

URBAN INFLUENCED	REGIONAL	BACKGROUND
Acadia	Badlands	Denali
Cape Cod	Big Bend	Grand Canyon
Congaree	Canyonlands	Great Basin
Cowpens	Chiricahua	Yellowstone
Great Smoky Mountains	Craters of the Moon	Lassen Volcano
Joshua Tree	Theodore-Roosevelt	
Mammoth Cave	Glacier	
Pinnacles	Mesa Verde	
Rocky Mountain	Mt Rainier	
Sequoia	North Cascades	
	Petrified Forest	
	Shenandoah	
	Voyageurs	
	Wind Cave	
	Yosemite	
	Zion	

The sites of most interest for long-range trends are the regional and background sites. Near-urban sites are expected to show a much closer relationship in their trends to new sources and control strategies. The time frame for monitoring is shorter, presuming that real cleanup starts to occur. Background sites have little regional emission influences since transport is very long range. Consistent with Table 3 and network assessments, ozone monitoring sites are further categorized according to trend, compliance, and site-specific objectives in Table 4.

Table 4. Layer and purpose of monitoring stations.

MONITORING LAYER	PARK LOCATIONS	COMMENTS	HOW LONG
Trend	GRCA, YELL, DENA, GRSM, SHEN, BIBE, ROMO	Parks with long records, multiple networks, and good regional representativeness.	indefinite
Compliance	SHEN, GRSM, SEKI, JOTR, YOSE, ROMO, PINN, MACA, ACAD, COWP, COSW	These stations are in ozone, sulfur dioxide, or PM2.5 non-attainment areas or have concentrations that are close to the standard. Nearby sources strongly influence the pollution levels in these parks.	For 3-5 years after returning to attainment (>80% of NAAQS)
Targeted	GRSM-LR, MACA, YOSE, THRO, WICA, BADL, ACAD	Extended monitoring NOx, CO, PM State operated extended monitoring w/ ARD cooperation	Stated in study plan Indefinite
	HAVO, YELL, JOTR	Technical Assistance Requests Toxic SO2 levels – visitor health Winter use – adaptive management. Ozone & PM spatial studies	Indefinite 2 - 5 years 3-5 years
	DINO, PAIS, CAVE, ASIS, OLYM, COLO, MORA, CUGA, ABLI, NATR, YOSE-2	POMS stations	3-5 years
Undefined	VOYA, NOCA, GLAC, ZION, PEFO	Stations currently used for trends, background, or vegetation injuries studies support	Funding dependent 1-4 years

Several parks (Sequoia, Great Smoky Mountains, Mammoth Cave, and Yosemite, Joshua Tree) currently operate more than one ozone station due to the biological effects studies or specific short-term studies being conducted at these parks. In general, it is the division's policy to support only one station at each park using service-wide air quality funding; however, when additional stations are required as part of biological effects studies or for special studies to be conducted at the park, the division may fund additional sites. Very few parks have multiple stations in the IMPROVE, NADP, and CASTNet networks unless they are for special projects or for quality assurance.

The EPA has been reviewing the national air quality monitoring operations and has proposed a new monitoring network design referred to as "NCore" that refocuses monitoring resources to emphasize fine particulates, ozone, and ozone precursors. This is partly a recognition that most criteria pollutants are now well below the NAAQS standards. NCore would stress that monitoring sites incorporate multiple pollutant monitors and more continuous monitoring that can be used with modeling and to better understand transport issues. Two-thirds of the approximately 70 NCore stations are expected to be in urban settings and the remaining third in rural locations, a few of which are park locations (Great Smoky Mountains and Acadia). The NCore stations are very similar to the "enhanced monitoring" stations that the NPS has run at a few parks. When the network is complete by 2011, detailed information is expected to become available for transport and transformation analysis using observation and computer models. NPS will participate in this advanced monitoring when the opportunity and partnerships are available.

The inventory and monitoring (I&M) program has depended heavily on the ARD air quality monitoring data and method of interpolating pollutants based on national monitoring networks. Many of the I&M networks may have made plans with the idea that the ARD-supported monitoring would stay in place. To the extent possible, the passive ozone samplers and POMS should be used to provide the inventory baseline data that a network might want when the Air Atlas estimates are not adequate or need to be confirmed Only if pollutants are found near or above the standard should a full regulatory-level station be considered

Deposition Monitoring Program

The wet deposition network (NADP/NTN) has NPS stations with data for up to 27 years. There are 28 stations with more than 20 years of data and another 14 with less than 10 years. This network was designed to be rural and regionally representative. The spatial representation is considered a key feature. The CASTNet dry deposition program also is rural based. Although the EPA sites in the eastern U.S. have data for over 21 years, the NPS stations are generally newer and have approximately 16 years of data. The overlap of co-located wet and dry deposition stations is an important factor in getting total deposition estimates. The dry deposition network is relatively sparse and much more expensive to operate than the wet deposition; it has several deficiencies that need to be addressed (see appendix – Gaps and Deficiencies). Ammonia measurements need to be added to the measurements and NPS should assist this effort with special studies, method development, and by early adoption of the NH3 measurements at our core monitoring parks.

Replacements of the rain gauges and modifications to the rain collectors have been initiated for the NADP stations. The funds for replacement equipment need to be allocated and the upgrades completed within the next five years.

Partnerships

A great deal of leveraging is currently being used in the GPMP network by partnering with state agencies, the EPA (IMPROVE, CASTNet, OAQPS, Regions), the Department of Energy (DOE), the Tennessee Valley Authority (TVA), and the Regional Planning Organizations (RPOs). Table 5 summarizes some of the networks and parks where other agencies contribute to monitoring activity in NPS units. Tables 5, 6, and 7 list parks where ozone and CASTNet monitoring is supported by other agencies, while Table 8 shows portable ozone monitors that are operated in various park units, often with the support of Inventory and Monitoring Program networks.. Furthermore, of 53 IMPROVE sites, the NPS currently supports particle monitoring at 5 IMPROVE stations and optical monitoring at 12 sites.

Table 5. Partnerships in NPS monitoring.

EPA	CASTNet , IMPROVE, NADP/NTN (interagency funds transferred)
States	THRO, ACAD-MH, JOTR-CW, BADL, WICA, COWP, COSW, (no cost agreements)
DOE	CRMO (fund transfers to NPS)
TVA	GRSM, MACA (in kind)

Table 6. Park units where either CASTNet or ozone monitoring is supported by other agencies.

Regular Network Site Operating Information			**Networks**			
Site name	**Abbrev.**	**Ozone monitor**	**CASTNet**	**State**	**Other GPMP**	**POMS**
Acadia NP	ACAD	X	1	1		
Cape Cod NS	CACO	X		1		
Chamizal N Mem.	CHAM	X		1		
Congaree Swamp NM	COSW	X		1		
Cowpens NB	COWP	X		1		
Great Smoky Mtns. NP – Purchase Knob	GRSM-PN	X		1		
Mount Rainier NP - Paradise	MORA	X		1		
Saguaro NP	SAGO	X		1		
Theodore Roosevelt NP	THRO	X	1	1		
Wind Cave NP	WICA	X	1	1		
Yellowstone NP – West Entrance	YELL-WE	X		1		

Table 7. Park units where other agencies support ozone monitoring in proximity to the park.

Code	Park name	Unit type	State	Dist (mi)*	AQS site ID
APPA	Appalachian Trail	National Trail		1.0	250334002
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	370990005
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	370870035
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	370210030
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	371990003
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	370110002
BLRI	Blue Ridge Parkway	National Scenic Parkway	NC	0.0	510970002
BLRI	Blue Ridge Parkway	National Scenic Parkway	VA	0.0	511611004
BLRI	Blue Ridge Parkway	National Scenic Parkway	VA	0.0	511630003
BOHA	Boston Harbor Islands	National Recreation Area	MA	0.0	250250041
CUVA	Cuyahoga Valley	National Park	OH	1.0	391530020
FOBO	Fort Bowie	National Historic Site	AZ	2.2	40038001
GUCO	Guilford Courthouse	National Military Park	NC	2.7	370810013
GWMP	George Washington	Memorial Parkway	MD	1.5	515100009
INDU	Indiana Dunes	National Lakeshore	IN	0.0	180890022
INDU	Indiana Dunes	National Lakeshore	IN	1.0	180910005
INDU	Indiana Dunes	National Lakeshore	IN	0.0	181270024
MISS	Mississippi	National River & Recreation Area	MN	1.0	270376018
MISS	Mississippi	National River & Recreation Area	MN	4.0	270031002
MISS	Mississippi	National River & Recreation Area	MN	4.0	551091002
MISS	Mississippi	National River & Recreation Area	MN	4.0	271636015
PETR	Petroglyph	National Monument	NM	2.5	350010027
ROCR	Rock Creek-Achbold Parkway	Park	DC	1.6	110010025
SAIR	Saugus Iron Works	National Historic Site	MA	1.8	250092006
SARA	Saratoga	National Historical Park	NY	0.0	360910004
EVER	Everglades	National Park	FL	3.0	120860029
OLYM	Olympic	National Park	WA	5.0	530090005
BITH	Big Thicket	National Preserve	TX	0.0	CASTNet ALC188

Table 8. POMS monitoring sites.

Regular Network Site Operating Information			**Networks**			
Site name	**Abbrev.**	**Ozone monitor**	**CASTNet**	**State**	**Other GPMP**	**POMS**
		X				1
Assateague Island NSS	ASIS-MA	X				1
Carlsbad Caverns NP	CAVE-VC	X				1
Colorado NM	COLM-MA	X				1
Cumberland Gap NHP	CUGA-PI	X				1
Dinosaur NM	DINO-WE	X				1
Joshua Tree NP	JOTR-PW	X				1

Although these partnerships expand the monitoring that ARD does, they also reduce our flexibility to shut down stations or modify what species we monitor. We also have agreements with researchers for enhanced monitoring or resource injury studies that require us to continue monitoring at some locations. Our partners should be consulted and given adequate lead time prior to NPS taking actions that would negatively affect the larger networks in which we participate.

New monitoring – ammonia

Ambient ammonia has not been routinely measured by any of the national monitoring networks. Nitrogen deposition of ammonia and ammonium ion has been found to be a significant portion of total nitrogen deposition. The available ammonia also determines the amount of ammonium nitrate and sulfate particulate matter formed in an area. PM has a much lower deposition rate which causes it to be transported farther. Several different monitoring networks are now planning to add ammonia monitoring. The ammonia monitoring that ARD plans to participate in is listed in the table 9. Although the ideal ammonia measurement would be hourly averages from a continuous measurement instrument, a truly NH3 specific instrument is still needed that can be used in a routine monitoring network. A passive sampler (2 week exposures) network at park sites in planned at NADP and IMPROVE sites.

Table 9. Networks planning to do gaseous ammonia sampling.

Network	**Method**	**Time resolution**	**Parks (total # sites)**
AMoN/CASTNet	Passive samplers	2 weeks	(9)
CASTNet	SASS denuders		(3)
AMoN/ARD	Passive samplers	2 weeks	MORA, GLAC, CRMO. YOSE, SEKI, JOTR, CHIR, ROMO, GRSM, EVER , GRTE(11)
IMPROVE	filters	24-hr, 3x/week	CHIR, BAND, MEVE, ROMO, YELL, GLAC, WICA, CEBL, Bondville, IL (9)
ARD	Ion mobility, chemiluminesence	Continuous, hourly averages	GRTE (1)

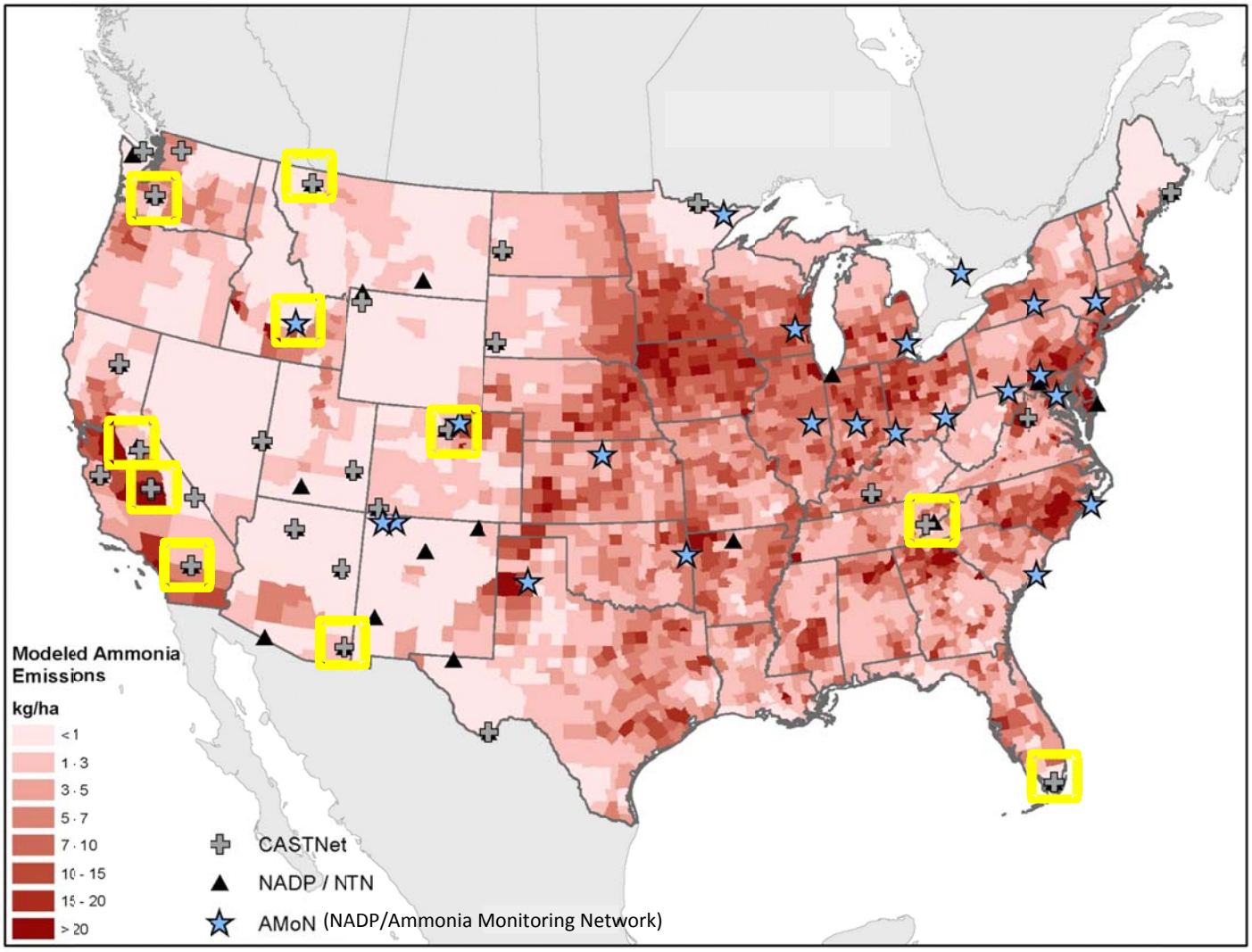

Figure 7. Location of 10 sampling sites for NPS monitoring of ammonia using passive samplers as part of the AMoN network under the NADP program. Exposures are for two weeks.

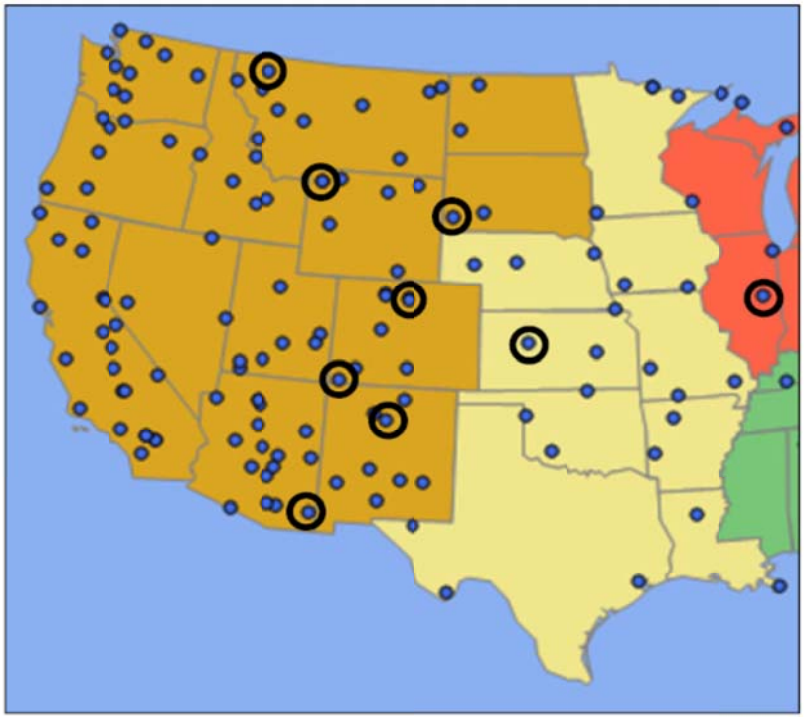

Figure 8. NOx sampling locations using modified IMPROVE samplers. North-south and east-west cross-sections are planned to capture transport from the Midwest ammonium hotspot. IC analysis will be used to determine PM2.5 NH4 and gaseous NH3.

Strategy 2 - Current condition communication and advisories to parks and the public

Effective protection of park resources from unhealthy air quality conditions can be enhanced by communication of current conditions as advice, warnings, and public information. When monitoring or forecast data are provided along with clear information on health effects it allows the public and park staff to make direct judgments on actions to be taken. For example, sensitive people with asthma might decide to hike in a park on a different day or at a different time based on air quality information and warning provided to them.

Air quality advisories in parks
Air quality forecasting assistance to parks

- AirNow forecast model outputs
- Pollutant climatology to assist forecasts
- Tools to bring forecast information together
- Simple statistical forecast tool
- Documentation on how to assemble a pollutant forecast

Current data and visual images on the web

- Current data tables and charts – color flags of NAAQS exceedances
- Webcam images and current readings for visual range, pollutant concentrations and weather. http://www.nature.nps.gov/air/webcams/index.cfm and http://www.nature.nps.gov/air/data/current/index.cfm

Summary reporting of exceedances and violations of the NAAQS

- Monthly NAAQS exceedances table http://www.nature.nps.gov/air/monitoring/exceed.cfm
- Annual tables of NAAQS exceedances and violations

Strategy 3 - Targeted monitoring to answer specific air pollution questions

This includes monitoring, special studies, and support to researchers to meet specific information needs by either the ARD programs or for park-specific issues. For example, specific studies have been conducted for Hawaii Volcanoes NP because of extremely SO2 concentrations from the volcano and for Yellowstone NP because air pollution from winter over-snow vehicle traffic. The issue of nitrogen deposition at Rocky Mountain NP had an extensive research program. These very park-specific programs are usually done at the request of the parks and with their support.

Other targeted monitoring may be to address broader issues but may be conducted in a limited number of parks. These special studies can effectively answer questions dealing with source attribution and transport. Targeted studies such as WHITEX, MOHAVE, and PREVENT have been instrumental in developing source-receptor relationships that linked emissions from large coal-fired power plants to haze in national parks. As a result, the power plants significantly reduced their sulfur dioxide emissions. BRAVO, another targeted study, identified the relative contributions of Mexico and large source regions to haze in Big Bend National Park, while an ongoing study, ROMANS, will for the first time determine the link between nitrogen deposition in Rocky Mountain National Park and source emissions of reactive nitrogen such as NH_3 and NOx.

A common denominator in many target studies is the measurement of key aerosol and gaseous species at multiple locations surrounding the park unit or units of interest. For instance, in BRAVO measurements were made throughout Texas, New Mexico, Arizona, and Mexico, while in ROMANS measurements were made in Colorado, Nebraska, and Utah. These measurements are used in source-oriented receptor models and to calibrate deterministic models. These various modeling efforts are reconciled and apportionment estimates are established with well-specified accuracy.

Other uses for targeted studies are to:

- determine nonattainment status and track progress; provide feedback to states on effectiveness of SIPs and control strategies;
- assess the AQ risk to parks, prioritize, work toward reversing trend or existing poor conditions;
- track the trends in rural ozone for both background and ambient changes; provide feedback on the effectiveness of NOx control programs and changes in NOx emissions;
- use monitoring data to argue higher than critical load and excessive concentration conditions; use to respond to permits, to influence SIPs, and to propose needed emission reductions.

Generally, targeted studies would be for specific parks, have their own set of objectives, and have a limited time in which the objectives would be accomplished.

Leadership is provided by the ARD visibility program in understanding the connections between emissions and haze, the changes in chemistry and the effects on visibility, transport of haze, source attribution, and prediction of changes. Monitoring development is still needed to differentiate man-made from naturally occurring organic mass and to assess the hygroscopicity of organic aerosols especially as they relate to man-made vs. natural origins. Targeted studies to relate emissions to visibility impairment are still needed for some haze-impacted parks.

Ozone is the primary criteria pollutant in the gaseous monitoring program. Because it is a secondary pollutant formed from a mix of many other air pollutants, it is also a good indicator of air quality. The ties to the CASTNet program tend to favor long-term monitoring at geographically distributed locations. Other criteria pollutants are well below the standard in most non-urban parks, and their inclusion in monitoring plans is more in line with the EPA shift to multiple-pollutant monitoring to better understand atmospheric transformations and transport. The NPS and state monitors that participate in the NCore program will provide data for improved computer modeling.

Particulate matter ($PM_{2.5}$ and PM_{10}) is measured with continuous monitoring instrumentation that is comparable with other gaseous and meteorological measurements. For that reason, the number of continuous $PM_{2.5}$ monitors has grown at GPMP sites in recent years. There is an overlap with the visibility program in the PM monitoring. The ARD has funded very few of these $PM_{2.5}$ monitors, but encourages partners to provide the instruments because of the health issues and the connection to wildfire smoke.

Table 10. Location and funding source for PM2.5 continuous monitors in parks.

NPS funded $PM_{2.5}$ monitors	State or other agency funded $PM_{2.5}$
Joshua Tree (TSI DustTrak)	Acadia (TEOM)
Hawaii Volcanoes (SHARP-BAM)	Badlands (BAM)
Hawaii Volcanoes (TSI DustTrak)	Great Smoky Mountains (TEOM)

Yellowstone (BAM) Zion (BAM)	Mammoth Cave (TEOM) Wind Cave (BAM) Shenandoah (TEOM) Theodore-Roosevelt (TEOM) Yosemite (BAM) Sequoia-Kings Canyon (BAM)

BAM - Beta Attenuation Monitor

TEOM - tapered element oscillating microbalance

There is also an overlap with the deposition program and toxic studies because of the gaseous nature of those pollutants or their atmospheric transformations through gaseous species. For example, volatile organic compounds (VOCs) have been measured in specific studies, some mercury species are transported in the atmosphere as gaseous compounds, and many of the compounds on the EPA's hazardous air pollutants (HAPS) list are gaseous pollutants. Inclusion of other pollutants than ozone, PM, and SO_2 will be solely in short-term special studies, not as a routine network.

To the extent possible within budget limitations, the POMS program will continue to be used to survey ozone concentrations at locations without adequate monitoring. Parks and I&M networks are being encouraged to decide where these measurements are needed and to help provide for some of the monitoring costs. The ARD will continue to provide the guidance, instrument calibration, maintenance facility, and quality assurance oversight to insure that the data are of high quality and meet data objectives. Passive sampler support will be provided in a similar way. The ARD has the expertise and contracts to facilitate these measurement methods, even if it cannot fully fund all aspects the monitoring.

Two targeted studies are planned in the immediate future:

1. Effects of oil and gas development in Utah, Colorado, and Wyoming (3 State Study) on ozone and deposition. This is a monitoring and modeling study to assess the impacts of gas field development. High winter ozone have already be observed in some areas. This is a joint study with multiple state and federal agencies.

2. Nitrogen transport, characterization, and deposition study at Grand Teton National Park (GrandTReNDS). This is a followup and next phase to the RoMANS study. It is combined with water quality studies of high elevation lakes. Partners include Colorado State University researchers and the Wyoming Department of Environmental Quality.

NPS Operation of Monitoring Stations for Other Agencies

In some cases the Air Resources Division may operate an air quality monitoring station for another agency when it is in the interest of NPS or NPS is participating in a larger program or study that serves NPS objectives. Likewise, ARD may arrange for another agency to operate and submitted data on our behave to the EPA AQS database. These exchanges are usually governed by an MOU or IAG that details the objectives and responsibilities.

Examples of cooperation with other agencies include the following:

Agency cooperator	Parameters measured	Locations
BLM	O3, PM2,5, NOx, met	Meeker and Rangely , CO stations
EPA, Region 8	O3, met, VOC	Escalante, UT and Wamsutter, WY stations
USFS	O3, met	Escalante, UT station
NPS ARD	O3, met	POMS at DINO (UT), COLM (CO) (12-month)

These stations are operated as part of the Three-State Study to characterize air quality conditions and changes related to oil & gas development in the states of Utah, Colorado, and Wyoming. A modeling exercise is associated with the project to help predict the effects of gas development on ozone concentrations. High winter-time ozone have already been observed from the network.

Stategy 4 - Use New Technology and Shared Resources

Several new technologies are expected to play an increasing role in the monitoring program (figure 9). Satellite-based observations systems are increasingly useful for tropospheric measurements of CO, NO_2, some organics, aerosols, CO_2, meteorological parameters, O_3, and SO_2. Generally, these measurements are less certain right at the surface, have a broader area of representation (grid size), and have less time resolution than the hourly measurements. However, the spatial coverage is much greater and transport can often be determined over time. The products and availability of the satellite information are expected to get better over the next 5–20 years as satellites already in the pipeline come on board. More detailed hourly data from satellites are not imminent. Combinations of satellite and ground-based networks are likely to provide the best information over the next 10 years.

- Availability of satellite measurements in increasing spatial and temporal scale
- Data interpolation to get first-order approximations

- Lower-cost portable monitors to do survey measurements
- Fusion methods to combine surface monitoring data with either satellite data or computer modeling outputs to improve spatial concentration estimations

Other significant resources for pollutant information and understanding are the computer models, such as CAMx or CMAQ, that calculate concentrations and the transport of pollutants. Increasing computer power makes smaller grids and longer model periods possible. The incorporation of satellite data into the models has the potential to further increase the quality of the model outputs. The prediction ability and timing of peaks by the models are currently worse than the observational accuracy; however, this is improving. Initially, computer modeling will be of most use in checking existing pollutant conditions, predicting transport and pollutant budgets, and predicting a broader range of pollutant concentrations than measured in the monitoring networks. Annual and seasonal pollutant concentrations and depositions will soon be possible to obtain.

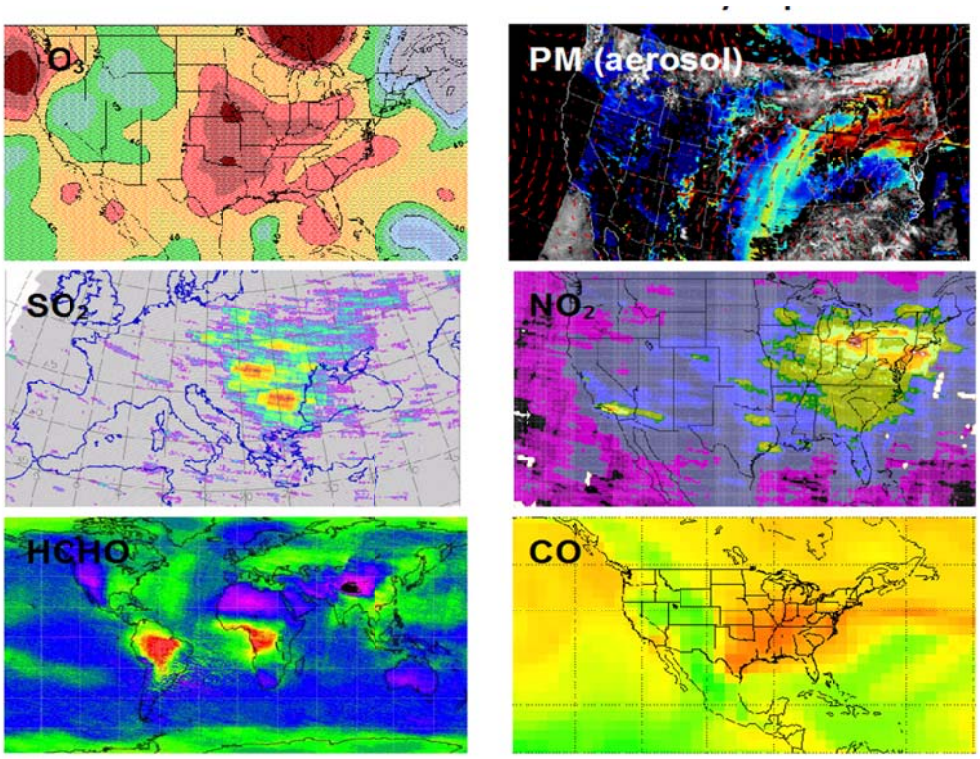

Figure 9. Examples of the satellite air quality data currently available for the troposphere. Some of the problems with the satellite data are listed on the left. Hourly data for all hours is far away since the satellites are only on the drawing boards for such detailed temporal air quality measurements. *Source:* *http://www.epa.gov/ttn/amtic/files/ambient/monitorstrat/precursor/measurement.ppt*

These advanced technology products can be used to augment and eventually replace the spatial interpolation products in Air Atlas. Far more park locations can have estimated or approximate pollutant concentration values using these data input than could be afforded by ground-based monitoring at each site. To take advantage of these tools, new partnerships with NOAA, NASA, and the EPA will been needed, ARD staff will have to move from monitoring analysis to satellite and modeling analysis, and new contractors will be needed to do the routine preliminary data processing and archiving.

Uses of satellite data in NPS AQ programs

- Emission sources
- Tracking plumes from fixed sources or exceptional events (wildfires, dust storms, volcanoes)
- Spatial concentration estimations over monthly or annual periods –
- Pollutant event tracking
- Estimations of ozone formation potential and transport

At present the satellite data is semi-quantitative for surface pollutant concentrations because of problems in getting tropospheric observations only versus column values and because of interferences/problems such as clouds, surface reflectance, or satellite-view coverage. Good current uses of satellite data include tracking events or specific plumes of pollutants. The key to ARD using more satellite data is going to be the development of more practical air quality tools by NASA, NOAA, and other parties and the ability of ARD to ingest the data files and extract the key information at resolution levels appropriate for use at the park level.

What ARD could do now with satellite data:

- Identify exceptional events, such as wildfires, that effect the monitored concentrations of ozone and particulate matter at specific locations. This is useful for exception event flagging of data and for source identification.
- Determine monthly, seasonal, and annual averages of O3, CO, NO2, and PM2.5 for comparison to surface-measured concentrations. Use those relationships to improve the GIS spatial interpolation estimates.
- In combination with back trajectory analysis, use the satellite data to track and explain pollution events (O3, PM2.5, NO2)

Strategy 5 - Determine the connections to Climate Change and its effects on parks

The broad issue of global climate change has seemed far beyond the immediate control and park-centric concern of air quality. This is partly because the pollutants usually of concern as greenhouse gases are atmospheric trace gases that are not generally toxic to plants or humans at

anywhere near the concentrations they are found in the atmosphere. Furthermore, greenhouse gases were not addressed in the Clean Air Act or amendments, which therefore leave little specific legislative direction. The effects of greenhouse gases and climate change are more indirect in their action and effects on park resources. However, climate change will affect the air pollutants we now monitor, and criteria air pollutants have connections to the greenhouse effect that drives recent climate change. For example, tropospheric ozone is a strong greenhouse gas, though of short duration in the atmosphere. Control of ozone involves control of NOx and organic compounds. The concentrations of methane, also a long-lived greenhouse gas, are tied to carbon monoxide (CO) and NH_3 emissions. Aerosols that make up haze can have a cooling effect. Thus, actions taken to control or change air pollutants can have an effect on climate-changing greenhouse gases, either directly or indirectly.

The role for the ARD in the climate change issues is to acknowledge the interactions and consider them in decisions, to use monitoring data to help understand changes that are occurring and to support modeling efforts, and to assure that future monitoring is adequate to provide feedback on how conditions are changing in the parks and how greenhouse gas reduction strategies are working. No direct monitoring of greenhouse gases is anticipated in the parks. Data from other networks and satellite data can be used to assess impacts on pollutants we already monitor.

Strategy 6. Provide analysis and interpretation in support resource management

For the monitoring program to be effective, the results must be communicated to park staff, to ARD managers, to EPA and other agencies, and to researchers. More than just raw data reporting is needed to provide meaning and perspective of the air quality information.

Using the data collected effectively and consistently is an important part of a monitoring program. The conversion of raw data to useful information should be planned and budgeted just as the physical activity of running the monitoring networks are. Results from those analyses include

- Present-value statistical presentation of data
- a summary of NAAQS and resource relevant statistics
- multiple methods of trend analysis
- updates and comparisons to Air Atlas estimates
- transport analysis to identify sources areas
- use tracers to characterize pollutant aging and broad sources types

The most through and useful analysis conclude with a report or peer-reviewed publication. Input into plans, policies, state SIPS, reviews of permits, proposed emission control strategies, and resource management plans are all outputs for the data and analysis from the monitoring.

Reporting and Presenting Results

Feedback and accountability to our partners in the parks is absolutely necessary. Previously, the networks have demonstrated that the data was collected and give data quality indicators, while providing limited analysis products. The most detailed analysis and interpretation of the data often appears in publications that park staff may have limited access to. There is also some disconnect in that the message behind the publications may not be forwarded to or even understood by people involved in the policy arena. This is especially true when dealing with pollutants without a defined standard. There are also researchers not directly affiliated with the ARD monitoring and analysts from other agencies who report and publish results using our monitoring data. The ARD web site (http://www.nature.nps.gov/air/index.cfm) is providing a communication tool that greatly broadens access to the monitoring information and tools to use and understand the results.

The ARD will provide analysis, interpretation, and perspective on the air quality data collected. These include tables and accounting with regard to compliance with the NAAQS, trends in pollutants at the parks to serve as indicators and provide accountability, current data and camera images on the ARD web site, and risk assessments of pollutant injury to vegetation and comparisons to thresholds for injury, A new web page tool is proposed for assembling all the NPS air quality and deposition data together in a database with an interface that can provide results and summaries in table and graphic formats to park users.

The ARD will support the NPS I&M program by providing expertise and advice, by sharing monitoring data, by providing air quality inventories, and by posting the data, GIS layers, analysis results, and modeling results to databases and web pages that serve the I&M effort.

Budgets and Monitoring

The monitoring strategy and network assessments (appendix) will be used to determine how many monitoring stations can be supported and which stations have priority. Budget projections over the next five years predict decreasing program funds, therefore, some existing monitoring stations may have be shut down, overall costs reduced, more partnerships used to replace funding, and efficiencies extracted in current operations. Appendix B has a cost reduction schedule that may be followed if budget shortfalls happen as projected. New equipment and new monitoring parameters, such as additional ammonia or mercury monitoring, may mean accelerated or more cutbacks in other areas of monitoring. The network assessment appendix has rules that are applied to evaluate and rank the monitoring stations and park needs in line with our monitoring objectives and the proposed structure to the networks.

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Appendix A – Glossary

ARD Air Resources Division of NPS, a Washington Office under the Natural Resources Directorate

AQRV Air quality related values - general term used in the Clean Air Act for any resource that might be affected by air quality.

CASTNet Clean Air Status and Trends Network - national program to monitor dry deposition and ozone. Prescribed in the Clean Air Act Amendments. Originally to track progress of the acid rain program.

GPMP Gaseous pollutant monitoring program. ARD network for ozone and meteorological measurements

IMPROVE Interagency Monitoring of PROtected Visual Environments - a national visibility monitoring program

NAAQS National Ambient Air Quality Standard, for each criteria air pollutant.

NADP/NTN National Atmospheric Deposition Program / National Trends Network – a multi-agency cooperation national to measure primarily wet deposition.

NCore EPA program to have national monitoring in urban and non-urban locations that measures key precursors to ozone formation at trace concentrations.

MDN Mercury Deposition Monitoring program operated in conjunction with NADP for wet deposition of mercury.

RHR Regional Haze Rule – Regulation requiring visibility improvement over a 60 year span to return to natural background levels for mandatory Class I areas as defined by the Clean Air Act Amendments.

RPOs Regional Planning Organizations that were setup to determine how best to meet the objectives of the Regional Haze Regulation.

SLAMS/NAMS State, local, and national monitoring stations used for regulator compliance.

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

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National Park Service
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