

INTERAGENCY MONITORING OF PROTECTED VISUAL ENVIRONMENTS



QUALITY MANAGEMENT PLAN

**for the Aerosol
Monitoring Network Component
of the
IMPROVE
Visibility Monitoring Program**

May 2002

QUALITY MANAGEMENT PLAN IDENTIFICATION AND APPROVAL

The attached QMP for the aerosol component of the IMPROVE Program is hereby recommended for approval and commits the resources and personnel to follow the elements described within.

******* ORIGINAL SIGNATURES ARE AVAILABLE UPON REQUEST *******

Office of Air Quality Planning and Standards

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Dr. William Malm, Technical Lead

U.S. Forest Service

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FOREWORD

The following document is a Quality Management Plan (QMP) for the environmental data operations of the Aerosol Monitoring Network component of the IMPROVE (Interagency Monitoring of Protected Visual Environments) Visibility Monitoring Program. This QMP outlines the roles of organizations involved in the IMPROVE Aerosol Monitoring Network.

This QMP was generated using the EPA Quality Assurance (QA) regulations and guidance as described in EPA QA/R-2, *EPA Requirements for Quality Management Plans*¹. All pertinent elements of the QMP regulations and guidance are addressed in this document.

ACKNOWLEDGMENTS

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ACRONYMS AND ABBREVIATIONS

AQRV	Air Quality Related Values
BLM	Bureau of Land Management
CAA	Clean Air Act
CBI	Confidential Business Information
CD-ROM	Compact Disc – Read Only Memory
CFR	Code of Federal Regulations
CIRA	Cooperative Institute for Research in the Atmosphere
CNL	Crocker Nuclear Lab
CO	Contracting Officer
COTR	Contracting Officer's Technical Representative
DQA	Data Quality Assessment
DQOs	Data Quality Objectives
DRI	Desert Research Institute
EDO	Environmental Data Operation
EMAD	Emissions, Monitoring, and Analysis Division
EPA	U.S. Environmental Protection Agency
EPM	Environmental Program Management
FAR	Federal Acquisition Regulations
FLMs	Federal Land Managers
FTP	File Transfer Protocol
IA	Interagency Agreement
IMPROVE	Interagency Monitoring of Protected Visual Environments
IPA	Instrument Performance Audit
LOGS	Name of CNL collection database
MARAMA	Mid-Atlantic Regional Air Management Association
MQAG	Monitoring and Quality Assurance Group
MQOs	Measurement Quality Objectives
MSR	Management System Review
NAAQS	National Ambient Air Quality Standards
NAMS	National Air Monitoring Station
NAPAP	National Acid and Precipitation Assessment Program
NAREL	National Air and Radiation Environmental Laboratory
NESCAUM	Northeast States for Coordinated Air Use Management
NOAA	National Oceanic and Atmospheric Administration
NPS ARD	National Park Service Air Resources Division
OAQPS	Office of Air Quality Planning and Standards
OFPP	Office of Federal Procurement Policy
ORIA	Office of Radiation and Indoor Air
PE	Performance Evaluation
PIXE	Particle Induced X-ray Emission
PESA	Proton Elastic Scattering Analysis
PM _{2.5}	Particulate matter less than 2.5 microns in diameter
PO	Project Officer
PR	Purchase Requisition
PSD	Prevention of Significant Deterioration
QA	Quality Assurance

QAAR	Quality Assurance Annual Report
QAC	Quality Assurance Coordinator
QAM	Quality Assurance Manager
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
QS	Quality Staff
R&IE	Radiation and Indoor Air Environments National Laboratory
RTI	Research Triangle Institute
SLAMS	State and Local Air Monitoring Stations
SIP	State Implementation Plans
SOP	Standard Operating Procedure
SOW	Statement of Work
SQL	Structured Query Language
STAG	State Assistance Grants
STAPPA	State and Territorial Air Pollution Program Administrators
TEP	Technical Evaluation Panel
TSA	Technical System Audit
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
WAM	Work Assignment Manager
WESTAR	Western States Air Resources Council
XRF	X-Ray Fluorescence

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1.0 PROGRAM ORGANIZATION AND MANAGEMENT

The purpose of this section is to document the overall quality assurance policy, scope, applicability, and management responsibilities of the Aerosol Monitoring Network component of the IMPROVE Program. The section describes the program, organization, and management as it relates to quality assurance.

1.1 INTRODUCTION

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 (CAA), 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 which impairment results from man-made air pollution.” The U.S. Environmental Protection Agency (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. In 1999, the EPA promulgated Regional Haze Regulations² requiring states to develop state implementation plans (SIPs) that include reasonable progress goals for improving visibility in Class I areas, and present strategies to achieve those goals.

Monitoring of visibility-related parameters has and will be used to document existing conditions and identify trends in ambient visibility. The IMPROVE Program was established in 1985 in response to the 1977 Clean Air Act Amendments. Federal Land Management agencies (FLMs) responsible for Class I areas joined the EPA in a collaborative program known as the Interagency Monitoring of Protected Visual Environments (IMPROVE) Program. Three primary visibility monitoring networks operate under the IMPROVE Program:

Aerosol Monitoring Network:	Applies speciation filter samplers to measure the physical properties of visibility-related ambient atmospheric particles (chemical composition, size, concentration, distribution, and other properties).
Optical Monitoring Network:	Applies transmissometers and nephelometers to measure the ability of the ambient atmosphere to scatter and absorb light.
Scene Monitoring Network:	Applies photographic and digital camera systems to document the appearance of a scene viewed through the atmosphere.

Data from these three networks have been compiled to better understand and document ambient visibility events and trends.

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. Section 109 calls for EPA to establish primary and secondary NAAQS in order to protect public health and public welfare, respectively. For many years, visibility has been recognized as a “welfare effect” of particulate matter. In July 1997, EPA established new air quality standards for $PM_{2.5}$ (particulate matter less than 2.5 microns in diameter). The annual $PM_{2.5}$ standard, to be averaged over a period of 3 years, is 15 micrograms per cubic meter. The 24-hour standard is 65 micrograms per cubic meter. In this action, EPA also set secondary standards for $PM_{2.5}$, equivalent to the suite of primary standards.

The $PM_{2.5}$ monitoring regulations at 40 CFR Part 58 recognize the importance of monitoring for protection of secondary NAAQS and also allow the use of the IMPROVE protocols for the purpose of characterizing background or transported levels of $PM_{2.5}$. The $PM_{2.5}$ and IMPROVE programs are closely related through this provision. It will be important to understand the regional nature of $PM_{2.5}$ levels in order to improve the accuracy of regional PM models and ultimately to develop effective control strategies. Section 165 of the Act provides for pre-construction review of air quality impacts associated with new or modified major sources. The Prevention of Significant Deterioration (PSD) program protects Class I areas by allowing only a small increment of air quality deterioration in these areas and by providing for assessment of potential impacts on the air quality related values (AQRVs) of Class I areas. AQRVs include visibility and other fundamental purposes for which these lands have been established.

1.2 FINE PARTICLE MONITORING

Figure 1-1 illustrates the overall EPA national fine particle monitoring program. As can be seen from this figure, the second tier of the pyramid deals with routine speciation monitoring. The IMPROVE Aerosol Monitoring Network is a key component of the EPA’s national fine particle monitoring and is critical to tracking progress related to the Regional Haze Regulations. The data quality of the IMPROVE Aerosol Monitoring Network is the subject of this QMP. This QMP deals strictly with the IMPROVE Aerosol Monitoring Network. As such, the IMPROVE Aerosol Monitoring Network will support the understanding of the fine particle problem and will tie into the overall EPA program.

To support implementation of the $PM_{2.5}$ standards and the regional haze regulations, EPA provided for a significant expansion of the IMPROVE Aerosol Monitoring Network in 1999. EPA recognizes the need to provide visibility monitoring guidance to ensure that the methodologies used to collect and analyze visibility-related aerosol data are consistent and applicable for tracking progress toward visibility goals in the future.

Fine particle monitoring in the IMPROVE Program is achieved by using the IMPROVE aerosol sampler to collect filter samples, which are laboratory analyzed for specific aerosol species. The standard IMPROVE sampler has four sampling modules, designed to obtain a complete signature of the composition of the airborne particles that affect visibility. Module A (Teflon[®]), B (nylon), and C (quartz) collect fine particles ($PM_{2.5}$). Module D (Teflon[®]) collects PM_{10} particles. Laboratory analysis of filters from Module A provides most of the fine particle data, with $PM_{2.5}$ mass, elements H and Na-Pb, and the coefficient of optical absorption. Module B, with a denuder before the filter to remove acidic gases, is used primarily for nitrate. Module C with tandem quartz filters, measures carbon in eight temperature fractions.

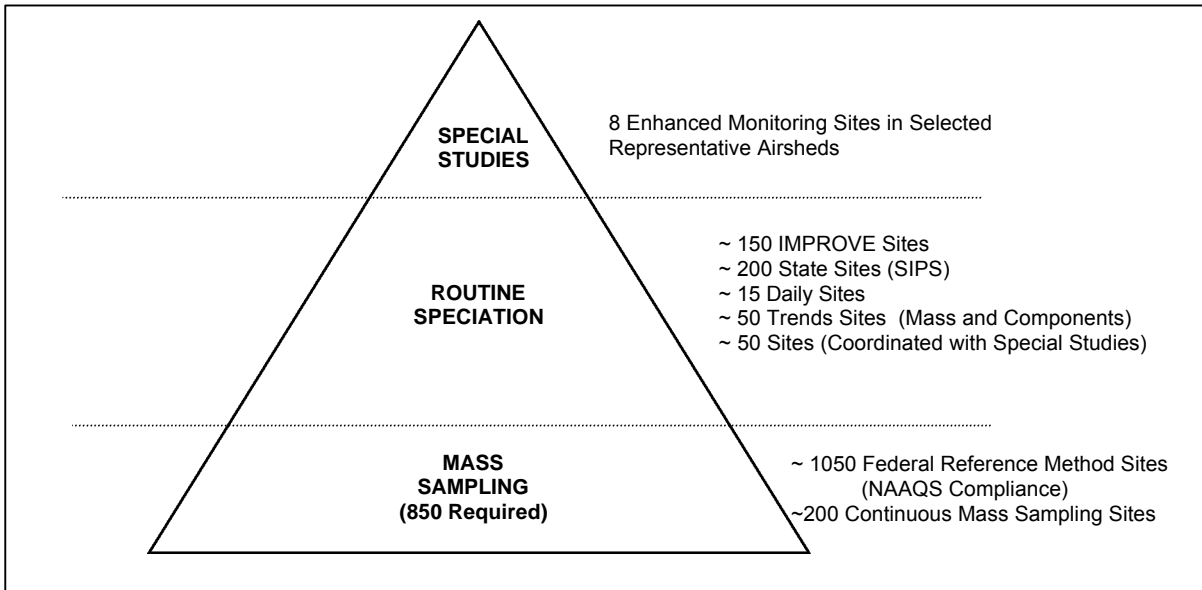


Figure 1-1. Overview of the EPA National Fine Particle Monitoring Program (as of May 2002).

1.3 ROLES AND RESPONSIBILITIES

Figure 1-2 illustrates the organization of the IMPROVE Aerosol Monitoring Network. Three distinct groups exist within the Program. The chart shows the quality control (QC) and management organization; the gray boxes within the chart represent external quality assurance (QA) organizations. Below are descriptions of each organization.

1.3.1 IMPROVE Steering Committee

The IMPROVE Steering Committee consists of representatives from the ten (10) member and one (1) associate member organizations listed below. These representatives provide oversight to the entire program and meet at least annually to discuss any and all issues that concern the program. In addition, they will interact with the Quality Assurance Coordinator (QAC) and the organizations involved in field, laboratory, analysis, and reporting activities.

- National Oceanic and Atmospheric Administration
- U.S. Environmental Protection Agency
- National Park Service
- Bureau of Land Management
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- NESCAUM (Northeast States for Coordinated Air Use Management)
- STAPPA (State and Territorial Air Pollution Program Administrators)
- WESTAR (Western States Air Resources Council)
- MARAMA (Mid-Atlantic Regional Air Management Association)
- State of Arizona (associate member)

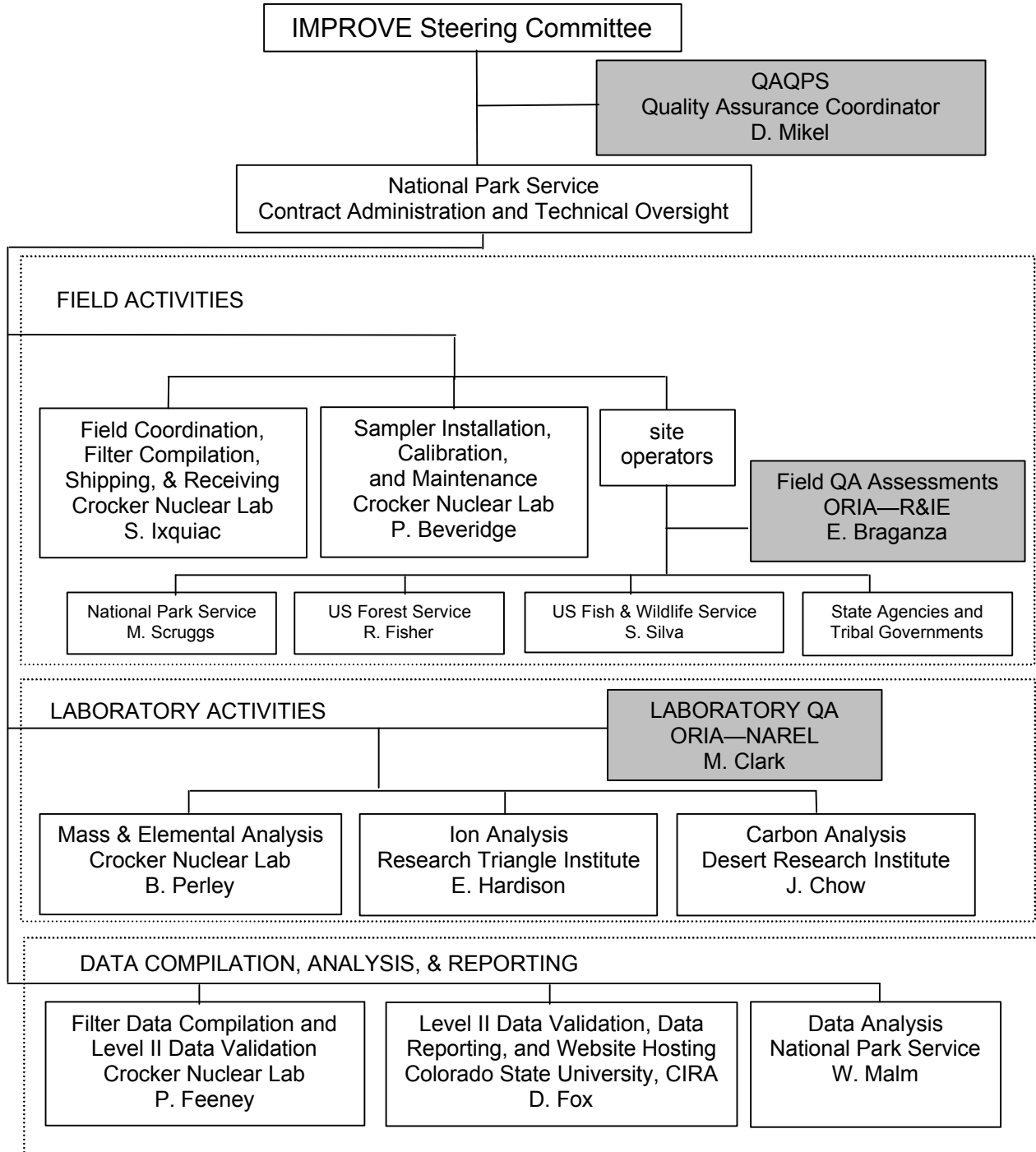


Figure 1-2. IMPROVE Aerosol Monitoring Network Organizational Chart.

1.3.2 Office of Air Quality Planning and Standards(OAQPS) - QAC

At the top of the QA structure is the OAQPS-QAC. It is the QAC's responsibility to oversee that QA is implemented into the program and oversee the work performed by the following QA agencies:

- Office of Air Quality Planning and Standards (OAQPS), Raleigh, NC.
 - Quality Assurance Coordinator (QAC) – D. Mikel

- Office of Radiation and Indoor Air (ORIA).
 - National Air and Radiation Laboratory (NAREL), Montgomery, AL – M. Clark
 - Radiation and Indoor Air Environments National Laboratory (R&IE), Las Vegas, NV – E. Braganza

The QAC will meet periodically with NAREL and R&IE, the two supporting agencies and IMPROVE Steering Committee to discuss QA issues as they arise throughout the program. Assessment reports will be given annually to the QAC by the supporting agencies and other program participants as noted in Table 2-2. In addition to NAREL and R&IE, the QAC may also perform a management system review (MSR) or technical system audits (TSAs) on any of the agencies in the QA or monitoring system.

The QAC's primary responsibilities are to:

- Ensure that the methods and procedures used in making air pollution measurements are adequate to meet the program's objectives and that the resulting data are of satisfactory quality.
- Develop a Quality Management Plan.
- Periodically review the field and laboratory Quality Assurance Project Plan (QAPP).
- Evaluate the performance of organizations making chemical speciation measurements through mechanisms such as technical system audits, performance evaluations, and management system reviews.

1.3.3 National Air and Radiation Environmental Laboratory (NAREL)

NAREL in Montgomery, Alabama, is one of two ORIA laboratories that will have a major role in the quality assurance system and will perform independent audits for the IMPROVE Program. NAREL will fill a specific and vital role in the laboratory quality assurance aspects of the program. These duties are briefly listed below (details are presented in the NAREL QA Management Plan³):

- Review SOPs and QAPP.
- Perform Performance Evaluation (PE) Round Robin.
- Perform on-site laboratory Technical System Audits (TSAs).

- Forward audit report to OAQPS.
- Maintain a repository of PE samples that could be used as double-blind PEs by states, diagnostic tools by laboratories, etc.

1.3.4 Radiation and Indoor Air Environments National Laboratory (R&IE)

R&IE is the other ORIA laboratory that will have a major role in the quality assurance system and will perform independent audits for the IMPROVE Program. The Las Vegas, Nevada, office will fill specific and vital roles in the field quality assurance aspects of the program. These are briefly listed below:

- Provide the major portion of the field QA for this program, consisting of field TSAs; site visits; and flow, temperature, and pressure sensor checks in the field.
- Provide observations of ongoing work to document conformance with specified field SOPs and QAPPs.

1.3.5 National Park Service (NPS)

The National Park Service (NPS) is the key operational agency of the IMPROVE Program. The agency is responsible for implementing the technical direction of the Steering Committee; operating many of the IMPROVE sites; issuing and administering all IMPROVE contracts; performing final QA on all data; performing data analyses; and distributing the data, analyses results, and project information through the IMPROVE Web site.

The NPS is critical to all aspects of the program. Specifically, the agency's responsibilities include:

- Participate in the IMPROVE Steering Committee.
- Issue and administer the following IMPROVE support contracts:
 - Aerosol Monitoring Network support and mass and elemental speciation (current contract to University of California-Davis; Crocker Nuclear Lab – CNL)
 - Ion filter analysis (current contract to Research Triangle Institute – RTI)
 - Carbon filter analysis (current contract to University of Nevada; Desert Research Institute (DRI)
 - Data quality assurance, analysis, and reporting (current contract to Colorado State University; Cooperative Institute for Research in the Atmosphere (CIRA)
- Provide technical oversight to all aspects of the program in response to the IMPROVE Steering Committee.
- Perform detailed data analyses including the preparation of scientific papers and presentations.

- Operate NPS IMPROVE monitoring sites through cooperating national parks:
 - Operate and maintain IMPROVE samplers
 - Receive, install, and unload filter modules
 - Ship modules to CNL

1.3.6 Crocker Nuclear Laboratory (CNL)

Crocker Nuclear Laboratory (CNL) is the coordinating laboratory for all field operations and speciation laboratory work. CNL will coordinate filter pre-sampling, shipping, sampling, and post-sampling activities. Many QA activities will be performed by CNL internally. The QA activities are detailed in CNL's Quality Assurance Project Plan⁴. Some of the QA activities are briefly listed below:

- Track and recordkeep all samples as they move through the program.
- Perform mass and/or elemental analyses on IMPROVE Module A and D filters.
- Distribute Module B and C filters to and receive analysis data from participating ion and carbon laboratories.
- Participate in all TSAs and MSRs.
- Analyze the PEs when received from the NAREL laboratory.
- Coordinate with other contract laboratories (RTI and DRI) and assure that good laboratory practices and QA are performed.
- Maintain adequate internal documentation and quality control.
- Perform Level 0, Level I, and some Level II data validation.
- Perform precision and bias analyses on collected data.
- Perform annual calibrations, adjustments, and major repairs of the field samplers.
- Install instrumentation at new monitoring sites.
- Coordinate the manufacturing of IMPROVE samplers.

1.3.7 Research Triangle Institute (RTI)

Under contract to the NPS, RTI will perform ion chromatography on all IMPROVE Module B nylon filters. Specifically, RTI will:

- Receive all Module B nylon filters and associated flow and run-time data from CNL.
- Perform ion chromatography on all sample filters and blanks.
- Report all results to CNL.
- Maintain good laboratory practices, internal documentation, and quality control.

1.3.8 Desert Research Institute (DRI)

Under contract to the NPS, DRI will analyze all IMPROVE Module C quartz filters for carbon. Specifically, DRI will:

- Prefire all Module C quartz filters and forward them to CNL.
- Receive all Module C filters and associated flow and run-time data from CNL.
- Perform carbon fraction analyses on all sample filters and blanks.
- Report all results to CNL.
- Maintain good laboratory practices, internal documentation, and quality control.

1.3.9 Cooperative Institute for Research in the Atmosphere (CIRA)

Under a cooperative agreement with the NPS, the Colorado State University – Cooperative Institute for Research in the Atmosphere will perform the following data management, analyses, and reporting functions for IMPROVE:

- Receive data from CNL with Level I and some Level II validation, and perform additional Level II data validation.
- Maintain all IMPROVE data, reports, and program documentation on the IMPROVE Web site.
- Develop, maintain, and host the IMPROVE Web site.
- Perform scientific analyses of IMPROVE data as directed by the NPS. Prepare scientific papers and presentations including video and CD-ROM presentations.

1.3.10 U.S. Forest Service (USFS)

The U.S. Forest Service (USFS) is a member of the IMPROVE Steering Committee and serves as one of the agencies that will perform the field work for the program. The field operators of USFS sites will be USFS employees or contractors who will:

- Operate and maintain the IMPROVE samplers.
- Receive, install, and unload the filter modules.
- Ship modules to CNL.

1.3.11 U.S. Fish and Wildlife Service (USFWS)

The U.S. Fish and Wildlife Service (USFWS) is a member of the IMPROVE Steering Committee and serves as one of the agencies that will perform the field work for the program. The field operators of USFWS sites will be USFWS employees or contractors who will:

- Operate and maintain the IMPROVE samplers.
- Receive, install, and unload the filter modules.
- Ship modules to CNL.

1.4 KEY QA PERSONNEL

1.4.1 Steering Committee Chairman - Dr. Marc Pitchford

Dr. Pitchford will serve as the chairman of the IMPROVE Steering Committee. He will schedule IMPROVE Steering Committee meetings, call them to order, facilitate the meetings, and distribute the minutes. He will coordinate with all project participants to ensure that the program develops and maintains an adequate quality system.

1.4.2 EPA Quality Assurance Coordinator – Mr. Dennis Mikel

Mr. Mikel of EPA will oversee the quality assurance aspects of the IMPROVE Program. He will be designated as the QAC and will:

- Coordinate the input to the EPA QAAR.
- Ensure that updated QAPPs are in place for all environmental data operations associated with the program.
- Ensure that technical system audits (TSAs), management system reviews (MSRs), audits of data quality, and data quality assessments occur within the appropriate schedule and conduct or participate in these audits.
- Coordinate the ORIA quality assurance activities.

The QAC has the authority to carry out these responsibilities and to bring to the attention of the Steering Committee any issues related to these responsibilities.

1.4.3 National Park Service, Fort Collins, Colorado – Dr. William Malm

As the IMPROVE administrative agency, the NPS will be responsible for ensuring that the direction of the IMPROVE Steering Committee is carried out. The NPS activities are directed by Dr. William Malm. NPS responsibilities include:

- Prepare and maintain the QAPP through NPS IMPROVE contractors.
- Coordinate and review all QA procedures and documentation for all aspects of the program.
- Verify all QA procedures are met by the NPS/IMPROVE contractors.
- Plan and review QA/QC studies.

1.4.4 Crocker Nuclear Laboratory, Davis, California – Quality Assurance Manager – Dr. Lowell Ashbaugh

As directed by the NPS and CNL program manager, Dr. Ashbaugh of CNL is responsible for the QA aspect of the field and laboratory programs and will:

- Review and maintain the quality assurance procedures for the field and laboratory aspects of the program, in cooperation with the CNL program manager and NPS.
- Verify that all field and laboratory QA procedures are met.
- Review QA documentation by staff members.
- Supervise field-related QA/QC studies, including those conducted at the field station.
- Validate the analytical results of gravimetric, HIPS, X-Ray Fluorescence (XRF), Particle Induced X-ray Emission (PIXE), and Proton Elastic Scattering Analysis (PESA).
- Validate the aerosol data set to Level I and some Level II.
- Conduct annual internal audits of CNL operations.
- Prepare the CNL QA Annual Report (QAAR) and forwarding the electronic formatted report to the OAQPS QAC.
- Prepare other reports as needed.

1.4.5 NAREL – Montgomery, Alabama Team Leader – Mr. Michael Clark

Mr. Clark of NAREL is responsible for overseeing laboratory QA activities of the IMPROVE Program and will:

- Implement and oversee the laboratory IMPROVE QA policy within the team.
- Oversee analysis of the QA samples.
- Report the QA data to the OAQPS QAC.
- Oversee the preparing of QA samples for the contract laboratories (CNL, RTI, and DRI).
- Lead the MSRs and TSAs on the contract laboratories.

1.4.6 R&IE – Las Vegas, Nevada, Branch Manager – Mr. Emilio Braganza

Las Vegas personnel will oversee the field QA activities. Mr. Braganza, the R&IE branch manager, will:

- Participate in the development of data quality requirements (field) with the appropriate QA staff.
- Perform field TSAs and performance audits.
- Oversee the verifying of all required field activities are performed and insure that measurement quality standards are met as required in the QAPP.
- Send a QA report to the OAQPS QAC for inclusion into the annual EPA Quality Assurance Annual Report (QAAR).

1.4.7 Research Triangle Institute, Research Triangle Park, North Carolina – Dr. Eva Hardison

As directed by the NPS, RTI is responsible for the laboratory QA aspects of Module B filter analyses, and will:

- Prepare and maintain all ion chromatography laboratory SOPs.
- Verify that all laboratory QA procedures are met.
- Review QA documentation by staff members.
- Validate to Level 0 all Module B ion analyses data.
- Prepare the ion component of the QA Annual Report (QAAR) and forward the electronic formatted section to CNL.

1.4.8 Desert Research Institute, Reno, Nevada – Dr. Judith Chow

As directed by the NPS, DRI is responsible for the laboratory QA aspects of Module C filter analyses, and will:

- Prepare and maintain all carbon laboratory SOPs.
- Verify that all laboratory QA procedures are met.
- Review QA documentation by staff members.
- Validate to Level 0 all Module C carbon analyses data.
- Prepare the carbon component of the QA Annual Report (QAAR) and forward the electronic formatted section to CNL.

1.4.9 Cooperative Institute for Research in the Atmosphere, Fort Collins, Colorado – Dr. Douglas Fox

As directed by the NPS, CIRA is responsible for the QA aspects of the validation, maintenance, and distribution of the final data set and overall program documentation, and will:

- Prepare and maintain SOPs for Level II validation.
- Prepare and maintain SOPs for ingestion of IMPROVE aerosol data into the online database and calculation of all aggregated data values.
- Prepare QA documentation for the QA Annual Report (QAAR).

2.0 QUALITY SYSTEM DESCRIPTION

A quality system is defined as a structured and documented management system describing the policies, objectives, principals, organizational authority, responsibilities, accountability, and implementation of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. This section will describe the principle components comprising the quality system and how they are used to implement the quality system. In addition, the latter part of this section will briefly discuss the monitoring system and how samples and data flow through the system.

2.1 DESCRIPTION OF THE AEROSOL MONITORING NETWORK

Figure 2-1 illustrates the IMPROVE Aerosol Monitoring Network and Table 2-1 lists the aerosol monitoring locations. In 1999 and 2000, the total number of sites in the IMPROVE network increased from 30 to 110. These 110 sites are under the supervision of the IMPROVE committee and represent 155 of the 156 mandatory Class I areas.

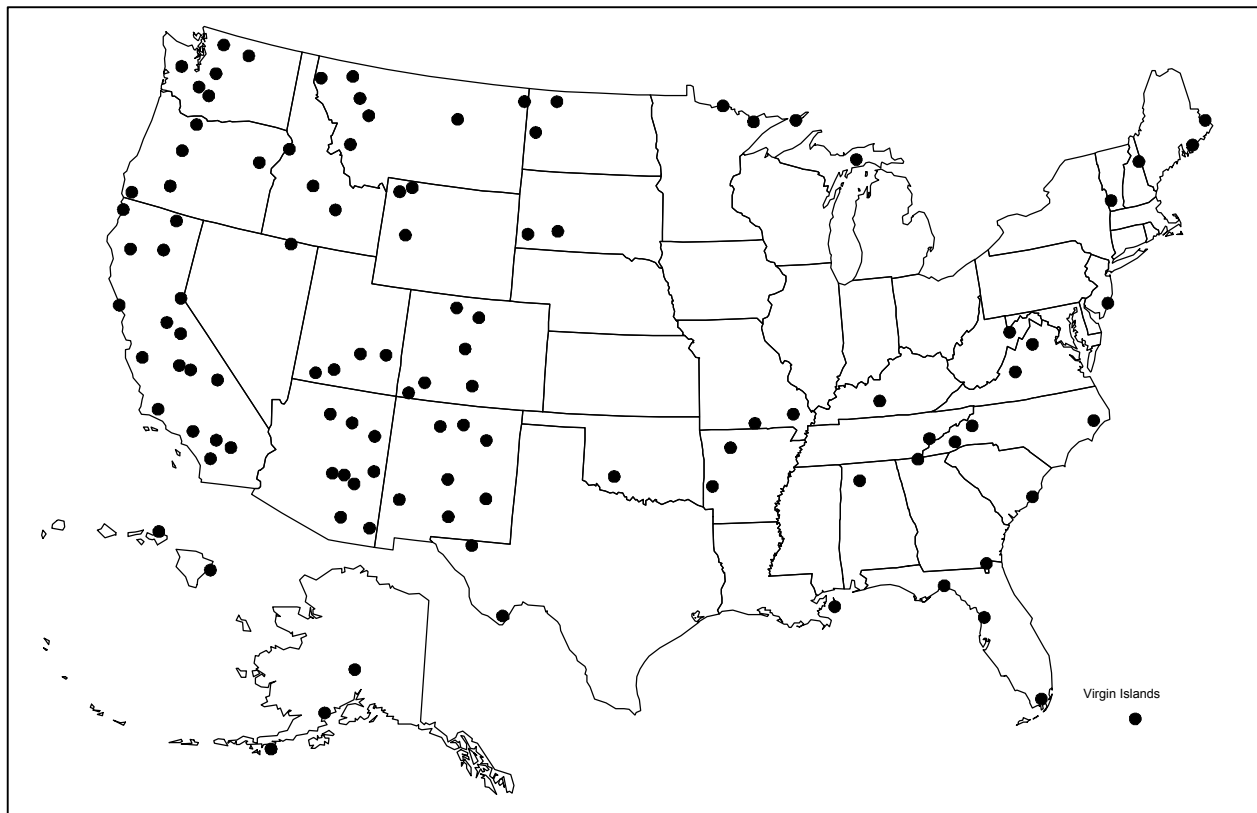


Figure 2-1. IMPROVE Aerosol Monitoring Network as of 2002.

Table 2-1. IMPROVE Aerosol Monitoring Sites: Current Sites for 2002.

Site Number	State	IMPROVE Represented Class I Areas
1	ME	Acadia
2	ME	Moosehorn, Roosevelt Campobello
3	VT	Lye Brook
4	NH	Great Gulf, Presidential Range-Dry River
5	NJ	Brigantine
6	VA	Shenandoah
7	VA	James River Face
8	WV	Dolly Sods, Otter Creek
9	KY	Mammoth Cave
10	TN	Great Smoky Mountains, Joyce Kilmer-Slickrock
11	NC	Shining Rock
12	GA	Cohutta
13	NC	Linville Gorge
14	NC	Swanquarter
15	SC	Cape Romain
16	GA	Okefenokee, Wolf Island
17	FL	St. Marks
18	FL	Chassahowitzka
19	FL	Everglades
20	LA	Breton
21	AL	Sipsey
22	MI	Seney
23	MN	Boundary Waters
24	MN	Voyageurs
25	MI	Isle Royale
26	MO	Mingo
27	AR	Upper Buffalo
28	MO	Hercules-Glades
29	AR	Caney Creek
30	OK	Wichita Mountains
31	TX	Big Bend
32	TX	Guadalupe Mountains, Carlsbad Caverns
33	NM	Bandelier
34	NM	San Pedro Parks
35	NM	Wheeler Peak, Pecos
36	NM	Salt Creek
37	NM	White Mountain
38	NM	Bosque del Apache
39	AZ	Chiricahua NM, Chiricahua W, Galiuro
40	AZ	Saguaro
41	AZ	Petrified Forest
42	NM	Gila
43	AZ	Mount Baldy
44	AZ	Superstition
45	AZ	Sierra Ancha

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Table 2-1 (continued). IMPROVE Aerosol Monitoring Sites: Current Sites for 2002.

Site Number	State	IMPROVE Represented Class I Areas
46	AZ	Mazatzal, Pine Mountain
47	AZ	Sycamore Canyon
48	AZ	Grand Canyon
49	UT	Bryce Canyon
50	UT	Canyonlands, Arches
51	UT	Zion
52	UT	Capitol Reef
53	CO	Great Sand Dunes
54	CO	Mesa Verde
55	CO	Weminuche, Black Canyon of the Gunnison
56	CO	Maroon Bells, West Elk, Eagles Nest, Flat Tops
57	CO	Rocky Mountain
58	CO	Mount Zirkel, Rawah
59	SD	Badlands
60	SD	Wind Cave
61	ND	Theodore Roosevelt
62	ND	Lostwood
63	MT	Medicine Lake
64	MT	UL Bend
65	WY	Bridger, Fitzpatrick
66	WY	Yellowstone, Grand Teton, Teton, Red Rock Lakes
67	WY	North Absaroka, Washakie
68	NV	Jarbidge
69	ID	Craters of the Moon
70	ID	Sawtooth
71	MT	Anaconda-Pintler, Selway-Bitterroot
72	MT	Glacier
73	MT	Bob Marshall, Mission Mountains, Scapegoat
74	MT	Gates of the Mountains
75	MT	Cabinet Mountains
76	OR	Eagle Cap, Strawberry Mountain
77	ID	Hells Canyon
78	WA	Mount Rainier
79	WA	Goat Rock, Mt. Adams
80	WA	Alpine Lakes
81	WA	North Cascades, Glacier Peak
82	WA	Pasayten
83	WA	Olympic
84	OR	Three Sisters, Mount Jefferson, Mount Washington
85	OR	Mount Hood
86	OR	Crater Lake, Diamond Peak, Mountain Lakes, Gearhart Mountain
87	CA	Lava Beds, South Warner
88	CA	Redwood
89	OR	Kalmiopsis
90	CA	Lassen Volcanic, Caribou, Thousand Lakes

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Table 2-1 (continued). IMPROVE Aerosol Monitoring Sites: Current Sites for 2002).

Site Number	State	IMPROVE Represented Class I Areas
91	CA	Point Reyes
92	CA	Pinnacles, Ventana
93	CA	San Gabriel, Cucamonga
94	CA	San Rafael
95	CA	Desolation, Mokelumne
96	CA	Yosemite, Emigrant
97	CA	Hoover
98	CA	Sequoia, Kings Canyon
99	CA	San Geronio, San Jacinto
100	CA	Agua Tibia
101	CA	Joshua Tree
102	AK	Denali
103	AK	Tuxedni
104	CA	Marble Mountain, Yolla Bolly Middle Eel
105	AK	Simeonof
106	VI	Virgin Islands
107	HI	Hawaii Volcanoes
108	HI	Haleakala
109	CA	Dome Land
110	CA	Kaiser, Ansel Adams, John Muir

2.2 QUALITY ASSURANCE SYSTEM

Figure 1-2 illustrates the three distinct systems in place for IMPROVE Aerosol Monitoring Network QA. The following sections highlight the QA system.

2.2.1 IMPROVE Steering Committee

The IMPROVE Steering Committee provides oversight to the entire program. This group meets at least annually to discuss any and all issues that concern the program. In addition, they will interact with the QAC and the agencies involved in the field and laboratory activities. IMPROVE Steering Committee members are listed in the Contact List (at the end of this document).

2.2.2 OAQPS

At the top of the QA structure is the OAQPS-QAC. It is the QAC's responsibility to oversee that QA is implemented into the program. The QAC will oversee the work performed by NAREL in Montgomery, Alabama, and R&IE, in Las Vegas, Nevada. The QAC will meet periodically to discuss QA issues as they arise throughout the program. Assessment reports will be given to the QAC on an annual basis. These will include the results of the assessments listed in Table 2-2 (see Section 2.3.4) performed during the previous year. In addition, the MQAG may also perform MSR or TSAs on any of the agencies in the QA or monitoring system.

2.2.3 NAREL – Montgomery, Alabama

NAREL has QA oversight of IMPROVE laboratory operations. As such, NAREL will annually perform TSAs or MSRs on the CNL, RTI, and DRI laboratory operations. In addition, NAREL will create laboratory audit samples (PEs) that will be forwarded to the CNL for distribution to the appropriate aerosol filter analysis laboratory.

2.2.4 R&IE – Las Vegas, Nevada

R&IE has QA oversight of the field operations. As such, R&IE will perform TSAs and performance audits at NPS, USFS, and USFWS IMPROVE monitoring stations. At this time, the schedule and extent of the TSAs and performance audits are not known. When the audits are completed, the QA reports will be forwarded to OAQPS for incorporation into the QAAR.

2.2.5 National Park Service

As the IMPROVE administrative agency, the NPS will be responsible for ensuring that the direction of the IMPROVE Steering Committee is carried out. The NPS activities are directed by Dr. William Malm. NPS responsibilities include:

- Preparing and maintaining the QAPP through NPS IMPROVE contractors.
- Coordinating and reviewing all QA procedures and documentation for all aspects of the program.
- Verifying all QA procedures are met by the NPS/IMPROVE contractors.
- Planning and reviewing QA/QC studies.

2.2.6 Crocker Nuclear Laboratory

As directed by the NPS, CNL's QA functions include but are not limited to:

- Sample collection and handling for all filter modules.
- Gravimetric mass and elemental filter processing and review for Module A and D filters.
- Compilation and review of data from all laboratories, and review of data; Level 0, Level I, and some Level II.
- Review of precision and bias data for the network.
- Documentation of field and CNL laboratory quality assurance manuals and SOPs.

2.2.7 Research Triangle Institute

As directed by the NPS, RTI's QA functions include:

- Ion analysis of Module B filters and blanks.
- Preparation of precision and bias data for Module B filter analysis.
- Documentation of ion laboratory quality assurance manuals and SOPs.

2.2.8 Desert Research Institute

As directed by the NPS, DRI's QA functions include:

- Carbon analysis of Module C filters and blanks.
- Preparation of precision and bias data for Module C filter analysis.
- Documentation of carbon laboratory quality assurance manuals and SOPs.

2.2.9 Cooperative Institute for Research in the Atmosphere

As directed by the NPS, CIRA's QA functions include:

- Receipt, validation, storage, and public dissemination of aerosol speciation, optical, scene (photography), and surface meteorological data collected routinely by monitoring contractors as part of the IMPROVE network; and calculation and public dissemination of composite data and data products.
- CIRA's Level II validation activities include the examination of spatial and long-term temporal trends for the composite aerosol components and optical measurements to look for inconsistencies; comparison of similar measurements such as measured sulfur and sulfate; and comparison of aerosol and optical data for sites that include both types of monitoring.
- Dissemination of data, composite data, and data products is done as part of the IMPROVE Web site operated by CIRA.
- Composite data include mass of the major components calculated from the measured species, total and species light extinction calculated from the major species, and determination of the best and worst haze periods. All composite calculations are performed using algorithms from EPA's *Guidance for Tracking Progress Under the Regional Haze Rule*.
- Data products are restricted to statistical summaries and graphic displays of data and composite data that states need to track progress under the Regional Haze Rule.

2.3 QUALITY DOCUMENTS

The IMPROVE Program will implement the following documents, plans, and guidelines for the Aerosol Monitoring Network.

2.3.1 Quality Management Plan

This QMP (described herein) outlines the management structure and how the QA system will be implemented. All entities listed in this QMP will adhere to these guidelines.

2.3.2 Quality Assurance Plans

As directed by the NPS, CNL has developed a QAPP for the laboratory and field operations. This includes CNL, RTI, DRI, the NPS, USFS, USFWS, state and local agencies, and tribal governments. All monitoring and analytical organizations will adhere to the QAPP and standard operating procedures (SOPs). OAQPS, R&IE, and NAREL have developed their own SOPs that describe in detail the operations of these laboratories. The SOPs will be integrated with the NPS/CNL QAPP.

2.3.3 Network Plan

The network plan is in place for the program. At the direction of the NPS, the Cooperative Institute for Research in the Atmosphere, at Colorado State University's Foothills Campus in Fort Collins, Colorado, maintains the network plan on the IMPROVE Internet Web site. The Web site can be accessed at: <http://vista.cira.colostate.edu/improve/>. The Web site maintains the latest information concerning the monitoring locations, instrumentation, latitude/longitude coordinates and maps of the areas. In addition, the Web site allows users to query data, review reports, and communicate with different members of the IMPROVE Program.

2.3.4 Assessment Reports

Several assessments tools will be implemented by the QA system. Each assessment will be followed by an annual report that will be forwarded to the QAC. The QAC will then combine the various QA reports into a final EPA QAAR. Table 2-2 illustrates the implementation of assessments. Each of these assessments will be discussed in detail in Section 9.

Table 2-2. Assessments Performed in the IMPROVE Program.

Agency	Type of Assessment	Agency Assessed	Frequency
NAREL/OAQPS	TSAs, MSRs, and PEs	CNL, RTI, DRI	Annually
R&IE/OAQPS	TSAs, Performance Audits	NPS, USFS, USFWS	Annually*

* Not all monitoring sites or laboratories in the program will be audited every year. It is estimated that 25% of the sites and laboratories will be audited annually.

Assessments will be performed on a periodic basis after January 2002.

3.0 PERSONNEL QUALIFICATIONS AND TRAINING

This section outlines the process involved and training available for air monitoring professionals in the IMPROVE Program.

3.1 PERSONNEL QUALIFICATIONS

The IMPROVE Program is responsible for providing training. As such, each IMPROVE organization will make every effort to provide training to all who participate in this program. Personnel assigned to the IMPROVE Program should meet the educational, work experience, responsibility, personal attributes, and training requirements for their positions.

3.2 TRAINING

Appropriate training is made available to persons supporting the IMPROVE Program, commensurate with their duties.

Site operators (provided by NPS, USFS, USFWS, states, local agencies, or tribes) are given training on routine equipment operations, sample collection, log recording, preventive maintenance, and troubleshooting by CNL field technicians. A training session is conducted during new site installations and repeated during the annual maintenance visit. This training session consists of all steps needed to change filters, plus how to program the sampler time and date. CNL also provides ongoing telephone support to site operators. Site operators can call for assistance to resolve operational issues. Written SOPs provide detailed guidance for all procedures. The CNL field operations manager keeps the current records on trained site operators.

The CNL field operations manager trains the CNL field technicians on all instrument calibration, maintenance, and site operator training procedures at the time of employment. Written SOPs provide the training guidance for all procedures.

The individual CNL, RTI, and DRI laboratory managers train their respective lab technicians in sample handling, filter analysis, data validation, and reporting at the time of employment. This is done through a series of sessions, each one on a specific station in the lab. Written, laboratory-specific SOPs provide detailed guidance for all procedures.

CIRA staff working on the IMPROVE Program are trained in their respective validation, analysis, reporting, documentation, and Web management duties by senior CIRA staff and by NPS scientists. Most CIRA staff have professional experience in their individual disciplines.

The field audit team members will be trained by the QAC. The audit team will meet with the QAC and perform field audits under the supervision of the QAC. The NAREL laboratory audit team has been trained under the ORIA training program.

3.3 CERTIFICATION

Each site operator is given a certificate that verifies that the person is trained to operate the field sampler.

4.0 FUNDING AGREEMENTS AND PROCUREMENT OF EQUIPMENT AND SERVICES

This section summarizes the agreements and procedures in place to ensure that all acquired equipment and services are procured within federal regulations, are delivered in a timely fashion, and are within the required specifications.

4.1 FUNDING AGREEMENTS

4.1.1 OAQPS Funds

Each year OAQPS plans the activities it will pursue in the upcoming fiscal year. The OAQPS – IMPROVE monitoring and QA leads work with various work groups and cooperators to prioritize the use of the environmental program management (EPM) funds. These funds may be used to acquire equipment and services through direct purchase, contracts, interagency agreements, or cooperative agreements.

OAQPS, through the Decision Memorandum – Interagency Agreement With the Department of the Interior, has provided a 5-year interagency agreement (IA) with the Department of the Interior and the National Park Service, to monitor visibility through the IMPROVE Program. The EPA provides the bulk of the IMPROVE Program financial support through this IA. The use/allocation of the funds are re-negotiated every five years. All EPA funds allotted to the program are transferred to the NPS.

4.1.2 Federal Land Management Agency Funds

The National Park Service, as the operating agency for IMPROVE, also receives funds from several federal agencies, including the USFS and USFWS, to assist with the continuing operation, maintenance, and expansion of the IMPROVE visibility monitoring network (in addition to providing funding of their own). The funds from cooperating land management agencies are transferred to the NPS through IAs.

Funding for IAs may occur annually or less frequently, depending upon the balance in the account. For example, the USFS transfers funds to the NPS annually through an IA to continue aerosol monitoring at several of their IMPROVE sites.

4.2 PROCUREMENT

Equipment and services are procured by the NPS through direct purchase, contracts, or cooperative agreements. All procurement procedures strictly follow federal procurement regulations as administered by the NPS.

4.2.1 Direct Purchase

The NPS has the responsibility to procure all equipment and services for the IMPROVE network. The NPS procures equipment in two ways. Depending upon the scope of work in a particular contract, the NPS may direct the contractor to purchase the equipment. The other option is for the NPS to prepare a Purchase Order and procure equipment directly from the vendor. In the instance when a contractor provides IMPROVE samplers, the contractor may either build the samplers or competitively select a vendor to provide the equipment.

4.2.2 Contracts

Effective January 1, 2002, the Federal Business Opportunity is the sole Web site (<http://www.FedBizOps.gov>) that provides federal government procurement opportunities, replacing the Commerce Business Daily. Commercial vendors seeking federal markets for their products and services can search, monitor, and retrieve opportunities by the entire federal contracting community. NPS normally awards contracts for one year with the option to extend the contract on an annual basis for up to an additional four years. When additional tasks are required during the term of a contract, the NPS will issue a Task Order Amendment and provide the necessary funding based upon an agreed scope of work and cost with the contractor. Contractors are reimbursed for their labor and equipment purchased on behalf of the NPS (cost plus fixed fee contract).

The NPS utilizes contractors to coordinate, operate, and maintain the IMPROVE Program. Laboratories are contracted to perform particle, ion, and carbon analyses of the IMPROVE samples. All contracts are competitively awarded. Bidders proposals are evaluated for both technical merit and cost. Current aerosol-related IMPROVE contracts administered by the NPS include:

- Aerosol Network Operations; including sampler fabrication, field operations, particle mass and speciation analysis of Module A and D samples, coordination with ion (Module B) and carbon (Module C) analysis laboratories, and data validation of all samples. The current contractor is the University of California at Davis (UCD).
- Ion Analysis; including laboratory analysis of Module B filter samples for ions. The current contractor is Research Triangle Institute (RTI).
- Carbon Analysis; including filter preparation and laboratory analysis of Module C filter samples for organic and elemental carbon. The current contractor is the University of Nevada, Desert Research Institute (DRI).

4.2.3 Cooperative Agreements

Assistance agreements are used when both parties (a federal agency and the group providing the service) derive benefit from the service. Federal grants or cooperative agreements with universities or states are a common example of mutually beneficial assistance agreements.

The primary IMPROVE cooperative agreement is between the NPS and CIRA, located at Colorado State University in Fort Collins, Colorado. The IMPROVE-related services provided by CIRA include data QC and QA; scientific analyses; preparation of reports, products, and presentations; and maintenance of the IMPROVE Web site and FTP server.

4.3 PROGRAM PERFORMANCE AND QUALITY ASSURANCE REQUIREMENTS

The NPS, at the direction of the IMPROVE Steering Committee, administers the IMPROVE Program to ensure that all procured equipment and services are delivered in a timely fashion and are within required specification. The overall IMPROVE QA requirements will follow the OAQPS guidelines developed in the *EPA Assistance Administrative Manual*⁵. Statements of Work (SOW) for project components will be developed by the IMPROVE Work Assignment Manager/Project Officer (WAM/PO). It is the responsibility of the WAM/PO to be knowledgeable of the EPA QA policy and to represent these standards during the development of the project's SOWs. The WAM/PO will list the conditions to which all project participants (operating under contracts, cooperative agreements, or interagency agreements) must adhere. For example, one of these conditions relates to QAPPs. Any project that includes Environmental Data Operations (EDOs) requires a QAPP be submitted 30 days prior to the commencement of any EDOs.

The NPS will have primary authority over IMPROVE contracts and cooperative agreements it administers. The responsibilities for technical work described in project-specific interagency agreements will be developed jointly by the cooperating agencies. For example, the NPS will work closely with EPA OAQPS to ensure that independent field and laboratory QA audits carried out by NAREL or R&IE will fully meet EPA and any specific IMPROVE Program requirements.

5.0 RECORDS AND DOCUMENTATION

The primary responsibility of record keeping falls upon OAQPS, ORIA laboratories, NPS, and their contractors. For this program, a number of documents and records need to be retained. A document, from a record management perspective, is a volume that contains information which describes, defines, specifies, reports, certifies, or provides data or results pertaining to environmental programs. As defined in the *Federal Records Act of 1950* and the *Paperwork Reduction Act of 1995* (now 44 U.S.C. 3101-3107), records are: “books, papers, maps, photographs, machine readable materials, or other documentary materials, regardless of physical form or characteristics, made or received by an agency of the United States Government under Federal Law or in connection with the transaction of public business and preserved or appropriate for preservation by that agency or its legitimate successor as evidence of the organization, functions, policies, decisions, procedures, operations, or other activities of the Government or because of the informational value of data in them...” All agencies will adhere to this guideline. Section 5.2 discusses the process that will be implemented for storing documents and records. Since many agencies are involved, their documentation storage capabilities and processes will differ; however, at a minimum, all documents and records for this program will be securely stored. For more information on document control and storage, please see the field/laboratory and audit QAPPs.

5.1 DOCUMENT HIERARCHY AND PROCESS

This section outlines the hierarchy of the documentation and illustrates the review process for the major documents created for this program.

5.1.1 Hierarchy

The CAA and EPA Order 5360.1⁶, July 1998, are the overarching documents for this program. As such, all authority to create programs and allocate funds is given in these documents. EPA Order 5360.1 gives the EPA authority to require all agencies that accept federal funds to create QMPs, QAPPs and Network Plans. OAQPS has the authority to require, review, comment and withhold funds if these requirements are not met. The order of hierarchy follows:

- The Code of Federal Regulation, through the CAA and Order 5360.1 are the overarching authority.
- The QMP encompasses the entire program. All agencies will adhere to the requirements and guidelines in the QMP. The QMP discusses the roles of each agency.
- The QAPPs for individual agencies will govern that agency. The agency must adhere to the statements made in their QAPP.
- The Network Plan/Internet Web site will outline how the network will be implemented and document the location of each sampler with all ancillary data.

5.1.2 Document Creation and Review Process

5.1.2.1 Quality Management Plan

The QMP for this program was generated by OAQPS, NPS, CNL, and CIRA. It has the overarching authority over all QAPPs, Network Plan and all other ancillary documents. This document will undergo thorough review by OAQPS, the IMPROVE Steering Committee, NPS, and its contractors. Since changes may be made in this program, any revisions must be reviewed by all agencies.

5.1.2.2 Quality Assurance Project Plans and Standard Operating Procedures

As directed by the NPS, the field and laboratory QAPP⁴ was written by the CNL QA manager. It describes the process of assuring the quality of the data for the field and laboratory operations. OAQPS reserves the authority to review, make comments, and approve this QAPP. The field audit QAPP was written by R&IE in conjunction with the QAC. The NAREL Quality Assurance Manual describes the work that is performed in the laboratory. The QA program QAPPs are reviewed and approved by OAQPS and ORIA. Any additional contractor QAPPs must be approved by the agency that hires the contractor.

The field and laboratory SOPs were written by CNL. OAQPS has reviewed and approved the field and laboratory SOPs. OAQPS in conjunction with R&IE have written IPA and TSA SOPs for assessments. These have been approved by the QAC. The TSA performed by NAREL of the laboratory operations is described in their Quality Assurance Manual, which was approved by OAQPS.

5.1.2.3 Network Plan

The existing Network Plan is described in Section 2.3.3. As the network changes, the NPS will direct CIRA to update the Internet site. Any parties that wish to review the network will be able to obtain these data expeditiously.

5.1.2.4 CNL Data Reports

At the direction of the NPS, the original data collected by the samplers and laboratory instruments are compiled, processed, and stored at CNL. CNL produces the following reports for this program.

- Monthly Progress and Financial Report
- Quarterly Data Report
- Annual Report
- QAAR

5.1.2.5 RTI and DRI Data Reports

The RTI and DRI contract laboratories each forward their filter analysis data and associated QA/QC data to CNL immediately after processing a filter batch as defined by CNL. CNL then compiles and reports all data to the NPS as noted above. Each laboratory also provides a Monthly Progress and Financial Report to the NPS.

5.1.2.6 CIRA Data Reports

CIRA reviews and compiles all data, program documentation, and reports into a Web-accessible database. Ongoing maintenance of the database is performed. The IMPROVE Web site is the primary information dissemination tool for the IMPROVE Program. The Web site will continue to change and grow to meet the needs of participating agencies, scientists, and the public.

Once the data have passed CNL's Level I QA/QC checks and the states have had an opportunity to examine the data, the data are placed into an SQL database and made available via the IMPROVE Web site. Every location, time, and species data record consists of the data point's value, uncertainty, minimum detection limit, status flag, and sampling flow rate and duration. The method of the sample collection and analysis is also stored. In addition, for each monitoring site detailed metadata is included, such as the latitude, longitude, elevations, and Class I area it represents. A monitoring site history identifying any changes to the sampling locations, instruments, filters, and filter analysis is also included.

Data aggregations the states need to track regional haze for each Class I area is conducted for all data in the IMPROVE database. This includes the 5-year average of the best and worst visibility days for all composite aerosol components and their estimated contributions to light extinction, and the individual days comprising the best and worst 20% of the visibility days and the values of their associated aerosol and light extinction components. All calculations are done using algorithms from EPA's *Draft Guidance for Tracking Progress Under the Regional Haze Rule*⁷.

Once a year CIRA performs a Level II QA/QC analysis on the previous year of aerosol and optical data. All graphical products examined during this analysis are made available via the IMPROVE Web site. Also, a summary of any data anomalies and other findings is provided.

5.2 DISPOSITION AND STORAGE OF DOCUMENTS AND RECORDS

This section will address the disposition, storage accessibility, and protection of documents and records. It is noted that the persons filling the roles mentioned above are responsible for the documents and record that they generate. The agencies listed in the QMP will take full responsibility for the disposition of these records. Long-term trends records for the monitoring program will be kept for a minimum of 5 years, and as long as program participants deem necessary.

5.2.1 Field Log Sheets

Field log sheets will be used for recording results of sampler runs. Dates, times, field conditions, temperature, pressure and flow rates will be recorded. Each site operator will mail the field logs and memory cards with the samples to CNL. CNL will extract the required information and archive the log sheets. The data from the log sheets and memory cards will be downloaded to the LOGS database at the CNL facilities. Pertinent information from the database will be sent to RTI and DRI along with filter batches.

5.2.2 Lab Notebooks

Notebooks will be created and maintained by each contract laboratory. These notebooks should be uniquely numbered and associated with the IMPROVE Program. One notebook will be available for general comments/notes; others will be associated with, the temperature and humidity recording instruments, the refrigerator, calibration equipment/standards, and the analytical balances and all instruments used for this program. Laboratory notebooks review and archiving are the responsibility of the individual investigators or researchers. All logs will be maintained for a minimum of 5 years, and as long as program participants deem necessary.

5.2.3 Other Documents

All other documents must be stored as specified in the QAPPs.

5.2.4 Electronic Data Collection

The electronic data system utilized by CNL is described in Section 6.1 of this QMP. The raw electronic data will be stored for a minimum of 5 years, and as long as program participants deem necessary. CIRA will perform daily archives of all information in the IMPROVE Web site. The active Web site will represent the primary source of IMPROVE data. The structure and contents of the Web site are described in Section 6.1. The audit reports will be stored at their perspective offices for a minimum of 5 years, and as long as program participants deem necessary.

5.3 DISPOSITION OF REPORTS

5.3.1 Data Reporting Package/Archiving and Retrieval

All the information, electronic and written, will be retained for a minimum of 5 years (from the date the grantee submits its final expenditure report) and as long as program participants deem necessary.

6.0 COMPUTER SOFTWARE AND HARDWARE

There is an increasing dependence upon computers and computer-related hardware in the collection of environmental data. Indeed, all environmental programs within and outside of the EPA use computers extensively to collect, store, validate, and analyze environmental data. This section will outline briefly what computer systems will be employed throughout the IMPROVE Program. This section will also describe the roles and responsibilities for system hardware and software.

6.1 COMPUTER SYSTEM DESCRIPTIONS

6.1.1 EPA OAQPS/ORIA

The QMP and related QAPPs will be archived in Research Triangle Park, North Carolina. All communications and hardcopy information will also be housed at the EPA facility in Research Triangle Park, North Carolina. The QMP, NAREL QA manual, and the R&IE SOPs will be posted on the EPA-OAQPS Web site, <http://www.epa.gov/ttn/amtic/visdata.html>. The IMPROVE Aerosol Network field and laboratory QAPP is posted at: <http://vista.cira.colostate.edu/improve/>.

6.1.2 Crocker Nuclear Laboratory

To handle the large number of samples, CNL has developed a computerized sample handling system, LOGS. The system is based on several work stations, each having a specific responsibility, and includes the gravimetric and absorption analyses. Approximately 150 steps are involved in sample processing. The system components are shown below and in Figure 6-1. Below is a brief description taken from the IMPROVE Field/Laboratory QAPP⁴.

- The computer keeps a log of every action at each workstation including the identification of the technician, date, and other appropriate information.
- The computer keeps an audit trail on every filter. The status of any filter can be determined at any time.
- The computer performs immediate quality assurance checks of all data entered and notes any problems.
- The computer verifies that all steps for a given filter are properly made.
- The computer system expedites and improves the data reduction and data validation processes of the final data set.
- The detailed standard operating procedures incorporated in the computer system are included in the IMPROVE procedures manual.

The controlling database is the LOGS database. This database is organized to include all data for a single site/sample date in one record. Each record includes all the information from each module at a site for one sample date. Site, sample date, pump vacuum for each module, initial and final small gauge vacuum readings for each module, initial and final magnehelic gauge readings for each module, start time, current temperature, elapsed time for each module, status of each sample, person entering the data, date the samples are returned from the field, calendar quarter, comments on status, and area of the sample are fields included in the LOGS database. Since the LOGS database is the primary CNL database, it is protected and input, other than through the programs listed in Figure 6-1, is restricted.

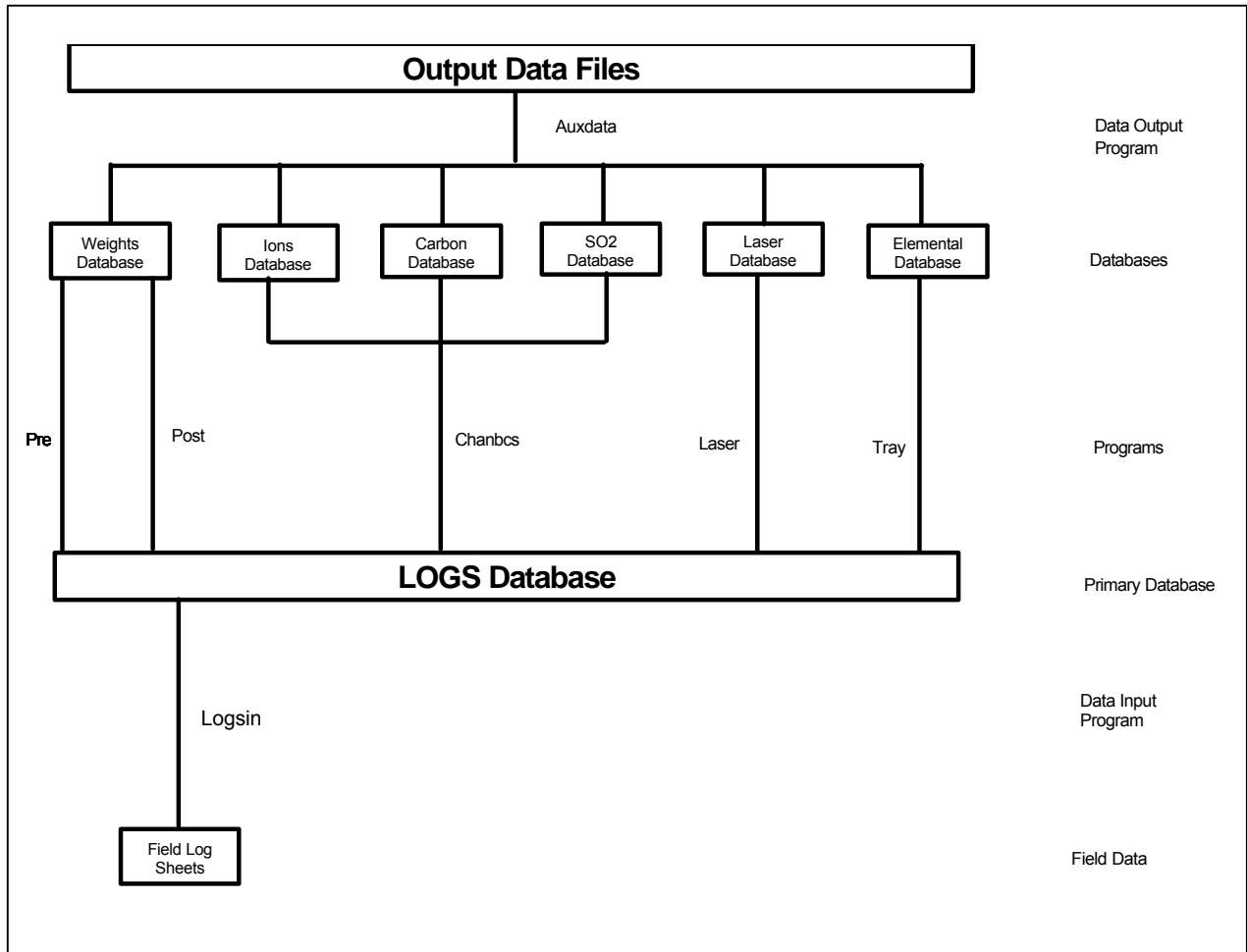


Figure 6-1. CNL LOGS Data Flow Diagram.

6.1.3 RTI and DRI Systems

Both RTI and DRI store their respective filter analyses results on process-specific computer databases. The databases are queried to yield analysis and QA files compatible with CNL LOGS (name of the CNL collection database) import routines. RTI and DRI create digital data files for each processed filter batch and electronically submit the files to CNL for input to LOGS. RTI and DRI each maintain active databases and archives of all filter data.

6.1.4 CIRA Database and IMPROVE Web Site

6.1.4.1 CIRA Database

Once the data have passed CNL's Level I QA/QC analyses, CNL sends the data to CIRA in a series of flat ASCII files with one file per site. A series of SAS-based programs are used to examine, organize, and reformat the files in the data ingest, looking for corrupt data files and calculating summary statistics, including the number of missing data points and data values below the minimum detection limit for each site and species. The raw ASCII files data are then posted on the IMPROVE Web site under a preliminary data page where states can review the data and perform their own QA/QC analyses. After a set period of time all comments by the states are addressed and the data are added to an online SQL database which the public can query from the IMPROVE Web site.

In the SQL database the data record for every location, time, and species consists of the data point's value, uncertainty, minimum detection limit, status flag, and sampling flow rate and duration. The method of the sample collection and analysis is also stored. In addition, detailed metadata is included for each monitoring site, such as the latitude, longitude, elevation, and Class I area it represents. A monitoring site history identifying any changes to the sampling locations, instruments, filters, and filter analysis is also included.

Once a year CIRA conducts a Level II QA/QC analysis on the data. The Level II validation activities include the examination of spatial and long-term temporal trends for the composite aerosol components and optical measurements to look for inconsistencies; comparison of similar measurements such as measured sulfur and sulfate; and comparison of aerosol and optical data for sites that include both types of monitoring. The composite data include mass of the major components calculated from the measured species, total and species light extinction calculated from the major species, and determination of the best and worst haze periods. All composite calculations are performed using algorithms from EPA's *Draft Guidance for Tracking Progress Under the Regional Haze Rule*⁷. The graphical products from this analysis are available from the IMPROVE Web site.

6.1.4.2 IMPROVE Web Site

The primary objectives of the IMPROVE Web site (<http://vista.cira.colostate.edu/improve/>) are to provide federal, state, and air quality regulatory agencies as well as the general public

access to IMPROVE data, data products, and metadata fully describing the IMPROVE database, including characteristics and history of all network sites. To accomplish these objectives, the IMPROVE Web site was implemented using a hierarchical structure with five main sections: 1) Data, 2) Tools, 3) Publications, 4) Special Studies, and 5) Education. Other features of the Web site include a user supported discussion Forum, and overview of the IMPROVE Program, visibility science and regulations, information on IMPROVE activities, and related Web links. A brief description of the content and capabilities of the five main sections of the Web site is presented below.

Data

The central feature of the Web site is the availability of IMPROVE data, its metadata, and high quality processed data products. A number of tools enable users to browse and access data resources. The content of the IMPROVE monitoring database can be explored via the metadata browser. This interactive tool allows the retrieval of detailed information about IMPROVE monitoring sites including the site's location, topography, air quality species measured, changes over time to the sampling and filter analyses, and pictures of the site and its surroundings.

The aerosol data and its metadata are available as ASCII files for each site and the entire database. Users can generate custom data files via ad-hoc queries to the IMPROVE database by selecting a subset of the monitoring site locations, time range, and parameters. The attributes one can retrieve for each data point are the value, uncertainty, minimum detection limit, status flag, sampling flow rate and duration, and the method of the sample collection and analysis. In addition, data aggregations the states need to track regional haze for each Class I area is available for all data in the IMPROVE database. All calculations are done using algorithms from EPA's *Draft Guidance for Tracking Progress Under the Regional Haze Rule*⁷.

The data are fully documented identifying known problems and changes to the network over time. A description of the QA/QC analyses and the graphical products used for quality control are available on the Web site. Based upon the QA/QC analyses, data are flagged accordingly and any issues that may impact the data's interpretation are identified, and where possible, solutions are provided.

Data Analysis and Visualization Tools

A goal of the Web site is to provide data analysts with tools to facilitate examination of IMPROVE data and to perform routine analyses required for compliance with regional haze regulations. To accomplish this goal, a Tools section containing standard algorithms for aggregating and deriving new variables, such as aerosol types and reconstructed light extinction from the IMPROVE speciated aerosol data has been provided. Data visualization tools are also available, such as WinHaze⁸, for estimating the impact of various air quality levels on the visual environment.

Publications

The Publication section contains documents derived from, or relevant to, the IMPROVE program. This section includes the tri-annual IMPROVE data analysis reports, network standard operating procedures, and IMPROVE newsletters. Principle visibility documents, such as the National Acid Precitation Assessment Program's (NAPAP) State of the Science Report, and a searchable reference database, which contains articles and abstracts from the NPS/CIRA reference database, are also included. These reference documents are a basic resource provided by the Web site and contain detailed information on the IMPROVE network and visibility science. Context sensitive links are provided throughout the Web site to this detailed information.

Throughout the course of the IMPROVE Program, an extensive set of analyses, reports, and presentations have been conducted that were never formally published. These documents contain important information on the monitoring network, filter analysis, and interpretation of the IMPROVE data. To increase the availability of these documents, they have been included in a "Gray" literature section of the Publications.

Special Studies

The Special Studies section of the Web site provides background information and findings from these studies. It focuses on resources generated by the NPS/CIRA group including the measured aerosol, optical, and meteorological data, reports, papers, and links to related web sites.

Education

The Education section of the Web site guides users through basic visibility science and regulatory information at their own pace. This unique portion of the Web site uses a multimedia presentation consisting of animations, voice, and still images to convey the basic concepts of visibility science and regulations. This section covers the definition of visibility impairment, visibility indices, measurement technologies, aerosol interactions with light, and sources of these aerosols.

7.0 PLANNING AND IMPLEMENTATION OF WORK PROCESS

7.1 PROJECT GOALS AND OBJECTIVES

This section outlines planning and implementation procedures that are employed in the IMPROVE Program. This program has several diverse agencies that are interacting at several levels. Therefore, to ensure that the work is being performed and that the quality of the data is acceptable, clear communication must be employed for this program. The following sections outline how this is accomplished.

7.1.1 Program Objectives

The goal of the IMPROVE Visibility Monitoring Program is to monitor the visibility in Class I wilderness areas. Objectives of the aerosol component of the IMPROVE Program are to:

- Establish baseline data and trends of fine particulate concentrations.
- Determine the relationship between visibility impairment and various atmospheric particulate constituents.
- Determine the existing sources of particles producing visibility impairment.
- Determine the sensitivity of visibility impairment at individual sites to varying concentrations of particles.

The NPS has been the lead agency for monitoring visibility in Class I areas. The NPS implemented a speciated aerosol monitoring program in selected Class I areas from 1981 to 1987. This network evolved into the IMPROVE Aerosol Monitoring Network in 1988 and has continued to evolve and grow into its present configuration.

7.2 INITIAL PLANNING AND CONCEPTUALIZATION

The NPS Visibility Monitoring Program started in 1978 without particulate measurements. A program administered by the Las Vegas office of the EPA began monitoring particulate concentrations in 1979 at several Class I NPS areas in the Rocky Mountain region. Using the samplers and protocols from the EPA network largely developed by CNL, the NPS Visibility Monitoring Program added a particulate component in 1981.

In 1985, the EPA established Federal Implementation Plans for states without approved visibility provisions in the State Implementation Plan. To assist states in meeting CAA objectives, in 1987, Federal Land Managers joined with the EPA in a collaborative monitoring program called IMPROVE. The IMPROVE committee consists of representatives of the four federal land managers, the EPA, and regional-state agencies.

The 1990 amendments to the CAA reaffirm the importance of visibility protection. Section 169B includes provisions for the EPA to conduct visibility research with the NPS and

other federal agencies, to develop an interim findings report on the visibility research, to develop a Report to Congress on expected visibility improvements due to implementation of other air pollution programs, and to provide periodic reports to Congress on trends in visibility improvements.

In 1991, three organizations were formally added to IMPROVE: 1) the State and Territorial Air Pollution Program Administrators, 2) the Western States Air Resources Council, and 3) the Northeast States for Coordinated Air Use Management. Also that year 10 sites in the eastern U.S. were added to the IMPROVE network. In 1997, the EPA published proposed amendments to the 1980 regulations (62 FR 41138) to set forth a program to address regional haze visibility impairment. EPA also established secondary National Ambient Air Quality Standards (NAAQS) for particulates with an aerodynamic diameter less than or equal to $PM_{2.5}$ as part of a final decision on revision of the existing NAAQS for particulate matter under Section 109(d) of the CAA. IMPROVE sites began $PM_{2.5}$ measurements a decade earlier.

In 1999 and 2000 the total number of sites in the IMPROVE network increased to 110. These 110 are under the supervision of the IMPROVE committee and represent 155 of the 156 mandatory Class I areas. Almost all are at remote sites. In addition, the sampling frequency changed from Wednesday-Saturday to 1-day-in-3. These changes required the design and fabrication of the Version II IMPROVE sampler. The growth of the IMPROVE network is shown in Figure 2-1. All sites operate with IMPROVE samplers through the IMPROVE contract.

7.2.1 Program Planning and Design

Planning occurs during the IMPROVE Steering Committee meetings, which are held at least annually. This is the opportunity for all members to congregate and discuss the previous results and look forward to the challenges of the upcoming year.

7.2.2 Program Execution

The IMPROVE Steering Committee makes all executive decisions regarding the program, which includes funding of contractors, expansion or reduction of the network, and all other technical and non-technical issues. The NPS is the key operational agency of IMPROVE. The NPS issues and administers all contracts for the Aerosol Monitoring Network and is actively involved in IMPROVE-related data analysis and research.

7.3 KEY PLANNING PERSONNEL

7.3.1 IMPROVE Steering Committee

The IMPROVE Steering Committee has the responsibility to make the final decision on the implementation of the program. The following agencies are represented on the IMPROVE Steering Committee:

- National Oceanic and Atmospheric Administration
- U.S. Environmental Protection Agency
- National Park Service
- Bureau of Land Management
- U.S. Forest Service
- U.S. Fish and Wildlife Service
- Northeast States for Coordinated Air Use Management
- State and Territorial Air Pollution Program Administrators
- Western States Air Resources Council
- Mid-Atlantic Regional Air Management Association
- State of Arizona (associate member)

Currently, the Committee Chair is Dr. Marc Pitchford. He has the responsibility to set agendas, call meetings to order, and present technical and financial information to the committee.

7.3.2 National Park Service

The NPS is the key operational agency of IMPROVE. The agency is responsible for implementing the technical direction of the IMPROVE Steering Committee; issuing and administering all IMPROVE contracts; operating a majority of IMPROVE sites; performing final QA on the data; performing data analyses; and distributing data, analyses, and all project information through the IMPROVE Web site.

7.3.3 QA Audit Team

The QAC performs the following planning activities:

- Oversee meetings between EPA and ORIA laboratories
- Set the next years' laboratory and field audit schedules
- Oversee the implementation of program from a technical perspective

7.3.4 Organization Program Managers

Each of the organizations within the IMPROVE Program will need to commit to planning for the program. The program managers must:

- Verify that the agency has enough manpower to perform the duties, whether they be field or laboratory.
- Communicate with CNL to ensure that samples are being shipped on the appropriate schedule.

7.4 INTERNET PLANNING ACTIVITIES

Under contract to the NPS, CIRA in Fort Collins, Colorado, supports and maintains a Web site on the Word Wide Web. IMPROVE data, program plans, guidance documents, SOPs, the field and laboratory QAPP, special announcements, and related documents are posted on the Web site. These documents can be downloaded from the File Transfer Protocol (FTP) areas of the Web site. In addition, all of the agencies involved in this program have electronic mail (e-mail) capabilities, by which information can be transmitted and all affected parties can be informed of meetings and special events.

8.0 IMPLEMENTATION OF WORK

The IMPROVE organization has developed a QAPP that describes the process and work performed for the program. The IMPROVE aerosol QAPP has been submitted to EPA - OAQPS, which has reviewed and approved the document. This section will outline the individuals in each agency that will be required to implement the work. The NPS, through its contractors, is ultimately responsible for the preparation of documented IMPROVE field operations, laboratory filter analysis, and data management procedures.

8.1 IMPLEMENTATION ROLES

8.1.1 National Park Service

The NPS is the primary operational agency for the IMPROVE Program. The NPS awards and administers all operational contracts for IMPROVE. Funding for all contracted work flows through the NPS. The IMPROVE Steering Committee depends on the NPS to implement its decisions.

8.1.2 Field Operators

Field operators are generally employed by the agency responsible for the monitoring site and are responsible for most work performed at the monitoring sites. This includes:

- Receiving and storing unexposed filter/cassettes.
- Loading cassettes into the samplers in a timely manner and adhering to the IMPROVE sampling schedule.
- Recording all appropriate information concerning the sample run log sheets.
- Shipping the samples and data cards with the appropriate logsheets and chain of custody forms to CNL.
- Performing preventive maintenance, troubleshooting, and repair of the samplers as directed by CNL.

8.1.3 CNL Laboratory Staff

CNL laboratory staff manages the distribution, sampling, and collection of filter samples. They also perform the filter analysis of the Module A and D samples and distribute the filters from the B and C modules to RTI and DRI respectively. These duties include but are not limited to:

- Preparing filter cassettes and sending them to the site operators.
- Receiving samples from the site operators.

- Logging in samples and distributing A and D module filters to the appropriate laboratory areas.
- Sending Module B and C filter samples to RTI and DRI respectively for analysis.
- Preparing and analyzing the filters according to the laboratory QAPP and SOPs.

8.1.4 CNL Data Processing Staff

CNL data processing staff will perform the statistical and screening analysis on the sample data. These duties include but are not limited to:

- Verifying that sample chain of custody is entered.
- Reviewing data for completeness.
- Performing Level 0, Level I, and some Level II analysis on the data set.
- Flagging data that do not conform to the screening test norms.
- Reporting data to NPS.

8.1.5 RTI and DRI Laboratory Staff

RTI and DRI will analyze module B and C filters respectively, and forward the analysis results to CNL.

8.1.6 CIRA Data Processing and Distribution

CIRA performs Level II validation of all aerosol data and loads the final data onto the IMPROVE Web site for distribution to interested parties. Under NPS direction, CIRA also performs specific data analyses and reports that are also posted on the Web site.

9.0 DATA QUALITY ASSESSMENTS

This section describes the quality-related activities necessary to support the IMPROVE Program for assessment, and reporting.

9.1 PROGRAM ASSESSMENT TECHNIQUES

Assessment is an all-inclusive term used to denote any of the following: TSAs, performance audits, data quality assessments (DQAs), performance evaluations and Management System Reviews (MSRs). Definitions for each of these activities can be found in the Glossary. Table 9-1 provides information on the parties implementing the assessment and their frequency.

Table 9-1. IMPROVE Program Aerosol Network Assessment Schedule.

Agency	Type of Assessment	Agency Assessed	Frequency
NAREL/OAQPS	TSA, MSRs, and PEs	CNL, RTI, DRI	Annually
R&IE/OAQPS	TSAs, Performance Audits	NPS, USFS, USFWS	Annually*

* Not all monitoring sites or laboratories in the program will be audited every year. It is estimated that 25% of the sites and laboratories will be audited annually.

9.1.1 Technical System Audit

Field TSAs are performed by the R&IE and OAQPS staff. TSAs are performed by QA staff using a checklist of pertinent questions and are directed to the site operators. Several of the questions deal directly with sample handling. The site operator is asked to illustrate the exact procedures used in handling of the samples. The laboratory TSA will be performed by NAREL and occasionally OAQPS staff. The laboratory TSA consists of a lengthy questionnaire that is directed to the laboratory staff at CNL, RTI, and DRI. The auditors will examine all aspects of the laboratory operations to see if techniques used and QA system are being adhered to according to the laboratory QAPP. The results of the audits will be submitted to the OAQPS QAC as described in Section 10 of this manual. The results will be published in the EPA QAAR.

9.1.2 Performance Audits

Performance audits will be instituted by R&IE and OAQPS staff. The audit consists of measuring the flow rate of each channel and verifying the ambient and instrument temperature, time and date indicators and barometric pressure gauges. All audit devices will be the property of the EPA and be independently calibrated and maintained. Any deviations from the Measurement Quality Objectives as stated in the project QAPP will be reported as described in Section 10 of this manual. Corrective actions will be performed as stated in the QAPP.

9.1.3 Performance Evaluations

NAREL is the lead agency for performance evaluations. NAREL will submit PEs to CNL, and indirectly to RTI and DRI. The results from the PEs will then be submitted to the OAQPS QAC who will share this information with the NPS QA Manager, who will share the results with CNL, RTI, and DRI. This information will be included in the QAAR according to the procedures outlined in Section 10.

9.1.4 Management Systems Review

OAQPS/NAREL and R&IE are the agencies that will periodically perform MSR. The MSR will be incorporated into the annual TSA, but will occur from time to time when the QA oversight agencies deem that is necessary. The results from the MSR will then be submitted to the OAQPS QAC who will share this information with the NPS QA Manager. This information will be included in the QAAR according to the procedures outlined in Section 10.

9.2 REPORTS TO MANAGEMENT

Internal reports to management will be submitted according to the approved QAPP for the individual agencies.

9.3 PLANNING, TRAINING, AND AUTHORITY

The following sections will discuss process of planning, training, and the authority of those whom will be performing assessments.

9.3.1 Planning

The QMP is the first step toward having an effective planning process. This QMP will outline how assessors, QA managers, field and laboratory staff will plan, schedule, implement, and participate in assessments. At the beginning of the year, those who have been assigned to perform assessments will set out their tentative schedule for assessments. This schedule will first be submitted to the NPS, CNL, and the field operators who are scheduled to be assessed. Usually, one month before the assessment, the agency to be assessed is notified by telephone of the exact dates and times. At this time, the assessment form (TSA forms) are submitted to the agency to be assessed (in writing or via e-mail). This allows the agency the time to review the forms and gather the information needed to be presented to the assessors. This has a two-fold objective: it allows those to be assessed knowledge of what will be required and it can minimize the time that assessors are in the field and that managers and scientists are away from their other duties.

9.3.2 Training

Training is essential to assessors in two ways: the assessor needs to understand the process by which data are generated, without this knowledge the assessment may be inadequate, and in order to communicate clearly with the agency that is being assessed, the assessor must be competent. Training fills these needs. A part of training that is not seen or documented is the fact that those chosen for assessment should have experience in the field in which they are assessing. Although most QA criteria and theory are universal, understanding the process by being experienced in working in that field is essential. It is the responsibility of OAQPS that the R&IE and NAREL staff have a thorough understanding of the IMPROVE Program.

9.3.3 Authority

All personnel that are chosen to conduct assessments have the authority to do so through the EPA. OAQPS has the overall responsibility and authority over this QA portion of this program. It delegates this authority to perform assessments to its agents that perform such duties. All personnel in this capacity have the right and responsibility to:

- Identify problems.
- Identify and cite noteworthy practices that may be shared with others to improve the quality of their operations.
- Propose recommendations for resolving quality problems.
- Independently confirm implementation and effectiveness of solutions.
- Report these finding to the OAQPS QAC, site operator, and NPS QA manager.

9.3.4 Disputes

Occasionally, findings in an assessment report may be disputed by laboratory or field staff. Any disputes that are announced should first be handled as it is described in Section 10 of this document. If this fails to satisfy the situation, then the IMPROVE Steering Committee has the final authority to make a decision concerning a dispute.

10.0 QUALITY IMPROVEMENT

This section will outline planning and implementation procedures that will be employed for improving the quality of the program. All agencies involved have the responsibility to improve the quality of the program over an unspecified period of time. There can be no set dates on when this improvement can or will occur, however, all of the agencies will make every effort to improve the system during the life of the IMPROVE Program.

10.1 QUALITY IMPROVEMENT PROCESS

This section will outline the process flow of the quality improvement paradigm, as seen in Figure 10-1.

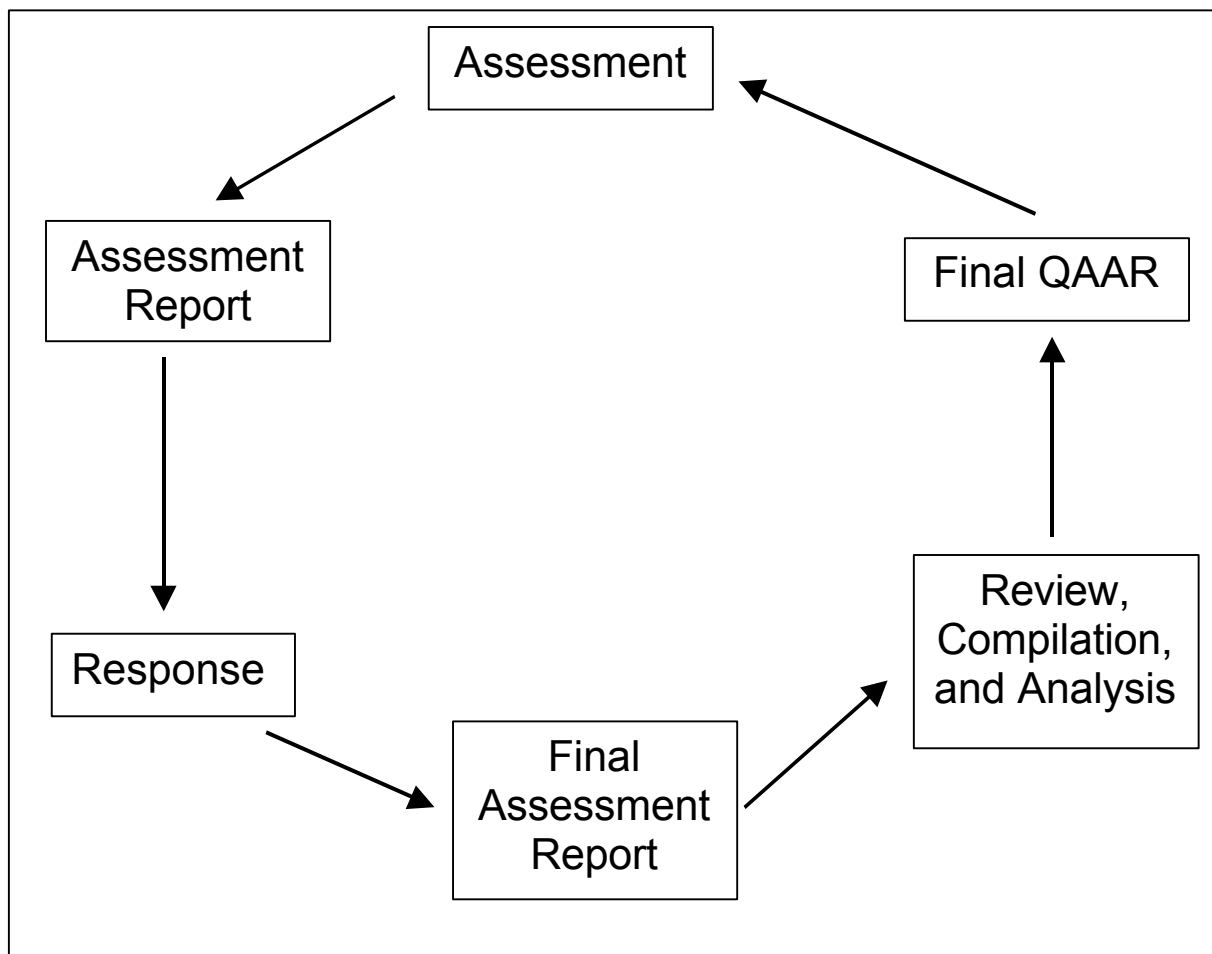


Figure 10-1. Assessment Strategy for the IMPROVE Program Aerosol Network.

10.1.1 Assessment

Assessments that are planned for the IMPROVE Program are detailed in Section 9 of this QMP. Once the assessment agency has completed the assessment, a report will be sent to the OAQPS QAC, NPS, and CNL.

10.1.2 Assessment Report

The assessment report will state the who, what, where and when of the assessment. The report will highlight the findings of the assessment. The NPS and CNL staff will work in conjunction to investigate the findings if the results show that the system is outside of the MQOs or requirements of the QAPP.

10.1.3 Response

The NPS and/or CNL have the right to respond in writing or e-mail. All responses will be reviewed by the assessor and the OAQPS QAC. The assessor will respond in kind. If any disputes arise from the assessment this will be dealt as detailed in Section 9.3.4 of this QMP. All parties have electronic mail (e-mail) capabilities, by which information can be transmitted and all affected parties can be informed of teleconferences and/or meetings.

10.1.4 Review, Compilation, and Analysis

Once OAQPS has received the final assessment reports from all of the IMPROVE QA components, the QAC or his designee will compile the information and analyze the data. Any disputes concerning the assessments will be finalized at that time.

10.1.5 Final Quality Assurance Annual Report

The QAAR will be created in the OAQPS office and distributed to all agencies involved with the IMPROVE Program. This report will highlight the findings of the assessment and recommendations.

10.2 QUALITY IMPROVEMENT ASSURANCE

The QAAR from OAQPS will assess the quality of the IMPROVE data set. This assures that the researchers understand the limitations of the data and should act responsibly in presenting their results to the scientific community.

11.0 REFERENCES

- ¹ EPA QA/R-2, 2001, *EPA Requirements for Quality Management Plans*, (EPA/240/B-01/002). U.S. Environmental Protection Agency, Washington, D.C., March.
- ² Federal Register, Section 64, Chapter 35765. July 1, 1999.
- ³ NAREL, 2001. *NAREL Quality Assurance Management Plan*. NAREL, Montgomery, AL, May.
- ⁴ UC Davis, 2002. *IMPROVE: Interagency Monitoring of Protected Visual Environments, Quality Assurance Project Plan*. March.
- ⁵ EPA-5700, 1988, *EPA Assistance Administration Manual*, (EPAX-8911-0040-5700). U.S. Environmental Protection Agency, Washington, D.C.
- ⁶ EPA Order 5360 A1, 2000, *EPA Quality Manual for Environmental Programs*, U.S. Environmental Protection Agency, Washington D.C., May.
- ⁷ EPA, 2001, *Draft Guidance for Tracking Progress Under the Regional Haze Rule*, U.S. Environmental Protection Agency, Research Triangle Park, NC, September.
- ⁸ WinHaze Version 2.8.0 Level I Visual Air Quality Modeler (February 7, 2001), Air Resource Specialists, Inc., Fort Collins, CO.

GLOSSARY OF QUALITY ASSURANCE AND RELATED TERMS

Activity — An all-inclusive term describing a specific set of operations of related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication), that, in total, result in a product or service.

Assessment — The evaluation process used to measure the performance or effectiveness of a system and its elements. As used here, assessment is an all-inclusive term used to denote any of the following: audit, performance evaluation (PE), management system review (MSR), peer review, inspection, or surveillance.

Audit (quality) — A systematic and independent examination to determine whether quality activities and related results comply with planned arrangements and whether these arrangements are implemented effectively and are suitable to achieve objectives.

Audit of Data Quality (ADQ) — A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality.

Certification — The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Collocated samples — Two or more portions collected at the same point in time and space so as to be considered identical. These samples are also known as field replicates and should be identified as such.

Computer program — A sequence of instructions suitable for processing by a computer. Processing may include the use of an assembler, a compiler, an interpreter, or a translator to prepare the program for execution. A computer program may be stored on magnetic media and referred to as “software,” or it may be stored permanently on computer chips, referred to as “firmware.” Computer programs covered in a QAPP are those used for design analysis, data acquisition, data reduction, data storage (databases), operation or control, and database or document control registers when used as the controlled source of quality information.

Corrective action — Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Data Quality Assessment (DQA) — The scientific and statistical evaluation of data to determine if data obtained from environmental operations are of the right type, quality, and quantity to support their intended use. The five steps of the DQA process include: 1) reviewing the DQOs and sampling design, 2) conducting a preliminary data review, 3) selecting the statistical test, 4) verifying the assumptions of the statistical test, and 5) drawing conclusions from the data.

Data Quality Objectives (DQOs) — The qualitative and quantitative statements derived from the DQO Process that clarify study's technical and quality objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors that will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data reduction — The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Design — The specifications, drawings, design criteria, and performance requirements. Also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Document — Any written or pictorial information describing, defining, specifying, reporting, or certifying activities, requirements, procedures, or results.

Environmental data — Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions.

Financial assistance — The process by which funds are provided by one organization (usually governmental) to another organization for the purpose of performing work or furnishing services or items. Financial assistance mechanisms include grants, cooperative agreements, and governmental interagency agreements.

Finding — An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative, and is normally accompanied by specific examples of the observed condition.

IMPROVE aerosol sampler – The standard IMPROVE aerosol sampler has four sampling modules, designed to obtain a complete signature of the composition of the airborne particles that affect visibility. Module A (Teflon[®]), B (nylon), and C (quartz) collect fine particles (PM_{2.5}) and Module D (Teflon[®]) collects PM₁₀ particles.

Independent assessment — An assessment performed by a qualified individual, group, or organization that is not a part of the organization directly performing and accountable for the work being assessed.

Inspection — The examination or measurement of an item or activity to verify conformance to specific requirements.

Level 0 – Validation level of data that includes manual review of data listings and plots in conjunction with log sheets, calibration reports, audit reports, and other documentation.

Level I – Validation level of data that includes a review of field operations, instrumentation performance, and questionable data coded for evaluation.

Level II – Validation level of data that verifies sample concentrations by contrasting with expected values.

Management — Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system — A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Management system review (MSR) – The qualitative assessment of a data collection operation and/or organization(s) to establish whether the prevailing quality management structure, policies, practices, and procedures are adequate for ensuring that the type and quality of data needed are obtained.

Organization — A company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, public or private, that has its own functions and administration.

Organization structure — The responsibilities, authorities, and relationships, arranged in a pattern, through which an organization performs its functions.

Procedure — A specified way to perform an activity.

Process — A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Project — An organized set of activities within a program.

Quality — The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality Assurance (QA) — An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality Assurance Project Plan (QAPP) — A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. The QAPP components are divided into four classes: 1) Project Management, 2) Measurement/Data Acquisition, 3) Assessment/Oversight, and 4) Data Validation and Usability. Guidance and requirements on preparation of QAPPs can be found in EPA QA/R-5 and QA/G-5.

Quality Control (QC) — The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality. The system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against “out of control” conditions and ensuring the results are of acceptable quality.

Quality improvement — A management program for improving the quality of operations. Such management programs generally entail a formal mechanism for encouraging worker recommendations with timely management evaluation and feedback or implementation.

Quality management — That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan (QMP) — A formal document that describes the quality system in terms of the organization’s structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system — A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC).

Requirement — A formal statement of a need and the expected manner in which it is to be met.

Round-robin study — A method validation study involving a predetermined number of laboratories or analysts, all analyzing the same sample(s) by the same method. In a round-robin study, all results are compared and used to develop summary statistics such as interlaboratory precision and method bias or recovery efficiency.

Self-assessment — The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing and/or performing the work.

Specification — A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Standard Operating Procedure (SOP) — A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps and that is officially approved as the method for performing certain routine or repetitive tasks.

Technical review — A documented critical review of work that has been performed within the state of the art. The review is accomplished by one or more qualified reviewers who are independent of those who performed the work but are collectively equivalent in technical expertise to those who performed the original work. The review is an in-depth analysis and evaluation of documents, activities, material, data, or items that require technical verification or validation for applicability, correctness, adequacy, completeness, and assurance that established requirements have been satisfied.

Technical System Audit (TSA) — A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a system.

Vendor — Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. An all-inclusive term used in place of any of the following: seller, contractor, subcontractor, fabricator, or consultant.

Verification — Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled. In design and development, verification concerns the process of examining a result of a given activity to determine conformance to the stated requirements for that activity.

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