NADP Quality Management Plan

National Atmospheric Deposition Program

For information about the National Atmospheric Deposition Program (NADP) contact:

NADP Program Office
Wisconsin State Laboratory of Hygiene
University of Wisconsin - Madison
465 Henry Mall
Madison, Wisconsin 53706

URL: http://nadp.slh.wisc.edu
e-mail: nadp@slh.wisc.edu
phone : 608-263-9162

Table of Contents

Document Change History

Version	Description	Effective Date
3	Major Review and Update by Quality Assurance Staff at the WSLH	11/2021
2.0	Updated with Wisconsin State Laboratory of Hygiene (WSLH) information and updated Program Office organizational structure and roles.	04/2020
1.8	Updates to Tables 3, 4 and 6 to reflect network operations, and improve clarity. Clarify response and corrective action for Quality Management System review (Section 3.0, Table 3) Add Data Manager position to NADP Management and Organization (Section 4.0). Add NADP Program Office organizational chart (Section 4.0, Figure 1)	06/2016
1.7	Updates to reflect newly approved changes to the governance structure (i.e., DMAS to DMAG) and approval of QA documents by QAAG	10/2014
1.6	Addition of bromide as a new NTN/AIRMoN analyte, Include support of electronic rain gages, streamline and clarify assessment programs, remove description of MDN blind-audit program	05/2014
1.5	Addition of AMNet and AMoN, 2 new NADP networks	05/2011
1.0	Initial document	09/2009

List of Tables

List of Figures

Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
ANSI	American National Standards Institute
ASQC	American Society for Quality Control
BAC	Budget Advisory Committee
CAL	Central Analytical Laboratory
CSREES	Cooperative State Research, Education, and Extension Service
DMAG	Data Management Advisory Group
DQI	Data Quality Indicator
DQO	Data Quality Objective
EC	Executive Committee
EPA	Environmental Protection Agency
EOS	Education and Outreach Subcommittee
HAL	Mercury (Hg) Analytical Laboratory
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NAPAP	National Acid Precipitation Assessment Program
NED	Network Equipment Depot
NOS	Network Operations Subcommittee
NTN	National Trends Network
PDA	Personal Digital Assistant
PO	Program Office
QA	Quality Assurance
QAAG	Quality Assurance Advisory Group
QAP	Quality Assurance Plan
QAPP	Quality Assurance Project Plan
QC	Quality Control
QMP	Quality Management Plan
QMS	Quality Management System
SAES	State Agricultural Experiment Stations
SOP	Standard Operating Procedure
SOW	Statement of Work
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WSLH	Wisconsin State Laboratory of Hygiene

1.0 Introduction

The National Atmospheric Deposition Program (NADP) was established in 1977 under State Agricultural Experiment Station (SAES) sponsorship. The Program was established to address the impacts of atmospheric deposition on agricultural crops, forests, rangelands, surface waters, and other natural and cultural resources. By the summer of 1978, the NADP began collecting and analyzing weekly precipitation samples from a network of monitoring stations across the United States. Samples are analyzed at a central laboratory for acid anions, inorganic nitrogen species, and base cations. This network merged with the National Acid Precipitation Assessment Program's (NAPAP) National Trends Network (NTN) in the 1980s, with the designation NADP/NTN. Later, the network designation was shortened to NTN (National Trends Network).

Weekly integrated precipitation (filtered) collections from the NTN are used to characterize geographic patterns and temporal trends in chemical wet-deposition for sulfate (SO_4^{2-}), nitrate (NO_3^-), chloride (Cl^-), ammonium (NH_4^+), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), free acidity (H^+ as pH), and specific conductance. The data from over 250 NTN sites are published to the NADP website (www.nadp.slh.wisc.edu) for no-fee use by scientists, regulatory agencies and the general public. Bromide (Br^-) was approved as an official analyte in fall 2011 but was discontinued in June 2019.

A second network, the Atmospheric Integrated Research Monitoring Network (AIRMoN) joined the NADP in 1992. AIRMoN measured the same chemical species in precipitation as the NTN, but sampling was event-based, rather than weekly, and samples were held refrigerated after collection and until analysis of unfiltered samples. The higher resolution data assisted researchers in evaluations of the effectiveness of emissions controls on precipitation chemistry and are important for atmospheric chemistry model development and validation and back-trajectory (source-region) analysis. AIRMoN ended operations in September 2019.

A third network, the Mercury Deposition Network (MDN), joined the NADP in 1996. MDN precipitation samples are collected weekly and analyzed for total mercury. Methylmercury is also measured at some MDN sites. Data from this network are used to evaluate the role of precipitation as a vector for removing mercury from the atmosphere and delivery to terrestrial and aquatic ecosystems.

The Atmospheric Mercury Network (AMNet) became an official NADP network in 2009. Atmospheric concentrations of gaseous elemental mercury (GEM) are measured at each site using automated, semi-continuous instruments; and further speciated at selected sites with measurements of gaseous oxidized mercury (GOM) and particulate bound mercury (particulate matter less than 2.5 microns in size) (PBM) using Tekran mercury speciation systems. Data from AMNet provides high temporal resolution atmospheric mercury concentrations and helps describe the mercury fractions that contribute to dry and total mercury deposition.

The Ammonia Monitoring Network (AMoN) became an official NADP network in 2010. The AMoN measures gaseous ammonia concentrations in the atmosphere at 2-week intervals using passive samplers from over 100 sites across the U.S. and Canada. With increased demands for

food production, atmospheric ammonia concentrations are expected to increase. And with reductions in several key secondary PM sources (e.g. sulfate and nitrate), ammonia is becoming increasingly important as a contributor to atmospheric particle formation. Data from AMoN will help establish a baseline value for the concentration of ammonia in the atmosphere.

In 2021, the status of the provisional Mercury Litterfall Network was upgraded to become the sixth NADP network. In combination with data from the MDN and AMNet networks, the litterfall data can be used to examine ranges of mercury dry deposition, to estimate combined wet and dry mercury deposition, and to evaluate mercury models.

A primary goal of the NADP quality management team and plan is to ensure uniformity of siting criteria, sampling protocols, analytical methods, and data validation procedures. This uniformity, in conjunction with long-term site operation, is essential to the collection of robust, high-quality data that can be used to accurately and precisely assess changes in atmospheric and precipitation chemistry and deposition across the nation. Such changes may occur over seasons, years, or decades.

Activities and requirements described in this document form the basis for the NADP Quality Management System (QMS). This document supersedes all previous versions of the NADP Quality Management Plan (QMP).

2.0 NADP Quality Management System (QMS)

The NADP Quality Management System (QMS) ensures that the data quality needs of NADP data users are assessed and met. This is achieved by developing, documenting, and maintaining a structured system for managing the Quality Assurance (QA) and Quality Control (QC) activities within the NADP and its networks. Documents supporting the Quality Management System include this document (the Quality Management Plan, QMP), Quality Assurance Plans (QAPs), Standard Operating Procedures (SOPs), training materials, assessment program materials, and the NADP Governance Handbook. Table 1 identifies activities within the NADP QMS, and the associated documentation. Documents referenced in Table 1 are available from the NADP website (http://nadp.slh.wisc.edu).

Table 1. Documents Supporting the NADP Quality Management System.

Activity	*Governance Handbook*	*QMP*	*Network QAP*	*Data Management Plan and SOPs*	*Analytical Laboratory QAP and/or SOPs*	*External QAPs and field operation SOPs*
Project organization/ management	X	X				
QA policy/general requirements		X			X	
Establishment/ maintenance of field sites			X			X
Field sample collection procedures						X
Data validation/ verification				X	X	
Laboratory analysis/QA					X	
Public data release protocols		X		X		
External QA programs						X

2.1 NADP Governance Handbook

The NADP Governance Handbook defines and describes the mission of the NADP, its organization both in terms of funding and operation, and its management. The Handbook provides the basis for NADP operations and its QMS.

The Handbook is available from the NADP website (http://nadp.slh.wisc.edu). The NADP Program Office will review this document on an annual basis. Updates to this document are made with input from the Executive Committee (EC), the Quality Assurance Advisory Group (QAAG), Network Operations Committee (NOS), and the Program Coordinator.

2.2 Quality Management Plan (QMP)

This QMP is designed to meet the requirements of "Part A: Management Systems" of the consensus standard ANSI/ASQ E4-2014 (ANSI/ASQ, 2014), and is consistent with the U.S. EPA's Quality System Requirements (U.S. EPA, QA/G-1, 2002; U.S. EPA, QA/R-2, 2001). The Program Coordinator and Systems QA Manager are responsible for implementation of the QMP and its elements.

The NADP Systems QA Manager reviews the QMP on an annual basis. Updates to this document are made with input from the Quality Assurance Advisory Group (QAAG) the NADP subcommittees, and the Data Management Advisory Group (DMAG). Both the NADP subcommittees and the advisory groups are defined and described in the NADP Governance Handbook.

2.3 Quality Assurance Plans (QAPs)

Quality Assurance Plans (QAPs), also known as Quality Assurance Project Plans (QAPPs), are documents that describe the specific QA and QC activities required for a specific project. The goal of a QAP is to ensure that project deliverables are of sufficient quality and quantify to meet the project Data Quality Objectives (DQOs).

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the required technical characteristics of project data. For NADP, these requirements are detailed primarily as Data Quality Indicators (DQI) spelled-out in respective QAPs, and approved by the NADP Executive Committee (EC), with input from the NADP subcommittees, NADP QA staff, and advisory groups. As of 2021, the NADP PO is currently exploring whether (and how) a more formal DQO process could make the NADP network operations more efficient and simultaneously maintain, and in certain cases, improve overall data quality. A DQO process and document drafted by NADP PO staff in 2009 was never implemented or formally approved. However, several components and ideas from that document are being re-imagined in the current DQO/DQI process. DQIs include: accuracy, comparability, completeness, precision, and representativeness. Each network and laboratory within the NADP will have its own DQIs. The QAP for each network and laboratory will reflect the required DQIs and will identify the party responsible for implementing the necessary QA/QC protocols to meet the DQIs.

The QAPs for the NADP networks and the associated analytical laboratories describe the activities that ensure their work will meet specified criteria. These documents are designed to meet the requirements of "Part B: Collection and Evaluation of Environmental Data" of the consensus standard ANSI/ASQ E4-2014 (ANSI/ASQC, 2014), and the U.S. EPA's Requirements for Quality Assurance Project Plans (U.S. EPA, QA/R-2, 2001). The Program Coordinator and Systems QA Manager are responsible for ensuring that NADP QAPs are implemented and maintained.

QAPs should be reviewed on an annual basis by the Systems QA Manager. In the case of the laboratory QAPs, the QA staff for the laboratory should review the document on an annual basis. Laboratory QA staff should update the QAP at least once every three years. Revisions to the Laboratory QAP are approved by the Systems QA Manager.

2.4 Standard Operating Procedures (SOPs)

SOPs are documents that detail the specific procedures for chemical analyses, data management, instrument maintenance, sample collection, etc. The goal of an SOP is to ensure that all participants perform the procedure consistently over time and to ensure a seamless and robust transfer of protocol knowledge from one NADP staff to another

SOPs are developed for each activity that is conducted on a routine basis. Areas appropriate for an SOP include the following: sample collection, equipment operation, laboratory operations, supply and shipping operations, staff training, and data management (i.e., verification, screening, and reporting). SOPs must be reviewed by users on an annual basis, for purposes of continued training, and must be available to all users. For the purposes of the NADP Quality Management System, training videos and network operation manuals are also considered SOPs.

SOPs may be developed internally, or may be adopted from approved procedures developed by state and federal agencies or by organizations that develop standards. The source for an SOP must be referenced clearly if it originates from an external source.

SOPs should be reviewed by designated personnel (e.g., Site Liaison, Analyst, QA staff, Systems QA Manager) on an annual basis, updating the document when appropriate. Version control is critical for effective SOP implementation. The QA managers will maintain an electronic list of current SOPs.

2.5 Other Documents and Records

Documents and records not mentioned above may be required in order to address specific network issues. The EC or Program Coordinator specifies the required format and standards, and the frequency at which these documents should be reviewed and revised.

2.6 Assessment Programs

Assessment Programs, typically run by an entity external to NADP, are used to evaluate NADP network and laboratory operations. The Systems QA Manager, Laboratory QA Manager, and QAAG ensure that these programs occur on a regular basis. Assessment Programs verify that QAPs and SOPs are followed, that DQI are met, and that corrective measures are taken when necessary. As part of an assessment, documentation, operating procedures, data products, and other activities are evaluated for bias, precision, completeness, and representativeness. Individuals who conduct the assessment are independent of the audited process but have equivalent professional experience in the process or discipline.

Data quality assessments determine whether data are of sufficient quality to support the stated network objectives. The QAPs are used to assess the collected data. The Systems QA Manager and DMAG ensure that periodic data quality assessments occur.

Existing NADP Assessment Programs include: Site Systems and Performance Review program, Laboratory Reviews, Inter-laboratory comparisons, and Field QA programs. Table 2 lists the assessment programs, applicable frequency of implementation, the required documentation, and the required response.

The Precipitation Chemistry Quality Assurance Project is currently operated by the USGS. Information regarding the Project is available at http://bqs.usgs.gov/pcqa. The Project operates as an independent evaluation of data quality for the NADP (and for other precipitation chemistry laboratories). It operates several programs to evaluate the performance of the NADP wet-deposition networks. These programs include the Field-Audit, Co-located Sampler, and Interlaboratory-Comparison programs for the NTN; and the System-Blank, and Interlaboratory-Comparison programs for the MDN. The program specifications are documented in USGS Open-File Reports 2005-1024 and 2007-1170 (U.S. Geological Survey, 2005 and 2007).

The USGS Field-Audit and System-Blank programs are designed to measure the effects of field exposure, handling, and processing on sample chemistry. Note: following from discussions held in 2021, these programs may transition to hybrid USGS/NADP operation in 2022.

Sites that participate in the USGS Co-located equipment program operate pairs of equipment. The equipment pairs may be the same make and model, different models from the same manufacturer, or different models from different manufacturers. This program is used to assess the overall variability in NADP measurements, and the bias imparted by changes to equipment in the wet-deposition networks.

The USGS Interlaboratory-Comparison programs assess the analytical precision and relative bias of participating laboratories, including the two analytical laboratories used by the NADP. Results from the Interlaboratory-Comparison programs are used to quantify the bias and precision of NADP chemical analysis data, and to provide a basis for comparison between NADP laboratories and other laboratories performing similar analyses for other monitoring networks. Results from each of these programs are available through the Precipitation Chemistry Quality Assurance Project at the USGS.

Assessment programs not mentioned above may be implemented to provide additional verification of NADP DQO attainment.

2.7 Modeling Guidelines

Modeling is not part of the current NADP mission statement. Should this change, protocols will be established to ensure that the DQOs continue to be met.

3.0 Personnel Qualifications and Training

Appropriate training of NADP Program Office staff, field site operators, and staff at associated laboratories ensures that individuals have sufficient knowledge to perform their duties and meet QA requirements. The QAPs and SOPs specify minimum training requirements for these individuals.

The Program Office Manager is responsible for ensuring that adequate resources are available to support the professional development and training of Program Office personnel. Program Office personnel maintain proficiency in the NADP Quality Management System through annual review of the QMP.

The Program and Field Coordinators ensure that site operator training is available and adequate. Training resources may include: on-site training, NADP-sponsored training courses, training videos, webinars, and printed materials (e.g., network operations manuals, and troubleshooting guides). A record of attendees at NADP-sponsored training programs is maintained at the Program Office.

Site support personnel provide the site operators and supervisors with training materials and SOPs. Site Supervisors should ensure that site operators have adequate access to training programs. Site operators should maintain proficiency by reviewing the Site Operations Manual and relevant SOPs on an annual basis.

Laboratory Managers are responsible for ensuring adequate resources for the professional development and training of laboratory personnel.

Table 2. NADP Assessment Programs.

Type	Frequency	Personnel	Documentation	Response and Corrective Action	Conflict Resolution
Program	4th year of 5 year funding, or as necessary	2 peer scientists, one may be a CSREES representative	Written report on multi-state activities presented to NADP EC Chair and Program Coordinator prior to spring meeting of regional SAES Directors. Report documents: 1) quality, technical feasibility, and validity of activity 2) relevance to stated goal 3) likelihood of achieving goal 4) responsiveness to stakeholder needs 5) extent of multidisciplinary, multi-state collaboration	NADP EC Chair selects individuals to formulate a response and timetable for corrective actions.	NADP EC Chair, Administrative advisors, CSREES National Program Leader
Quality System	External review every 3 years, on-site or remotely, follow-up within one year	3 member team	Written report to QAAG, EC documenting: 1) compliance with QMP 2) implementation of QMP procedures 3) compliance of data with DQIs 4) documentation and implementation of the Quality System	Program Coordinator formulates response and timetable for corrective actions. EC approves the response. Final review report and approved response sent to Review Team and EC.	NADP EC Chair
Laboratories	On-site or remotely, every 3 years, follow-up within one year	Up to 5 reviewers including: Technical systems reviewer(s) Data quality and management reviewer(s) Team leader Systems QA Manager as an observer	Written report presented to Systems QA Manager, NADP EC Chair, subcommittee Chairs, Program Coordinator, Lab Manager and Lab QA Managers 1) documentation and implementation of QAP and SOPs 2) compliance with QAP and SOPs 3) appropriateness and effectiveness of lab activities 4) data of sufficient quality to meet DQI requirements	Lab and QA Managers formulate response and timetable for corrective actions. Final review report and approved response sent to Review Team, Program Coordinator and subcommittee Chairs.	Systems QA Manager, Program Coordinator, NADP EC Chair

Table 2. NADP Assessment Programs - continued.

Type	Frequency	Personnel	Documentation	Response and Corrective Action	Conflict Resolution
Site Systems and Performance Surveys	approximately once every 4 years, on-site	Survey personnel under contract with U.S. EPA	Written reports to PO staff and U.S. EPA Program Officer documenting:1) compliance with siting criteria 2) compliance with field operations manual and SOPs 3) verification of equipment operation	Site Operator and Site Supervisor in coordination with Site Liaison and PO Manager. Document corrective actions that can be made and when those actions are made.	Systems QA Manager, U.S. EPA Program Officer
Data Quality	As needed (determined by EC, Program Coordinator, QAAG or DMAG)	Systems QA Manager and Data Manager in coordination with individuals appointed by QAAG or DMAG	Report format determined by Review requester, documenting: 1) data validation and verification processes in QAPs and SOPs. 2) compliance with QAPs and SOPs. 3) data quality sufficient to meet DQOs and SOW requirements	Systems QA Manager proposes corrective actions. DMAG Chair approves corrective actions.	NADP EC Chair
Ad-Hoc Assessment	As needed (determined by EC, Program Coordinator, NADP subcommittees, or QAAG)	Systems QA Manager in coordination with individuals appointed by QAAG, and NADP subcommittees	Report format determined by Review requester	Systems QA Manager proposes corrective actions.	NADP EC Chair

4.0 NADP Management and Organization

As previously discussed, the NADP Governance Handbook, along with network and laboratory QAPs, describe the mission, structure, management, and operation of the NADP. These documents are available from the NADP website. All NADP personnel must:

- Be familiar with and comply with all QA and QC practices within their job duties as outlined in QAPs, and task-specific SOPs.
- Report deviations from the approved QAPs and SOPs to supervisory staff, and take necessary corrective actions.

Figure 1 indicates the organizational structure of the NADP Program Office. Position specific responsibilities are listed below.

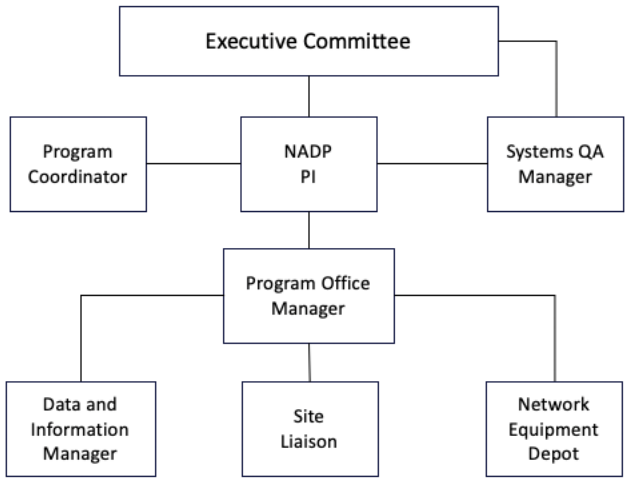

Figure 1. NADP Program Office Organizational Chart.

4.1 Program Office Manager

The Program Office Manager is responsible for managing the NADP PO. This position is also responsible for helping to ensure that the NADP Program Office runs smoothly and efficiently through coordination with the NADP Coordinator, Principal Investigator (PI) and QA Systems Manager, and works closely with the NADP Central Analytical Laboratory (CAL) and Mercury Analytical Lab (HAL) management. Responsibilities of the Program Office Manager under this QMP include:.

- Manage Program Office personnel;
- Oversee all network field operations;
- Overseeing network and laboratory operations as detailed in the corresponding QAPs.

4.2 Program Coordinator

The Program Coordinator is responsible for ensuring that the scientific, technical, and administrative work is in accordance with the terms and conditions of the grants, contracts, and cooperative agreements that fund the NADP. Responsibilities of the Program Coordinator under this QMP include:

- Developing and implementing the NADP QMP in cooperation with the Systems QA Manager.
- Along with the PO Manager, developing and implementing policies, programs, and activities approved by the EC.
- Ensuring that the Program Office is staffed with professionals who can carry out the administrative activities and responsibilities undertaken by the Program Office.
- Ensuring adequate resources are available for NADP QA programs and activities.
- Program outreach, promotion, and sponsor/site retention and/or expansion.
- Participating in NADP management and operations assessments.
- Coordinating annual planning activities.
- Approving SOWs for the analytical laboratories.
- Coordinating NADP training programs.
- Presenting budgetary requests, including QA activities, for consideration by the Budget Advisory Committee (BAC) and the Executive Committee.

4.3 Site Liaison

The Site Liaison reports to the Program Office Manager and has the following responsibilities under this QMP:

- Monitoring field operations and data from all network sites
- Providing technical oversight to identify and correct problems
- Develop improvements in collection and measurement of precipitation
- Implementing network SOPs.
- Participating in NADP management and operations assessments.
- Coordinating periodic NADP surveys, audits, reviews, and assessments for the NADP networks and associated laboratories.
- Evaluating new equipment proposed for use in NADP networks.
- Coordinating NADP Training programs.

4.4 Systems Quality Assurance (QA) Manager

The Systems QA Manager reports to the Principal Investigator and the Executive Committee. He/she is organizationally independent of other NADP personnel involved with the generation

and reporting of environmental data. The Systems QA Manager has the following responsibilities in implementing the NADP Quality Management System:

- Developing and implementing the NADP QMP in cooperation with the Program Coordinator, and with guidance from the Executive Committee and QAAG.
- Developing and implementing activity-specific QAPs for current and future NADP networks with guidance from the EC and the QAAG.
- Ensuring that QAPs and SOPs are developed and implemented by QA staff of the analytical laboratories.
- Work closely with the QAAG.
- Performing period assessments (including stress-testing) of the overall quality of NADP data-collection, management, and presentation processes.

4.5 Data and Information Manager

The Data and Information Manager reports to the Program Office Manager. The Data and Information Manager has the following responsibilities relating the NADP Quality Management System:

- Developing and implementing the NADP Data Management SOPs.
- Developing and implementing automated and manual checks of data and data products before posting to the NADP website.
- Work closely with the DMAG.

4.6 Analytical Laboratory Quality Assurance (QA) Staff

Each NADP affiliated analytical laboratory maintains QA staff. These individuals perform their QA roles effectively independent of personnel involved with the generation and reporting of environmental data. Laboratory QA staff report to the Manager of the analytical laboratory. The QA staff has the following responsibilities in implementing the NADP Quality System:

- Implementing the NADP QMP with guidance from the Systems QA Manager and the QAAG.
- Developing and implementing activity-specific QAPs for laboratory operations.
- Coordinating with the QAAG.
- Developing and approving SOPs for laboratory operations and QA activities.
- Participating in NADP management and operations assessments.
- Conducting regular internal audits.

4.7 Network Equipment Depot (NED)

The Program Office maintains a supply of replacement parts through the Network Equipment Depot (NED). Replacement parts include but are not limited to: motorboxes, sensors, rain gage collection chambers, Androids, Bluetooth and WiFi adapters, lightning arrestors, power supplies, batteries, and other replaceable parts. Replacement parts are shipped to sites within 7 days of notification of need. Replaced parts are returned to the NED for repair.

Equipment repair and calibration are performed at the NED in accordance with relevant SOPs. Equipment is tested to ensure that it meets specifications as documented in network QAPs and SOPs.

5.0 Procurement of Items and Services

Specifications for approved field equipment are documented in the network QAPs and relevant SOPs. Changes to equipment specifications or equipment types must be approved by the Executive Committee with recommendation by NOS. Supplies used for field operations must comply with specifications outlined in the field operations manuals. Supplies provided by the analytical laboratories for site use must meet specifications stated in the laboratory QAP and relevant SOPs. Contracted supplies, such as NTN bucket bags, must meet network quality requirements and acceptance from vendor may be subject to performance testing by the NADP laboratories.

Equipment repaired under outside contract must meet tolerance and performance criteria stated in the contract and comply with specifications documented in the network QAPs and SOPs. The NED tests and verifies vendor and subcontractor repairs to ensure that they meet NADP specifications.

Analytical laboratory services provided for the NADP must meet the specifications stated in the laboratory QAPs. The Program Coordinator reviews and approves the QAPs to ensure that changes to NADP policies and procedures are reflected. Laboratories must provide QC information to assess the quality of reported results for comparison to stated performance criteria. Supplies procured for laboratory NADP use must meet the specifications stated in the laboratory QAPs and SOPs.

Items and services procured by the Program Office must meet the specifications stated in the purchase request and be of acceptable quality to meet NADP objectives. For a new and/or replacement item to be approved for network use, its results must equal, or exceed, those of similar items already approved for network use. Results are evaluated in terms of detection limits, precision, and accuracy. Such items may include both field and laboratory equipment.

Items on bid should include adequate detail, including the quality and performance expectations of the acquired items. Certifications of calibration, performance, quality, and warranty information that accompany goods and services must be maintained in a secure location under

the control of designated personnel. External laboratory services must provide adequate QC information (e.g., compliance with accreditation requirements, QAPs, QMPs, and SOPs) to assess the bias and precision of the reported results.

6.0 Documentation and Records

Accurate and complete documentation is an important resource for data users and a critical feature of a robust quality management system. Effective documentation enables the broad spectrum of data users to evaluate data suitability to purpose from NADP networks. This section considers required NADP documentation, its preparation, approval, and maintenance. Documentation may include both printed and digital material, including video.

All NADP network and associated laboratory operations must prepare and maintain documents specified in this document. A consistent format should be used to allow tracking of documents and records, including revisions. Version control is essential. Header information should appear on each page and should include the title of the document and its effective date. Page numbering should be used for multi-page documents. Table 3 lists the required documents, and the individuals responsible for preparing, maintaining, and reviewing the documents.

Documents and records at the Program Office and the analytical laboratories should be maintained in a secure location. When appropriate, temperature, light, static, and moisture control should be considered in order to ensure the integrity of the documents. Data records are backed up nightly through WSLH OIS services.

Metadata must accompany data archives. Metadata should include the data format, data fields with associated units, and other information intended to inform the data user about the nature of the data, their quality, and their use. These records must be stored permanently with document control (title, version number, dates, and page numbers). Program Office final validated data archives must be updated at least annually. A duplicate copy of the data archive must be stored in a secure, off-site location

Table 3. Management of NADP Documentation.

Activity	*Governance Handbook*	*QMP*	*Network QAP*	*Data Management Plan*	*External SOPs*	*External QAPs*	*Laboratory QAP*	*Laboratory SOPs*
Responsibility	Systems QA Manager, Program Coordinator			Data Manager, Program Coordinator	Network-specific support staff	Contractor	Laboratory Manager, Laboratory QA Staff	Laboratory Manager, Laboratory Staff
Approved By	EC	QAAG				Funding Agency, Systems QA Manager	Systems QA Manager, Program Coordinator	Laboratory QA staff
Effective Date	effective from date of approval for a maximum period of five years, unless specified otherwise.							
Revision Schedule	review annually, update at least once every 3 years							
Distribution	NADP website							
Retention Time	permanent, unless specified otherwise (at Program Office)							

* Operations manuals and training videos are considered SOPs.

7.0 Computer Hardware and Software

Project deliverables and data quality management requirements must be considered when selecting computer hardware and software for use in the NADP. Table 4 considers the hardware and software requirements of the NADP Program Office, the associated laboratories, and the field locations. Each location has specific needs and requirements that must be addressed. Software includes design, data acquisition, data handling, data analysis, modeling, geographic information system scripts, and databases.

The Program Office follows the guidelines set out by the WSLH Office of Information Systems (OIS) which has numerous protocols in place to ensure the integrity, security, and reliability of the PO servers, workstations, and software.

Table 4. NADP computer hardware and software requirements.

Item	Location	Selection Criteria	Notes
Hardware	Field Operations	- meets specifications as stated in the QAPs and SOPs	
	Program Office	- sufficient to meet data deliverables - support long-term data storage - compatible with existing or proposed NADP hardware - website and database servers should meet current industry norms for speed, retrieval, and processing.	- at least weekly backup - at least 3 backup media used in rotation - off-site storage of 1 set of backup media - off-site storage of data archive updated at least once annually
	Laboratory	- meets specifications in the laboratory QAP - sufficient to meet data deliverables	- at least weekly backup - at least 2 backup media used in rotation - off site storage of 1 set of backup media
Software	Field Operations	- meets specifications as stated in the QAPs and SOPs	- documentation of formulae and algorithms for mathematical and computational software required - source code required if needed to customize the software - specify round-off/truncation protocols if commercial software is to be used
	Program Office	- compatible with existing or proposed NADP software - sufficient to meet data deliverables	
	Laboratory	- meets specifications in the laboratory QAP - sufficient to meet data deliverables	

Internally developed software should contain adequate documentation clearly stating the purpose, program limitations, and applications for which the software was developed. The

author(s) of the software should be identified. Whenever practicable, a complete listing of the source code should be available to users. All mathematical algorithms used in the software should be described in a narrative description accompanying the source code. Prior to use, newly developed software should be tested rigorously using predetermined acceptance criteria. When feasible, test data sets and databases should be used to confirm the accuracy and reliability of the software prior to its routine use.

NADP data and associated reports are maintained in an on-line repository. Access to that site is not restricted. The site may be accessed at http://nadp.slh.wisc.edu. DMAG approves data formats that are available on-line. These formats are compatible with industry standards. Data may be made available in an alternate format or via alternate means by special request.

Data integrity can be compromised during data entry, electronic capture from automated instruments, or when transferred between different data logging devices (e.g., datalogger, Android), different computers or databases. Written procedures for ensuring the accuracy and reliability of computerized data products should be described in individual QAPs. Data verification SOPs should be available which would explain these procedures in more detail. Data verification methods may include double entry, manual checking of a fixed percent of data, and computer-automated checking of the entire data record.

8.0 Network Expansion

When a site proposes to join an NADP network several steps must occur. This helps ensure continued integrity of the NADP, and that the mission of the NADP is preserved. Those steps are:

1. The Proposer reviews the *NADP Site Selection and Installation Manual* (NADP, 2019) to verify the appropriateness of the site based on NADP siting criteria.

2. The Proposer submits a completed *Site Information Worksheet* (SIW) to the Program Office requesting admission to a NADP network.

3. The Proposer submits a site sketch and photos of the proposed location to the Program Office.

4. The Site Liaison and Program Coordinator review the submitted documentation.

5. The Site Liaison works with Site Sponsor(s) and other site personnel to resolve any problems at the proposed site.

6. For cases where siting rules and guidelines cannot be met completely, supporting documentation is reviewed by the Program Coordinator, NOS Chair, and NOS Vice Chair, and Systems QA Manager for possible inclusion in the network with exception. Note, an exception is not an exemption. Depending on the situation, data

collected from the site may be qualified and/or censored from selected reports and products.

7. Once a decision is made, the Site Liaison notifies Site Sponsors and other site personnel of approval or rejection. When a site is approved, the Site Liaison requests that the site be sent start-up supplies from the network's analytical laboratory.

8. The Program Coordinator will ensure that appropriate agreements are in place for site sponsorship by working with the WSLH contracts office.

9. The Site Liaison enters site information into the site information database and creates an archive for all relevant documentation from the site.

10. Site information is posted on the NADP website.

9.0 New Networks and Special Studies

Proposals for new NADP initiatives must address, at a minimum, the items outlined in the document *Guide for New NADP Initiatives*. This document is available from the NADP website. Proposals are submitted to the NADP EC via the Program Office. A document outlining DQIs and required QA activities must be submitted to the QAAG before the network/initiative begins operation.

Periodically, the NADP conducts special studies to evaluate new methods, new equipment, or to evaluate existing protocols. Compliance with the NADP QMS is recommended but not required for special studies. As such, QA documentation and QC implementation may differ from that required for the primary NADP networks. Special studies conducted under the auspices of the NADP will not compromise the QMS for the NADP or any other network at a participating site.

10.0 Deliverables and Schedules

Table 5 lists the deliverables, the responsible agency, and the schedule for those items. The Program Office is responsible for the quality and timeliness of all deliverables, regardless of their origin.

11.0 Quality Improvement

The QAAG is responsible for overseeing and ensuring continued quality improvement in the NADP. The QAAG takes the lead in working with data users to define DQOs. Assessment programs ensure that DQOs are achieved and meet the needs of data users. NADP Subcommittees advise the QAAG.

Quality improvement programs focus both on field and laboratory operations. All individuals involved in NADP activities should seek continued quality improvement of the DQIs. Prompt identification of problems is essential. Once the nature and extent of a problem has been determined, corrective measures may be implemented.

The structure of the NADP promotes the free exchange of information. All individuals are encouraged to participate in efforts to improve the networks and enhance the scientific relevance of the NADP.

Table 5. NADP deliverables and schedules.

Deliverable	Action	Responsible Party	Schedule
Field supplies for sample collection	Notify Program Office, only when there is a problem	Analytical Laboratory	Sufficient for uninterrupted operation
Validated data, including data corrections	Submit to Program Office	Analytical Laboratory	90 days from collection
Laboratory report	Oral report to the NADP Subcommittees	Analytical Laboratory	At bi-annual NADP Subcommittee meetings
QA Report and revisions	Submit to Program Office for review	Analytical Laboratory	Final version by 01 October for previous calendar year's data
QAP and revisions	Submit to Program Office for review and approval	Analytical Laboratory	At least once every 3 years
SOPs and revisions	Submit to Program Office Upon request	Analytical Laboratory	Annual review by QA staff and review during external audit
Data submittal memos (including: site problems, equipment and personnel changes, site closures, site relocation)	Submit to Program Office	Analytical Laboratory	Monthly
Validated data	Post to NADP website	Program Office	30 days from receipt by PO
Data summary	NADP data summary report to data users, may include isopleth maps for concentration and deposition, and other figures	Program Office	Annual, by 01 October for previous calendar year's data
Program Office Report	Oral reports to the NADP Subcommittees and EC	Program Office	Oral reports at bi-annual NADP meetings
SAES Report	Written report to the SAES Regional Research Committees and National Information Management and Support System	Program Office	Annual, end of federal fiscal year
USDA Report	Written report to the USDA Current Research Information System	Program Office	Annual, end of federal fiscal year
QAP	Submit to QAAG for review and approval	Program Office	At least once every 3 years
QMP	Submit to QAAG for review and approval	Program Office	At least once every 3 years
Governance Handbook	Submit to NADP Subcommittees and EC for approval	Program Office	At least once every 3 years

Appendix A: Terms

Accuracy – the closeness of agreement between the result of a measurement and its true value.

Acidic compound – a chemical compound capable of transferring a hydrogen ion in solution.

Acidic precipitation – precipitation with **pH** below approximately 5.0.

ANSI/ASQC E4-1994 – American National Standards Institute/American Society for Quality Control - "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs."

Assessment – the evaluation process to measure the performance or effectiveness of a system and its elements; this all-inclusive term denotes evaluations, audits, or reviews.

Atmospheric deposition – removal of solid, aqueous, or gaseous materials from the atmosphere via fallout or precipitation.

Audit – a systematic and independent examination to determine whether practices comply with documented **QAPs** and **SOPs**, and that these practices are implemented effectively and are suitable to achieve stated objectives.

Base cations – chemical compounds capable of accepting a hydrogen ion in solution; for the purposes of the NADP, compounds of calcium, magnesium, potassium, and sodium.

Bias – systematic or persistent distortion of a measurement process that causes errors in one direction**.**

Comparability – a measure of the confidence with which one data set can be compared to another.

Completeness – a measure of the amount of valid data obtained from a measurement system compared to the amount that was possible given that **SOPs** are followed.

Conductance – a measure of a solution's capacity to conduct an electrical charge

Data quality assessment – scientific and statistical evaluations of validated data to determine if they are of the right type, quality, and quantity to support their intended use.

Data Quality Indicator (DQI) – quantitative statistics and qualitative descriptors used to interpret the degree of acceptability or utility of data to the user: principally **bias**/**accuracy**, **precision**, **comparability**, **completeness**, and **representativeness**.

Data Quality Objective (DQO) – qualitative and quantitative statements that specify the technical characteristics of data that are required to support the intended purposes and uses of the data. May include tolerances on the **Data Quality Indicators.**

Deposition – see **atmospheric deposition**.

Ecoregion – a regional classification based on climate and terrain; defined by Robert G. Bailey, **USDA**.

Emissions – release of pollutants from natural and human sources.

Environmental data – any measurements or information that describe environmental processes, location, or conditions; ecological or health effects and consequences; or the performance of environmental technology. Environmental data include information collected directly from measurements, produced from models, and compiled from other sources such as databases or the literature.

Free acidity – free hydrogen ions in solution not bound in other chemical compounds.

Metadata – data and other information about another related data set (e.g., instrument maintenance logs as metadata for direct instrument readings).

Nutrient – chemical compounds that enhance the growth of organisms.

Peer review – a critical review of a specific scientific and/or technical product to corroborate scientific defensibility, which may include an in-depth assessment of assumptions, calculations, extrapolations, alternative interpretations, methodology, acceptance criteria, and conclusions pertaining to the specific scientific and/or technical products and of the supporting documentation.

Performance evaluation – a quantitative test to determine whether a measurement system can obtain results that meet tolerance limits.

pH – a measure of free hydrogen ion in solution on a logarithmic scale.

Precipitation –water that falls from the atmosphere, generally snow, rain, and ice, but not fog.

Precipitation chemistry – chemical changes occurring in a liquid state in the atmosphere.

Precision – a measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions, expressed generally in terms of the standard deviation.

Quality Assurance (QA) – an integrated system of management activities involving planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the necessary type and quality expected by the client; generally implemented after an activity has occurred.

Quality Assurance Plan (QAP) – a formal document describing in comprehensive detail the necessary QA, QC, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy stated performance criteria.

Quality Control (QC) – the overall system of technical activities to measure 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; generally implemented while activities are being performed.

Quality improvement – a management program to improve the quality of operations using a formal mechanism to encourage worker recommendations, timely management evaluation, and feedback or implementation.

Quality Management Plan (QMP) – a document that describes the quality system in terms of the organizational structure, functional responsibilities of management and staff, lines of authority, and required interfaces for those planning, implementing, and assessing all activities conducted.

Quality Management System (QMS) – the overall management system of the organization that determines and implements the quality policy. Includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, documentation, and assessment) pertaining to the quality system.

Receptor – location where pollutants are deposited or ingested.

Record – a completed document that provides objective evidence of an item or process. Records may include photographs, drawings, magnetic tape, and other data recording media.

Representativeness – a measure of the degree to which data accurately and precisely represent the characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Specifications – a document stating requirements and that refers to or includes drawings or other relevant documents. They 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. The officially approved method for performing certain routine or repetitive tasks.

Statement of Work (SOW) – a written document detailing the procedures and deliverables required to meet contract obligations.

Wet deposition – removal of solid, aqueous, and gaseous materials from the atmosphere via precipitation.

Appendix B: References

American National Standards Institute and American Society for Quality Control (ANSI/ASQC), 2014. *Quality Management Systems for Environmental Information and Technology Programs: Requirements with Guidance for Use*. E4-2014. Milwaukee, WI.

Environmental, Engineering & Measurement Services (EE&MS). 2016. *Quality Assurance Project Plan (QAPP): Support for Conducting Systems and Performance Surveys of National Atmospheric Monitoring Stations*. Gainesville, FL.

National Atmospheric Deposition Program (NADP). 2019. *NADP Site Selection and Installation*. Manual. Wisconsin State Laboratory of Hygiene, Madison, WI.

United States Environmental Protection Agency (U.S. EPA). 2000a. *Guidance on Technical Audits and Related Assessments for Environmental Data Operations*. Reissue Notice May 2006. EPA QA/G-7: EPA/600/R-99/080. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2000b. *Policy and Program Requirements for the Mandatory Agency-wide Quality System*. CIO 2105.0. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2001a. *EPA Requirements for Quality Management Plans*. Reissue Notice May 2006. EPA/240/B-01/002: EPA QA/R-2. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2001b. *EPA Requirements for Quality Assurance Project Plans*. Reissue Notice May 2006. EPA/240/B-01/003: EPA QA/R-5. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2007. *Guidance for Preparing Standard Operating Procedures*. EPA/600/B-07/001: EPA QA/G-6. Washington, D.C.

United States Environmental Protection Agency (U.S. EPA). 2003. *Guidance on Assessing Quality Systems*. EPA/240/R-03/002: EPA QA/G-3. Washington, D.C.

United States Geological Survey (USGS). 2005. External quality-assurance programs managed by the U.S. Geological Survey in support of the National Atmospheric Deposition Program/National Trends Network: U.S. Geological Survey Open-File Report 2005-1024

United States Geological Survey (USGS). 2007. External Quality-Assurance Programs Managed by the U.S. Geological Survey in support of the National Atmospheric Deposition Program/Mercury Deposition Network: U.S. Geological Survey Open-File Report 2007-1170.