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Quality Assurance/Quality Control Documentation

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Authorizations

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0	Initial Document	Sept 2007	
1	Michael Kolians'n comments	May 2008	
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3	Annual and Contract Update	Dec 2018	

Quality Assurance Project Plan (QAPP)
Revision 3

Support for Conducting Systems and Performance Surveys of the National Atmospheric Deposition Program (NADP) Monitoring Stations

Prepared for:
U. S. Environmental Protection Agency
Washington, DC 20460

Prepared by:

1128 NW 39th Drive
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Contract No. EP-W-18-005

December 2018

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GROUP A: PROJECT MANAGEMENT

A1 Approval Sheet

Approved by:

Maria L. Jones, PE **Project Manager** **EEMS, Inc.**	**Date**
Alison Ray **QA Manager** **EEMS, Inc.**	**Date**
Timothy Sharac **Project Officer** **US EPA, Office of Atmospheric Programs**	**Date**
Gregory Beachley **Alternate Point of Contact** **US EPA, Office of Atmospheric Programs**	**Date**
Carlos Martinez **EPA Quality Assurance Officer** **US EPA, Office of Atmospheric Programs**	**Date**
Martin Shafer **NADP Quality Assurance Manager** **Wisconsin State Laboratory of Hygiene** **University of Wisconsin-Madison**	**Date**

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A2 Table of Contents

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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
CAAA	Clean Air Act Amendments
CAL	Central Analytical Laboratory
CAMR	Clean Air Mercury Rule
CASTNET	Clean Air Status and Trends Network
EEMS	Environmental, Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
GPRA	Government Performance and Results Act
GPS	global positioning system
HAL	Mercury Analytical Lab
Hg	mercury
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NADP PO	NADP Program Office
NIST	National Institute of Standards and Technology
NOS	Network Operations Subcommittee
NO_x	nitrogen oxides
NTN	National Trends Network
NWS	National Weather Service
OAP	Office of Atmospheric Programs
OTC	Ozone Transport Commission
PART	Program Assessment Rating Tool
PO	Program Office
QA	quality assurance
QAAG	Quality Assurance Advisory Group
QAPP	quality assurance project plan
QC	quality control
QMP	quality management plan
SIP	state implantation plan
SO_2	sulfur dioxide
SOP	standard operating procedures
WSLH	Wisconsin State Laboratory of Hygiene
µS/cm	micro Siemens/centimeter

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A3 Distribution List

Copies of the approved document "Quality Assurance Project Plan (QAPP) for Support for Conducting Systems and Performance Surveys of the National Atmospheric Deposition Program (NADP) Monitoring Stations", along with any subsequent revisions, are distributed via e-mail to the persons listed below:

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1.0 GROUP A: Project Management Elements

This Quality Assurance Project Plan (QAPP) has been prepared to meet the requirement of the Environmental Protection Agency (EPA) Contract Number EP-W-18-005 for the Support for Conducting Systems and Performance Surveys of National Atmospheric Monitoring Stations (from this point on referred to as the NADP Site Survey Program). This QAPP describes the objectives of the surveying activities to be performed at National Atmospheric Deposition Program (NADP) sites, data quality requirements and assessments, project management, organization and responsibilities of Environmental Engineering & Measurement Services, Inc. (EEMS) staff and consultants, and a schedule of activities and deliverables. This QAPP has been prepared to be compliant with EPA Order 5360.0 A2, *Policy and Program Requirements for the Mandatory Agency-wide Quality Systems* and with the EPA QAPP format as presented in the *EPA Requirements for Quality Assurance Project Plans*, EPA QA/R5 (EPA 2001).

1.1 A1 – Title and Approval Sheet

Title and Approval Sheet provided in preliminary section of this document.

1.2 A2 – Table of Contents

Table of Contents provided in preliminary section of this document.

1.3 A3 – Distribution List

Distribution List provided in preliminary section of this document.

1.4 A4 – Project/Task Organization

The NADP Site Survey Program is fundamentally a quality assurance role to ensure the reliability of data collected at these sites. This includes a thorough, on-site evaluation of facilities, equipment, personnel, training, procedures, documentation and reporting aspects of the field operations systems. Field systems survey results are used to ensure that good quality assurance/quality control (QA/QC) practices are being applied as defined in the NADP Quality Management Plan (QMP). The individuals with major responsibilities participating in this project are presented below.

<u>EEMS Project Manager</u>

The project manager is responsible for:

- Coordinating with the surveyors regarding survey schedules, procedures, standards and constants, and required supplies.

- Reviewing all survey results.
- Distributing the survey results to designated personnel in a timely fashion.
- Reviewing and approving any changes to the survey procedures.
- Preparing and maintaining the QAPP.
- Assisting in preparing the template for the surveying activities (Site Performance Survey Questionnaire).
- Coordinating survey schedules with the Survey Team Leader.
- Notifying the applicable personnel of any upcoming surveys.
- Reviewing and forwarding the survey deliverables to the applicable personnel.
- Preparing Monthly Technical Progress reports to the U.S. EPA.
- Preparing an Annual Summary Report to the U.S. EPA.
- Attending annual NADP meetings.
- Participating in QAAG meetings.

The EEMS Project Manager is Maria Jones, P.E.

Survey Team Leader

The Survey Team Leader is responsible for:

- Coordinating with the Project Manager regarding survey schedules, survey procedures, accuracy goals, required materials, and survey standards.
- Performing all required surveys in accordance with approved survey protocols as described in the specific Standard Operating Procedures (SOP).
- Maintaining all survey standards.
- Meeting with, observing and/or interviewing the site operators as needed during surveys.
- Documenting the survey results using the appropriate forms and database.
- Preparing and forwarding survey reports to the Project Manager.
- Assisting in preparing the QAPP.
- Assisting in preparing the template for the surveying activities (Site Performance Survey Questionnaire).
- Acquiring the appropriate equipment, supplies and standards to conduct the surveys
- Training other EEMS employees, or EEMS consultants (Survey Technicians) who may be expected to perform surveys.
- Finalizing and forwarding the survey deliverables to the EEMS Project Manager.
- Attending annual NADP meetings.
- Participating in QAAG meetings.

The EEMS Survey Team Leader is Eric Hebert.

Survey Team Technicians

The Survey Team Technicians are responsible for:

- Performing all required surveys in accordance with approved survey protocols as described in the specific Standard Operating Procedures (SOP).
- Meeting with, observing and/or interviewing the site operators as needed during surveys.
- Documenting the survey results using the appropriate forms and database.
- Preparing and forwarding survey reports to the Project Manager.
- Acquiring the appropriate equipment, supplies and standards to conduct the surveys

The EEMS Survey Team Technicians are Sandy Grenville, Martin Valvur and Korey Devins.

EEMS QA Manager

The QA Manager is responsible for:

- The review and approval of the QAPP.
- Document control.
- QC of database entries.
- Overseeing the maintenance of National Institute of Standards and Technology (NIST) traceable records and survey standards.
- The review all deliverables (including the QAPP) to the U.S. EPA and the NADP PO to ensure that these deliverables are of the type and quality required for their intended use.
- Participating in QAAG meetings.

The EEMS QA Manager is Alison Ray.

U.S. EPA Project Officer

The functions of the U.S. EPA Project Officer are:

- Providing overall technical direction for the project.
- Receiving notification of EEMS' activities on the project

- Receiving all EEMS' survey deliverables.

The U.S. EPA Project Officer is Timothy Sharac, and the alternate is Gregory Beachley.

U.S. EPA QA Officer

The functions of the U.S. EPA QA Officer are:

- Reviewing all deliverables (including the QAPP) to ensure that these deliverables are of the type and quality required for the intended use.

The U.S. EPA QA Officer is Carlos Martinez.

NADP QA Manager

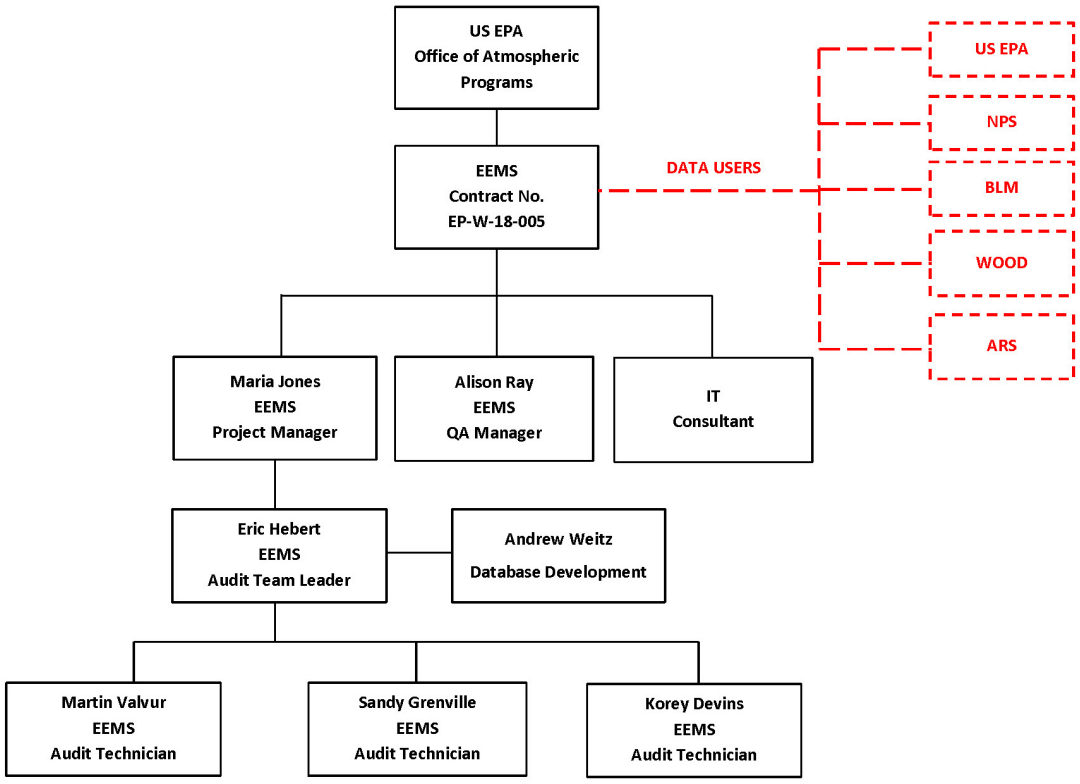
The functions of the NADP QA Manager are:

- Reviewing all deliverables to the NADP Program Office to ensure that these deliverables are of the type and quality required for the intended use.
- Assisting in preparing the template for the surveying activities (Site Performance Survey Questionnaire).
- Receiving all survey deliverables, including the annual QA report.

The NADP QA Manager is Martin Shafer.

Figure 1 shows the organizational chart for EEMS with the relationships and lines of communication among the project participants, together with the users of the data generated by this survey program.

Figure 1. Organizational Chart and Data Users



1.5 A5 – Problem Definition/Background

The Acid Rain Program, established under Title IV of the 1990 Clean Air Act Amendments (CAAA), requires major reductions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions from the electric power industry. Similarly, other programs such as the Ozone Transport Commission (OTC), NO_x Budget Trading Program and the EPA's NO_x State Implementation Plan (SIP), both of which are seasonal and regional NO_x reduction programs also require emissions reductions from the power sector. In the spring of 2005, EPA promulgated a suite of air quality rules designed to further the reductions of SO_2 and NO_x, as well as mercury (Hg) emissions from power plants. Assessing the environmental impacts of power generation such as regional air quality and atmospheric deposition of sulfur, nitrogen, ammonia, and mercury is important to understanding and evaluating the progress of these emission reduction programs. EPA adheres to several mandates such as Title IX of the Clean Air Act, the Government Performance and Results Act (GPRA), and the Program Assessment Rating Tool (PART) to report on the performance and overall progress of these programs. This involves evaluating the environmental effectiveness of these programs as measured by a variety of environmental

monitoring efforts at different scales, and examination of the link between emissions and atmospheric concentrations, deposition, and soil/aquatic chemistry and biological impact, and concentration levels and human health. EPA's air quality management strategy must continue and improve tracking regional patterns of pollutant concentrations, transport, and trends.

To understand the impact of emissions reductions on the environment, scientists and policy makers use data collected from long-term national monitoring networks such as the Clean Air Status and Trends Network (CASTNET) and the NADP's wet deposition and ambient concentration networks. These networks are complementary in many ways and provide information on a variety of indicators necessary for tracking temporal and spatial trends in regional air quality and atmospheric deposition. The NADP is a cooperative of multi-agency network, which measures precipitation chemistry and estimates atmospheric deposition for various pollutant ions and mercury. EPA has provided long-standing support for the operation of NADP. In addition to operational support, EPA provides support for the survey and quality assurance programs of the NADP networks. Contract Number EP-W-18-005 provides for the survey and quality assurance assessment of sites associated with three NADP wet-deposition networks–the National Trends Network (NTN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), and the Mercury Deposition Network (MDN). Examination of the AMoN (Ammonia Monitoring Network) shelters and the eight directional photographs of the samplers is also included as part of the quality assurance assessments. Surveys of sites under this contract will provide the necessary checks for the site operations and will serve to validate data provided by the sites in the network.

QA/QC activities for these networks improve overall data quality and ensure field measurements remain accurate and precise. Stringent QA and QC are essential for obtaining unbiased and representative atmospheric deposition measurements and for maintaining the integrity of the sample during collection, handling, and analysis across the networks. These activities strengthen the reliability and overall quality of the data the EPA uses for policy decisions and for measures of accountability.

1.6 A6 – Project/Task Description

The work to be performed under this contract involves support to the EPA, Office of Atmospheric Programs (OAP), Clean Air Markets Division (CAMD). Under this contract EEMS performs a survey of site operations for NADP's wet-deposition collection networks. All results are recorded in a relational database and reported to the relevant data users. The surveys provide quality assurance pertaining to siting, sample collection and handling, equipment operation and maintenance, recordkeeping, reports, and field laboratory procedures.

1.6.1 A6.1 Work Performed

The primary function of this contract is to provide in-field systems and performance survey services (herein after referred to as surveys) to assess and aid the performance and maintenance of the nationwide, long-term wet deposition monitoring networks of the NADP.

NADP collection stations are currently comprised of five networks which include: precipitation chemistry and wet deposition sites in the NTN; precipitation chemistry and wet deposition sites in the AIRMoN; and measurements of mercury concentrations in precipitation at wet deposition sites in the MDN. The most recently added networks include AMNet, Atmospheric Mercury Network which reports atmospheric mercury concentrations for determination of mercury dry deposition, and AMoN, Ammonia Monitoring Network which reports atmospheric ammonia concentrations to determine ammonia dry deposition.

There are currently over 250 wet deposition sites in the NADP/NTN, over 90 sites in the NADP/MDN, including over 40 that are collocated at NTN sites, and four sites in NADP/AIRMoN, including three that are collocated at NTN sites. NADP operates sites throughout the continental United States, Alaska, Canada, Puerto Rico, and U.S. Virgin Islands. Current maps with the sites for the three different networks can be found at http://nadp.slh.wisc.edu/. The number of sites in each network can vary at any given time and is expected to increase. EEMS will be responsible for maintaining a current inventory of sites, based on information provided by the NADP PO, located at the Wisconsin State Laboratory of Hygiene at the University of Wisconsin-Madison.

The NADP PO operates and/or administers the three precipitation chemistry networks (NTN, AIRMoN, and MDN), two independent analytical laboratories, the Network Equipment Depot (NED) along with the AMoN and AMNet networks. Each network has a particular objective and corresponding sampling analytes and periods.

1.6.2 A6.2 Participation in NADP's Standing Subcommittee on Network Operations

Appropriate representatives from EEMS will actively participate on NADP's standing Subcommittee on Network Operations (NOS) meeting twice a year. EEMS representatives will also attend the Annual Technical Committee Meetings, participate in the QAAG conference calls, and any other interim business meetings as appropriate. Changes to equipment and methods are discussed and decided at the subcommittee meetings. Participation in the subcommittees is essential for staying informed about changes in network operations.

1.6.3 A6.3 Site Systems and Performance Surveys

EEMS will conduct surveys of approximately 75 sites per year from the NADP NTN, AIRMoN, and MDN networks, including collocated sites. A monitoring site can have one or more collocated NADP collection stations at a single site location. Collocated sites include those sites that are within a 1 km radius. Each approved NADP monitoring station at the physical location will be considered a single monitoring station in the total for the year. The purpose of the surveys is to provide an independent quality assurance assessment of all NADP sites, documenting the conditions of the site, site operations, and site equipment. The survey team will conduct external quality assurance evaluations pertaining to NADP approved siting criteria, sample collection and handling, field measurement procedures and SOPs, equipment operation and maintenance, record keeping, reports and field laboratory procedures. As part of the site survey, EEMS will also perform minor repairs and preventive maintenance, and will assist in restoring proper function to site equipment. EEMS will conduct site operator training when necessary. Surveys may also include certain other monitoring activities and special studies located at approved NADP sites using approved NADP monitoring equipment. In such cases, EEMS will contact the NADP PO and the EPA Project Officer to verify whether a survey is applicable.

The items in the Site Performance Survey Questionnaire for each network will be checked at each collection site and entered into a computer database maintained by EEMS. This database will ensure and verify the validity of all entries. Database reports and tables will be electronically transferred to the EPA and NADP QA Manager. The database files will be in Microsoft Access® format and contain every item on the network Site Performance Survey Questionnaire. Digital site images will be provided (via a FTP server) in electronic format with a consistent, site specific naming convention. Additional survey documentation will be mailed or electronically transferred to the EPA Project Officer and the NADP QA Manager upon request. EEMS developed and follows a site survey procedure manual, or SOPs, that details the major functions and procedures involved in conducting a site survey as part of this program. If the NADP anticipates changes to equipment and procedures during the period of this contract, such changes, when approved by the NADP PO and subcommittees, will be considered within the scope of Contract Number EP-W-18-005.

The following tasks pertain to general preparation for conducting surveys at NADP monitoring sites.

1.6.4 A6.4 Work Performed in Preparation for Conducting Surveys

EEMS is familiar with the overall operations of each of the three NADP wet deposition networks, and will work closely with the NADP PO in the coordination of site surveys and to maximize the utility of information gathered.

Standards and supplies required to conduct the survey will include:

- Standard weights for calibrating Belfort rain gages, and verifying the calibration of the electronic rain gages.
- Global Positioning System (GPS) device equipped with a Wide Area Augmentation System (WAAS). Survey quality compass (NIST certified) for accurate proximity determinations of site equipment and site configuration purposes.
- At a minimum 4.0 mega pixel digital camera.
- Field-suitable laptop computer with Microsoft Access® 2010, or later version,
- Quality controlcheck samples and conductivity standards, as appropriate, provided by CAL.
- EEMS understands that in the event that the NADP updates site equipment over the period of this contract, EEMS may be required to procure additional equipment to verify calibration of new NADP-approved equipment.

EEMS will initiate communications with the NADP representatives and site liaisons and NADP QA Manager to obtain an update of the site status, and site operator information prior to initiating site surveys. Upon receiving updates of the status of the sites, EEMS will proceed to develop a proposed schedule of sites to be surveyed in the second year of this contract based on historical survey data.

EEMS developed a database that provides the EEMS team with electronic entry forms for inputting and handling information collected from the site surveys. The database is capable of storing historical information from previous surveys so data entry/exit rules can be written that will challenge entries that differ significantly from initial entries. This database generates an abbreviated exit report (Spot Report) from the preliminary numeric audit results and written findings. The Spot Report includes findings that could result in data invalidation. Further information on this database is provided in the NADP Site Systems Survey Standard Operating Procedures (NADP INSTALLATIONS) – SOP-NADP-1500 (Revision 4).

EEMS has developed a Quality Management Plan (QMP) according to EPA Requirements for Quality Management Plans (EPA QA/R-2) and this QAPP which conforms to EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5).

1.6.5 A6.5 Work Performed During the One-Year Option Period l and Each One-Year Option Period

EEMS will conduct surveys of approximately 75 monitoring sites each year. The first consideration will be given to those sites that have not been surveyed for four or more years.

Following this criteria, EEMS will develop a schedule of the sites to be surveyed during the each one-year period of the contract.

1.6.5.1 Prepare for Each Survey Trip

One month before the scheduled site surveys, EEMS contacts the EPA Project Officer, the NADP PO QA Manager, the appropriate site liaisons and site operators and supervisors to establish an agenda for the survey. Details pertaining to the contacting procedures can be found in SOP-NADP-1500 (Revision 4). EEMS also prepares the necessary supplies to conduct the site surveys. These supplies comply with NOS-approved specifications. Equipment repaired and/or calibrated on site by EEMS are performed in accordance with NOS-approved procedures. EEMS compiles the necessary information in preparation for the site survey, and generates the necessary field forms to conduct the surveys. This subject is further discussed in Section B3 – Data Handling and Custody.

1.6.5.2 Conduct Site Surveys

Survey Technicians meet the site operators and other interested parties as prearranged, and conduct the surveys in accordance with the SOPs included in Appendix A. These SOPs have been developed by EEMS for the different aspects of conducting the survey. Assistance from the site operator will only be required to obtain the information necessary to complete the Site Performance Survey Questionnaire that pertains to the historical data and to the evaluation of his or her sample handling techniques.

EEMS conducts quantitative performance assessments during the surveys. All information is recorded by EEMS in the Site Performance Survey Questionnaire forms.

1.6.5.3 Prepare and Forward Survey Deliverables

The Survey Technician verbally briefs the site operator (and supervisor if present) on the results of the systems and performance survey. As soon as practicable after the completion of the site survey, EEMS Project Manager or Survey Technician generates a Spot Report that includes any immediate action items necessary to restore proper function to the site. It contains a summary of survey activities and serves to document the visit.

1.6.5.4 Prepare Monthly Progress Reports

EEMS Project Manager prepares written technical progress reports (Monthly Progress Report) that includes the following items:

- A summary of EEMS' activities conducted during the reporting period
- A summary of EEMS' activities currently scheduled during the next reporting period
- A listing of outstanding actions awaiting EPA Project Officer authorization

The Monthly Progress Report is submitted electronically to the EPA by the 15th day of each month: the EPA PO, the EPA COR and the EPA Contract Specialist are copied.

1.6.5.5 Prepare Annual Summary Report

EEMS Project Manager prepares a written draft report summarizing EEMS' surveying activities and findings. The report includes the sites surveyed during each calendar year. The draft is prepared and submitted by EEMS to the EPA Project Officer, the EPA COR and to the NADP QA Manager. An effort is made to submit the draft report within 90 days following each calendar year or with sufficient time for the annual NADP interim subcommittee meeting. The recipients of the draft report have up to 45 days for review, and comment on the report. Once comments have been received, these are incorporated into the final report which is submitted within 30 days to the interested parties.

1.6.5.6 Semi-Annual NADP Meetings

EEMS Project Manager and Survey Team Leader (or representatives) attend the Annual Interim Subcommittee meeting (typically scheduled during the spring months) and actively participate on the NADP NOS. EEMS Project Manager and Survey Team Leader (or representatives) attend the annual NADP Technical Committee interim meeting (typically scheduled during the autumn months). A brief update of EEMS' recent activities is presented during the Annual Interim Subcommittee meeting. The EPA Project Officer and the NADP QA Manager provide updates and summaries as appropriate to NADP members. A summary of the results included in the annual summary report is presented at the Annual NADP Interim Subcommittee Meeting. EEMS also participates in the semi-annual QAAG conference calls.

1.6.5.7 Maintaining the QAPP

EEMS Project Manager periodically reviews the QAPP[1] for accuracy. The review should occur upon major changes in procedures or personnel, or at least annually, whichever is sooner. Approved revisions of the QAPP will be distributed electronically to those included in the document distribution list.

1.7 A7 – Quality Objectives and Criteria

The intent of the NADP Site Survey Program is to provide an unbiased assessment for all NADP wet-deposition sites and to document the results to verify that all evaluated parameters are consistent with the NADP performance and accuracy goals. The quality objectives of this survey program are to evaluate the parameters in a precise manner and to accurately report the findings.

[1] Reviews of the QAPP will only be distributed in electronic format.

1.7.1 A7.1 Project Quality Objectives

The project quality objective is to ensure that the survey data collected by EEMS are of the type and quality required by the EPA and the NADP PO to determine if the samples and field data collected at each network site are in conformance with NADP Network QAP. The project objective will be satisfied by:

- EEMS and the end users jointly developing the Site Performance Survey Questionnaire for gathering, recording and transmitting the data at the operations workshop
- Establishing regular communications between EEMS Survey Team Leader and NADP representatives (typically the NADP QA Manager and NADP network site liaisons).

Quality objectives will continue to be developed within the scope of this project.

1.7.2 A7.2 Measurement Performance Criteria

Historical data available from previous site surveys is entered into the Site Performance Survey Questionnaire for the upcoming surveys. All historical data is checked by EEMS during the survey, to verify if changes have occurred. Changes may be likely given that sites are surveyed approximately once every three years, and that sites are dynamic in terms of the performance of the site operators, the performance of the equipment, and site surroundings.

EEMS' goal is to obtain 100 percent data completeness of the Site Performance Survey Questionnaire. Difficulties in accomplishing this goal may include such factors as inclement weather during the survey, non-participation of the site operator during the survey, unexpected failure of any of EEMS' measurement equipment, and other factors beyond EEMS' control. EEMS expects to obtain an overall data completeness of the Site Performance Survey Report of at least 95 percent.

1.8 A8 – Special Training/Certification

No special training or certifications are required of EEMS personnel assigned to participate in this project. The EEMS Project Manager and EEMS Survey Team Leader and EEMS' survey team technicians attended the Project Operations workshop as was required by Contract Number EPW07061. EEMS personnel have extensive experience performing field survey activities.

Training of all new field personnel will be provided by the Survey Team Leader. All new field personnel will be trained by accompanying the Survey Team Leader to as many field sites as necessary to become proficient with the survey procedures.

An effort will be made to have the EEMS QA Manager observe the survey Team's procedures and techniques at various sites during NADP surveys. The QA Manager would then provide a

report regarding the proficiency of the Survey Technicians within one month of the observation (or field audit).

1.9 A9 – Documents and Records

During the course of this project the following documents and records are generated and revised as needed:

- The current QAPP and subsequent revisions
- The Site Performance Survey Questionnaire
- Survey announcement letters to the site operator, site supervisor and site sponsor
- Field Data Sheets of the Site Performance Questionnaire for data gathering
- The current individual network and instrument SOP and subsequent revisions
- Survey deliverables
- Monthly Progress Reports
- Annual Summary Reports
- Site Survey File
- Any other formal written correspondence from the EEMS Project Manager to the EPA Project Officer or the NADP QA Manager.

The EEMS QA Manager is responsible for review of and maintaining the distribution of the current version of the SOPs and QAPP.

Table 1 includes the different types of reports, generated for the NADP Site Survey Program, the recipient of each report and the level of detail.

Table 1. Documents Generated for the NADP Site Survey Program

Report Name	Recipients	Purpose and Description
Project SOPs	EPA Project Officer ; NADP QA Manager	Describes the procedures to follow when conducting all aspects of the site surveys
QAPP and Subsequent Revisions	EPA Project Officer; NADP QA Manager	Documentation of all aspects of QA/QC to be followed during the period of this contract
Site survey announcement correspondence*	Site supervisor; site operator EPA Project Officer, NADP QA Manager	Letter confirming date, time and location of the scheduled site survey along with a brief agenda and duration of the site survey
Survey Deliverable: Spot Report	Site Operator and Supervisor; NADP QA Manager; EPA Project Officer	Report of site activities and items requiring repair and maintenance

Report Name	Recipients	Purpose and Description
Survey Deliverable: Monthly Progress Report	EPA Project Officer Contract Specialist	Report of the previous month's activities and planned activities for the following month
Survey Deliverable: Annual Summary Report	EPA Project Officer ; NADP QA Manager	Summary of previous year's activities (Draft) Summary of previous year's activities (Final)
Database Transfer Tables Submitted Quarterly	EPA Project Officer ; NADP QA Manager	Electronic database file delivery

* Letter of Transmittal only

2.0 GROUP B: Data Generation and Acquisition

This section addresses all aspects of data acquisition to ensure that appropriate methods of data collection, data handling, and QC activities are being followed.

2.1 B1 – Data Collection Design

The NADP Site Survey Program is an external QA and maintenance function of sites of four of the five NADP networks. The design, location, acceptance, and operation of the sites within the networks are the responsibility of the NADP PO and subcommittees.

The NADP Site Survey Program is designed to test and assess each of the measurement and sample collection devices at all of the wet-deposition sites in the NADP. The locations of the sites can be found at http://nadp.slh.wisc.edu/.

The schedule of site surveys is established to enable each site in the NADP to be surveyed once approximately every four years. The current Site Survey Schedule is available to authorized personnel by accessing EEMS' FTP site.

The sites are comprised of instruments and equipment that have been approved by the NADP PO and subcommittees. Table 2 summarizes the instruments and equipment operated by the networks of the NADP and those used during the survey procedures to assess the operation of the equipment.

Table 2. Standard Instruments and Equipment

Site Instrument	Network			Survey Standards, Instruments and Tools
	NTN	MDN	AIRMoN	
Belfort Precipitation Gage	X	X		Weights, Linearity Tool
ETI NOAH IV Precipitation Gage	X	X	X	Weights, PDA[2], Voltmeter
OTT NADP Pluvio Precipitation Gage	X	X	X	Weights, PDA, Voltmeter
ACM Type Precipitation Collector	X	X	X	Temperature Probe, Weights, Voltmeter
N-CON Precipitation Collector		X		Temperature Probe, Voltmeter
Ohaus Balance	X		X	Weights

[2] PDA is used at some sites to communicate with the electronic raingage

Site Instrument	Network			Survey Standards, Instruments and Tools
	NTN	MDN	AIRMoN	
Scales (various)	X		X	Weights
pH meter (various)			X	Test solution and target values as provided by the CAL
Conductivity meter (various)			X	Test solution and target values as provided by the CAL

Other operational aspects of the sites are also assessed; those include the siting criteria and operational procedures, and are considered site systems surveys. The design and methods used for the assessment of all aspects of NADP site operations are described in the following sections.

2.2 B2 – Data Collection Methods

A performance survey and a system survey comprise the elements of a NADP site survey. When performing the site surveys, and collecting data, EEMS follows specific SOPs developed for each aspect of the survey and instrument. As the SOPs are followed, findings are recorded in the forms that constitute the Site Performance Survey Questionnaire. The Site Performance Survey Questionnaire can be found in Appendix B. The SOPs can be found in Appendix A.

2.2.1 B2.2.1 – Performance Survey Procedures SOPs

EEMS developed four SOPs where the overall or general procedures for conducting the performance survey for all sites and specifically in each of the three wet-deposition networks are specified:

- NADP Site Performance Survey Standard Operating Procedures – SOP-NADP-1500
- NTN Site Performance Survey Standard Operating Procedures – SOP-NADP-1010
- MDN Site Performance Survey Standard Operating Procedures – SOP-NADP-1020
- AIRMoN Site Performance Survey Standard Operating Procedures – SOP-NADP-1030

The performance survey procedures include verifying that sensors and gages are capable of making valid and accurate measurements as defined in the NADP Network QAP, performing maintenance and calibration on the equipment as required, evaluating field laboratory performance, documenting survey results using appropriate forms and database, and distributing the survey results to designated project personnel.

EEMS developed SOPs for conducting surveys of the different types of precipitation gages found at NADP sites:

- Belfort Precipitation Gage – SOP-NADP-1400
- OTT NADP Pluvio Precipitation Gage – SOP-NADP-1410
- ETI NOAH IV Precipitation Gage – SOP-NADP-1420

EEMS checks the response of the gages as found over the range appropriate for the gage, and when necessary, attempts to repair and recalibrate any Belfort gage in which the difference between the applied depth and recorded depth is out of tolerance as defined in the NADP QAP. Electronic gages will not be adjusted.

EEMS developed SOPs for conducting surveys of the different types of precipitation collectors found at NADP sites, including the collector sensor and motorbox:

- ACM NTN and AIRMoN Precipitation Collector – SOP-NADP-1310
- ACM MDN Precipitation Collector – SOP-NADP-1320
- N-CON Precipitation Collector – SOP-NADP-1330

EEMS developed SOPs for conducting surveys of the field laboratory activities, equipment and supplies found at NTN and AIRMoN NADP sites:

- Ohaus Balance (or electronic scale) – SOP-NADP-1210
- pH Meter – SOP-NADP-1220
- Conductivity Meter – SOP-NADP-1230

Field laboratory includes data that pertains to performance of the field laboratory equipment (bucket balance, pH measurement system and specific conductance measurement system), the inventory of supplies and recordkeeping by the site operator.

For AIRMoN sites, CAL provides EEMS with a simulated rain sample of known pH and specific conductance. EEMS then requests from the site operator that he or she analyze the sample as though it were a regular weekly sample. EEMS is able to assess the procedures executed by the site operator in completing this task.

The methods developed and described in the performance survey SOPs are intended to be used to determine and ensure that data collected and recorded by the NADP conforms to the performance acceptance criteria established in the NADP Network QAP. Table 3 is a summary of these performance acceptance criteria.

Table 3. Performance Acceptance Criteria

Site Measurement	Survey Method	Acceptance Criteria
Belfort Precipitation Depth	Standard weight	± 0.10 in
ETI Precipitation Depth	Standard weight	±0.05 in
OTT NADP Pluvio Precipitation Depth	Standard weight	±0.05 in
Collector Clutch	Weight lift	2 standard weights
Mass	Standard weight	0.5%
pH	Reference solution	Target values as provided by the CAL
Conductivity	Reference solution	Target values as provided by the CAL
Precipitation Sensor Temperature	Standard temperature probe	60 °C ± 10% in 10 minutes
Precipitation Sensor Grid Type	Observation	7 for NTN and 11 for NTN
Precipitation Thies Sensor	Observation	5 passes in 50 seconds

2.2.2 B2.2.2 – NADP Systems Survey Procedures

The NADP Systems Survey Procedures include data that pertains primarily to those aspects of the survey that are not instrument specific such as general site information, siting criteria, power source for the site, field laboratory and site operator evaluation and training. EEMS follows SOP-NADP-1500 when performing this part of the survey.

EEMS takes electronic photographs of the site in standard Windows JPG format at a resolution not less than 4.0 mega pixels. The 8 cardinal directions N, NE, E, SE, S, SW, W, and NW are photographed as viewed from a distance of 5 to 10 meters from the precipitation collector, with a directional badge indicating the direction of the photo along with an overview photo of the site. Additional views may also be taken if deemed to be necessary, by the Survey Technician, to adequately show the site. EEMS uses a GPS system for measuring latitude, longitude, and elevation of the site precipitation collector for each site location.

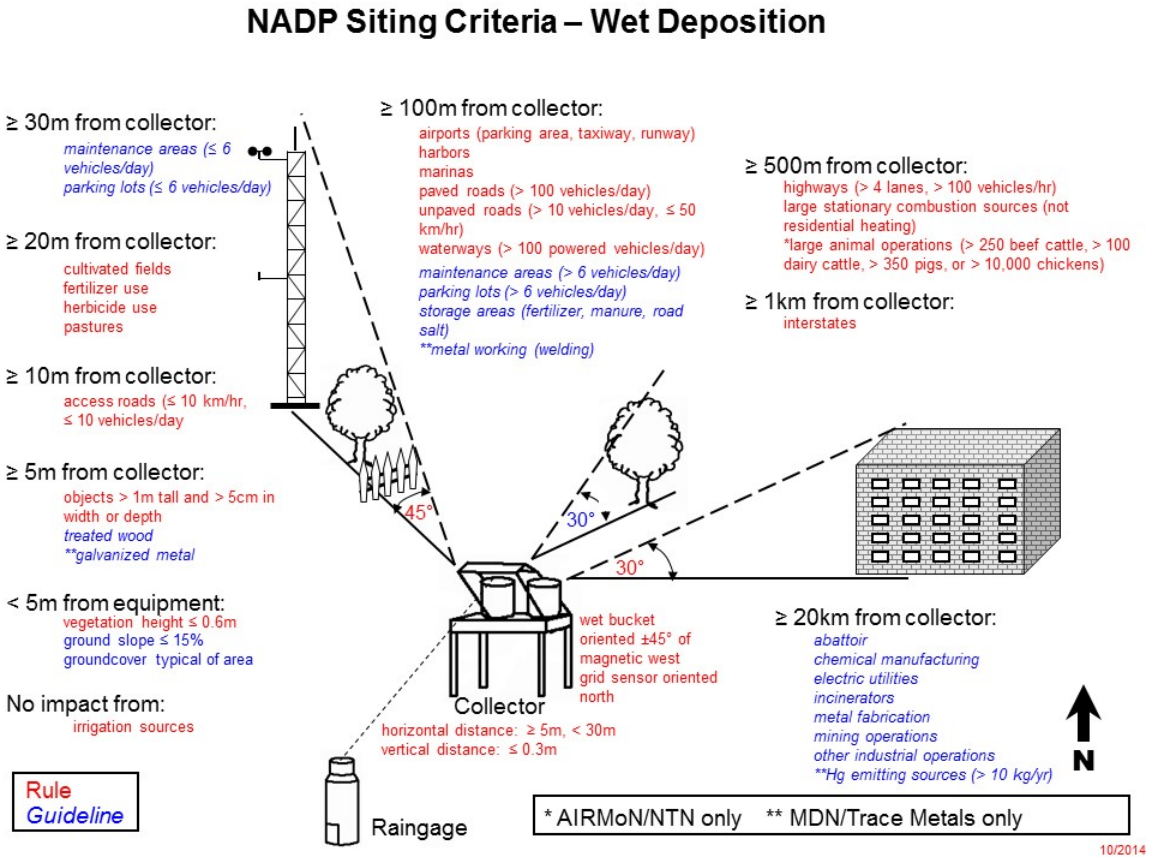
The methods developed and described in the system SOP are intended to be used to determine and ensure that data collected and recorded by the NADP conforms to the system acceptance criteria established in the NADP Network QAP. Table 4 is a summary of system acceptance criteria.

Table 4. Systems Acceptance Criteria

Site Measurement	Survey Method	Acceptance Criteria
Collector wet bucket oriented magnetic West	Certified compass	± 45 degrees
Collector and gage inlet height separation	Distance measuring device	± 0.3 m

Figure 2 shows the approved NADP siting criteria.

Figure 2. Accepted Siting Criteria



2.3 B3 – Data Handling and Custody

When a site survey is scheduled, EEMS requests from the NADP PO the most recent contact information for the site operator and site supervisor. EEMS will also request from the site personnel any information on modifications that may have been performed on the site instrumentation, and any operational problems that may exist at the site. EEMS then compiles

the Site Survey File. Detailed information regarding the Site Survey File can be found in site performance SOPs for the different networks (documents SOP-NADP-1010, SOP-NADP-1020, and SOP-NADP-1030).

Each Survey Technician is assigned a set of site survey equipment that includes tools, equipment, routine maintenance items, a field computer with FSSD, and survey supplies required to perform surveys. The Survey Technician is responsible for maintaining the equipment in working order and reporting any problems to the EEMS Survey Team Leader and/or QA Manager so that malfunctioning equipment may be repaired or replaced, as needed. The Survey Technicians are also responsible for replenishing field supplies, as needed. The EEMS QA Manager is responsible for maintaining the required annual certifications for all survey equipment. Certification dates and any required correction factors are printed and adhered to the corresponding equipment. An electronic copy of each certification is maintained on the EEMS FTP server which is routinely backed-up. An electronic copy of any equipment certification is provided to the technician for his/her records. A hardcopy of each certification is also maintained at the EEMS office.

During the site survey, the Survey Technician follows the specific SOPs, and records the data generated onto the Site Performance Survey Questionnaire forms. The historical data from the previous site survey is verified. As soon as practicable, the Survey Technician enters the data gathered into the FSSD. A backup of the data is created after each site survey and the files are e-mailed to the Project Manager who reviews the data, generates Spot Reports, and e-mails the Spot Reports to the interested parties. Once three sites have been surveyed, the Survey Technician sends the original forms to EEMS via FedEx. Photographs taken during the Site Survey are uploaded to the EEMS FTP site by the Survey Technician. Once uploaded to the EEMS FTP site, these are named following a naming convention and copied to the appropriate folder within the site by office personnel. These photos can then be accessed by the EPA PO and the NADP QA Manager.

The data collected then goes through the quality control process.

2.4 B4 – Analytical Methods

CAL will prepare simulated rain samples of known pH and specific conductance for use by EEMS in conducting surveys at AIRMoN sites. These samples will be prepared according to CAL's procedures and QAPP. These samples will be used by EEMS' Survey Technician to evaluate the technique of the site operators and to determine the accuracy of the instruments in question.

2.5 B5 – Quality Control

EEMS is acutely aware that the NADP Site Survey Program is one QA/QC role of the NADP program. As such, the internal site survey program QA/QC has added importance and consequence since not only data collected for the purpose of the survey, but data collected for the purpose of the NADP are jeopardized if the survey data are not accurate and quality assured.

EEMS QA Manager and Project Manager will review and oversee all of the procedures. Quality assurance documents (QMP and QAPP) will be prepared by the Project Manager with input and revisions by the QA Manager. These documents will specify the procedures followed as they relate to data collection and data entry.

Collected data will be recorded during the site surveys on the Site Performance Survey Questionnaire Forms. These handwritten entries will then be entered into the FSSD by the Survey Technician.

Double data entry of the data collected is performed by a technical assistant QA staff member. Any data discrepancies are revealed by the FSSD. It is the responsibility of the QA Manager and the Project Manager to resolve and reconcile any discrepancies between the two sets of data. Once the discrepancies have been resolved, a complete site report is generated and a more comprehensive QC process begins. The QA Manager then reviews all the photos taken during the site survey, and verifies that the data in the complete site report is correct and no inconsistencies are revealed between the photos and the report. When inconsistencies occur, the QA Manager will resolve these by contacting the Survey Technician and discussing the issues in question. Any records in the database that need to be modified after this screening are updated, and then a backup copy of the final data is generated.

2.6 B6 – Equipment Testing, Inspection, and Maintenance

A list of the equipment and supplies used by EEMS in conducting the surveys is presented in each SOP. EEMS personnel inspect all equipment for damage prior to use and operate and maintain the equipment in accordance with the manufacturer's instructions. EEMS QA Manager is responsible for maintaining the site survey equipment and to oversee that the field equipment and supplies are complete and that required testing and maintenance of the equipment is performed.

The purpose of the NADP Site Survey Program is the testing, inspection and maintenance of the equipment located at NADP sites. Table 5 below shows the type of maintenance to be performed

by the Survey Technician while conducting the site surveys. Any testing, maintenance, and calibration will be performed in accordance with existing NADP SOPs and equipment manuals.

Table 5. Maintenance Chart

Instrument Condition	Calibrate	Troubleshoot	Clean	Adjust	Replace
ACM-type Collector					
Worn thrust collar	NA	Yes	No	Yes	No
Faulty sensor	NA	Yes	Yes	No	Yes
Poor bucket lid seal	NA	Yes	NA	Yes	NA
Lid tension area	NA	Yes	Yes	Yes	No
Lid liner	NA	Yes	Yes	Yes	Yes
Faulty motor box	NA	Yes	NA	NA	Yes
Improper counter weight	NA	Yes	NA	Yes	Yes
Improperly mounted snow roof	NA	NA	NA	Yes	Yes
Missing or rusted mounting screws	NA	NA	Yes	NA	Yes
Missing chimney insulation (MDN)	NA	Yes	NA	Yes	Yes
Fuses	NA	Yes	NA	NA	Yes
N-CON Collector					
Poor lid seal	NA	Yes	NA	Yes	NA
Lid liner	NA	Yes	Yes	Yes	Yes
Adjust the arm set screws	NA	Yes	NA	Yes	NA
Electronic Raingage					
Connectivity issues	NA	Yes	NA	Yes	NA
Correcting corrosion issues	NA	Yes	Yes	NA	NA
Modify connectivity system	NA	Yes	NA	NA	Yes
Wiring of all collectors to datalogger	NA	Yes	NA	Yes	Yes
Belfort Raingage					
Faulty clock	No	Yes	No	No	Yes
Out of tolerance gage	Yes	Yes	Yes	Yes	No
Pen & event marker hang-up	NA	Yes	Yes	Yes	Yes
Low oil in damper	NA	Yes	No	NA	Yes
Pen traverse off time line	NA	Yes	Yes	Yes	No
Improper zero adjust	NA	Yes	Yes	Yes	No
Missing/loose screws	NA	Yes	No	Yes	Yes

Instrument Condition	Calibrate	Troubleshoot	Clean	Adjust	Replace
Field Laboratory (AIRMoN)					
Poor pH measurement	Yes	Yes	Yes	Yes	No
Poor conductivity measurement	Yes	Yes	Yes	Yes	No
Poor mass measurement	Yes	Yes	Yes	Yes	No

2.7 B7 – Instrument/Equipment Calibration and Frequency

Instruments and equipment located at the NADP sites are calibrated according to the NADP Site Survey Program schedule. EEMS is responsible for surveying approximately 75 NADP sites per contract year, resulting in calibrations at each site once approximately every four years. EEMS selects the sites to be surveyed following these criteria:

- Select sites that have not been visited as part of this project for at least four years;
- Select sites in regional geographic proximity to one another;
- Select sites in the northern or mountainous parts of the networks to be visited during spring, summer and autumn months (to help facilitate travel and surveying operations).

It is the responsibility of the QA Manager the routine maintenance, calibration and certification of instruments and equipment used by EEMS while conducting site surveys. The QA Manger is also responsible for maintaining the appropriate certification and maintenance documentation and complying with the recertification schedule. Table 6 shows the equipment requiring regular maintenance and certification.

Table 6. Equipment Certification Information

Item	Certifying Organization	Certification Frequency
Compass	Independent Laboratory	Annual
Electronic Balance	Independent Laboratory	Annual
Standard Weights	EEMS	Annual
Resistive Temperature Device (RTD)	EEMS	Annual
Multi meter	Independent Laboratory	Annual

2.8 B8 – Inspection/Acceptance of Supplies and Consumables

Upon receipt of items and prior to use, EEMS QA Manager performs an acceptance inspection in order to ensure conformance with the procurement requirements. The inspection may include verification of configuration or physical requirements, conformance with catalog descriptions, receipt of certifications, and no damage during shipping. The inspection also includes the calibration and/or setup of equipment and/or test of satisfactory performance. The QA Manager documents and maintains records of any relevant purchases, and any recertification schedule.

2.9 B9 – Non-direct Measurements

The only non-direct measurements or data relevant to this project are data provided by the NADP PO as historical data to be verified during the site survey. These historical data are entered or imported into the FSSD and becomes part of the Site Survey File. As the Survey Technician conducts the survey, this historical data is verified, by either recording the corrected values in the Site Performance Survey Questionnaire forms, or accepting the historical values as correct.

2.10 B10 – Data Management

Data management activities are performed according to the Systems and Performance SOPs developed for this project (see SOP-NADP-1010, SOP-NADP-1020 SOP-NADP-1030, and SOP-NADP-1500).

Among the preliminary survey activities EEMS requests from the NADP PO information pertaining to the sites scheduled to be surveyed. This type of information is presented in Table 7.

Table 7. Preliminary Site Communication Information

Site Name	Site ID	Survey Date	Previous Survey Date	NADP Network(s)
Site #1				
Site #2				
Site #3				
:				

Information gathered from the NADP liaison during the preliminary communication should include the information presented in Table 8 for each site.

Table 8. Initial Site Information

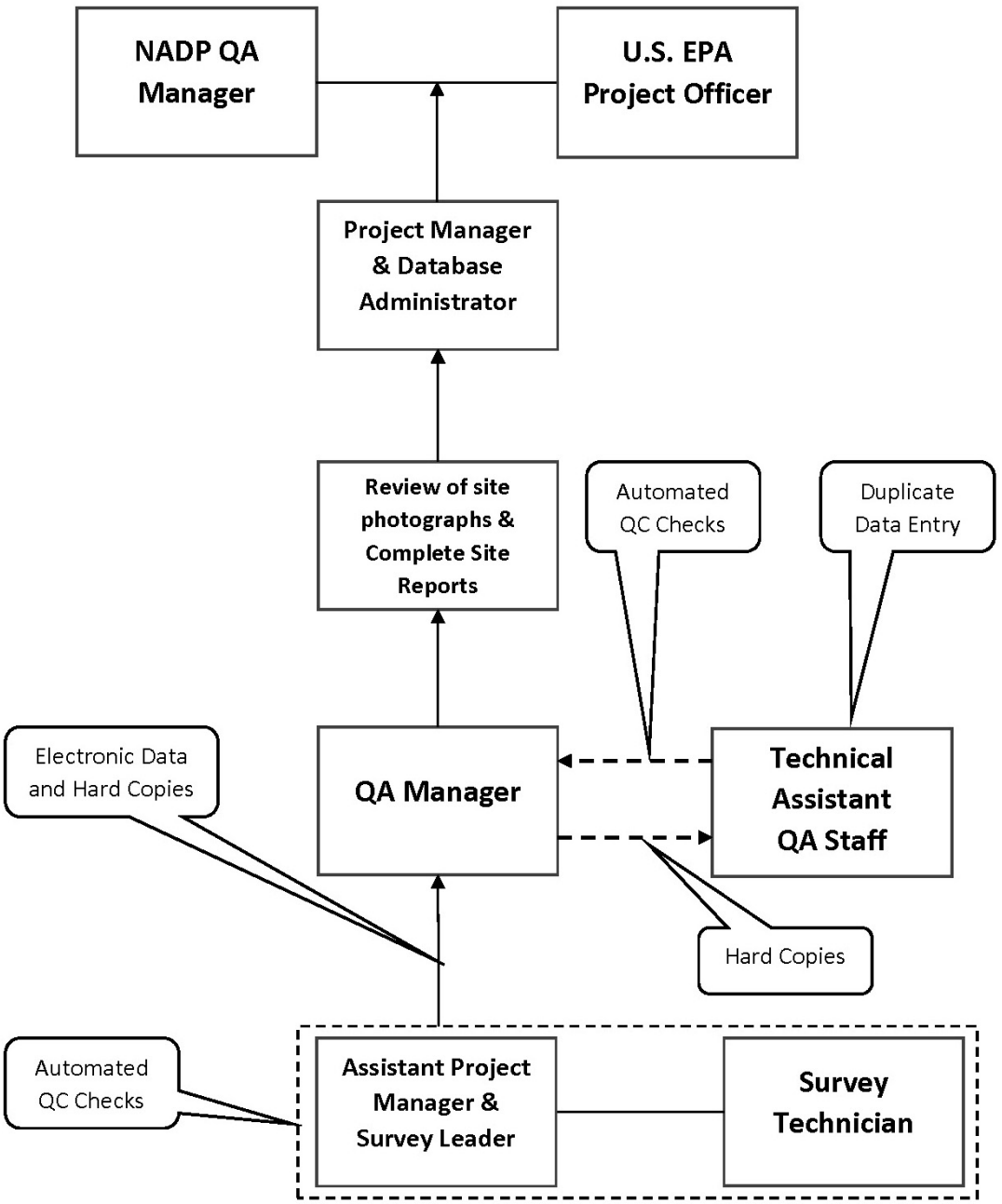
	Current Information
Site operator (name, address, phone, e-mail)	
Site supervisor (name, address, phone, e-mail)	
Site sponsor contact (name, address, phone, e-mail)	
Precipitation gage (manufacturer, model)	
Precipitation collector (manufacturer, model)	
Balance (manufacturer, model)	
pH meter (manufacturer, model)	
Conductivity meter (manufacturer, model)	
Site characteristics (i.e., solar power, remote, etc)	
Known problems (equipment and/or siting related)	
Additional requests (training issues, etc)	
Logistical concerns (i.e.,. passes or keys required, etc)	

This information is entered into the FSSD and becomes part of the Site Survey File which is backed up any time new data is incorporated.

As the Survey Technician conducts the site survey he or she records all data gathered in the Site Performance Survey Questionnaire forms. These data are then entered by the Survey Technician into the FSSD. After each site survey data set is entered the data tables are backed up and a copy is sent to the Project Manager who does a preliminary review, generates the Spot Reports and distributes them to the appropriate parties. The data then goes through the QA process, and then it is delivered to the EPA PO and NADP QA Manager in the form of tables.

Figure 3 shows the flow diagram of data management beginning with the data collection show at the bottom of the diagram.

Figure 3. Schematic Diagram of Data Management



3.0 GROUP C: Assessment and Oversight

The purpose of the NADP Site Survey Program is to ensure that good QA/QC practices are being applied as defined in the NADP Quality Management Plan, Revised 2016-04, Version 1.8 and associated network quality assurance plans. The assessment of each NADP site is strictly controlled by the implementation of the NADP Network QAP, Revised 2016-04, Version 1.8.

3.1 C1 – Assessments and Response Actions

The NADP Site Survey Program is an external assessment program for the NADP. It is EEMS' goal to review 100% of the data generated during the period of this contract. In order to accomplish this goal, EEMS implements an internal assessment program along with an independent assessment program. The internal assessment begins with the review of SOPs, field forms, database and other data management tools by the Survey Technicians. Any concerns and/or suggestions are addressed by the QA Manager and the Project Manager. The QA Manager and the Project Manager are also responsible for database assessments. The QA Manager and Field Operation Manager are responsible for assessments related to field techniques. In the event that the assessment program identifies problems with project data, as it pertains to data generation, data entry, data management or data reporting, response actions will be triggered. The nature of these actions will depend upon the severity and type of problem encountered, and will begin with a review of project procedures related to the identified problem.

3.1.1 C1.1 – Preventive Response Actions

These measures will be directed at preventing the identified problem from being repeated, and include the implementation of high-level monitoring of project activities associated with the problem to prevent further deviations; and initiation of a system of audits that will include random and unannounced evaluations of personnel and equipment to determine if procedures outlined in the QAPP are being followed. The Project Manager will be responsible for implementing corrective measures to address identified deviations from the QAPP.

3.1.2 C1.2 – Corrective Response Action

This measure will result in a correction of the problem and replacement of the problematic data with data that meet the project objectives. Corrective action will require re-entry of all questionable data into the FSSD.

3.1.3 C1.3 – Independent Assessments

Independent assessments are performed by the NADP and subcommittees, and EPA who review the SOPs, QAPP and annual reports.

Survey Technicians and the QA Manager will perform internal proficiency checks at least once every other year at one of the scheduled sites. The purpose of this exercise is to ensure that all Survey Technicians are performing the site surveys consistently and to evaluate their field techniques.

Reports of the assessment will be included in the Annual Report. The reports will discuss the effectiveness of the survey technique and procedures in meeting the goals of the NADP and EPA.

3.2 C2 – Reports to Management

EEMS generates monthly reports indicating progress and significant activities from the previous month as well as activities planned for the following month. This monthly report is distributed to the EPA Project Officer and Contract Specialist.

Included as part the monthly reports there is a summary of the latest deliverables to the appropriate organizations, a summary of any current project problems uncovered during the internal assessments mentioned above, or any deficiencies in meeting deliverable deadlines or quality assurance goals, and a list of outstanding actions awaiting EPA Project Officer authorization.

4.0 GROUP D: Data Validation and Usability Elements

This section addresses the QA activities that take place after data are collected during the site survey process.

4.1 D1 – Data Review, Verification, and Validation

It is EEMS' goal to review 100% of the data collected during site surveys. This is accomplished during the various stages of data entry and verification. It begins with the entry of field-collected data into the FSSD by the Survey Technician. This is followed by double entry of the same data into the FSSD by a different EEMS Technician, and the reconciliation of discrepancies encountered by the FSSD.

Maintaining current and valid certification of survey standards ensures that survey data are valid. Valid survey data in turn ensures that NADP data are valid. The QA Manager will report any certification results that would impact survey results if a standard was used for the survey that was found to be inaccurate. Any data qualifiers will be reported to EPA and other users.

4.2 D2 – Verification and Validation Methods

Data generated during the site surveys will be recorded by the Survey Technician on forms. Historical data will be verified or corrected during the survey. These data will then be entered into the FSSD. Field data will be entered a second time by a different EEMS team member into the FSSD. The FSSD will then reveal any discrepancies between the two sets of data. These discrepancies will be reconciled by the QA Manager and the Project Manager by further reviewing the original field forms and if necessary, consulting with the Survey Technician or site operator. The last review of the data is performed by the QA Manager who then scrutinizes all the information collected during the site visit including the photographs and the data already entered in the FSSD to ascertain that no inconsistencies exists in the data collected.

Data validation methods for this project consist of maintaining current any required certifications of standards used in the performance of the site surveys. Both data verification and validation methods are used for data collected during site surveys. Some data collected may be observations made by the Survey Technician for which no instrumentation is required. Other data collected during the site survey may be measurements made by instruments, or responses from standards that require certification to a reference. All data is verified, but only data collected by a measurement process requires validation.

This process resolves errors prior to data being available to the users. If a survey standard is found to be in error the questionable data is reported to the users when the error is discovered. Questionable survey data is identified and corrective actions reported in the next report of results.

Results from the NADP Site Survey Program are conveyed to the users by means of a number of deliverables. These consist of electronic reports (Spot Report, Monthly and Annual Report) and electronic data tables to be imported by the NADP PO into their data management system.

The Spot Report addresses the following items:

- Site, and site operator's information
- Immediate action items necessary to restore proper function to the site
- Any required site supplies or maintenance items
- Summary of survey activities

The Spot Report is submitted as an electronic copy (a hardcopy is submitted to those parties with no access to electronic mail) to the site supervisor and operator, NADP QA Manager and the EPA Project Officer at the completion of the site survey.

The Site Performance Survey Report is generated by the FSSD once all the data entered has undergone the initial QA/QC procedures and data are free of data entry errors. It is comprised of all the information gathered, and data recorded while conducting the survey and completing the Site Performance Survey Questionnaire forms. It covers all the areas covered during the survey: site information, siting criteria, all the instruments and equipment, site operator's assessment, and field laboratory. The Site Performance Survey Report is used by EEMS QA Manager to verify that all the information collected during the site survey is correct and complete. The verification of data in the Site Performance Survey Report will reveal any errors before the Database Transfer Tables are submitted to the EPA Project Officer and NADP QA Manager in electronic format on a quarterly basis.

The Monthly Progress Report is prepared for the EPA Project Officer indicating progress and significant activities from the previous month as well as activities planned for the following month.

The Annual Report are a summary of the sites visited and include the overall status of the sites, problems encountered, and how these problems may be impacting the performance of the network. The report provides information on the status of important performance measures, and describes any significant events or changes to the networks that may affect interpretations of results, the quality of data produced by the program and any limitation in using the data.

4.3 D3 – Reconciliation with User Requirements

The survey program and results are reviewed by the NADP PO and EPA Project Officer to identify changes or new requirements. The program documentation should be updated with any changes in program requirements. Survey results and network operation assessments are discussed with users at management meetings. Recommendations for improvements to the program are incorporated following periodic program review by EPA and data users.

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Quality Assurance/Quality Control Documentation

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Authorizations

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Revision History

Revision No.	Description	Date	Authorization
0		Sept 2007	
1	Michael Kolian's comments	May 2008	
2	Updates to equipment	Oct 2016	
3	Contract number change	Jun 2017	
4	Annual and Contract Update	Dec 2018	

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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
AMNet	Atmospheric Mercury Network
AMoN	Ammonia Monitoring Network
CAL	Central Analytical Laboratory
CD	compact disc
DAS	data acquisition system
DCN	document control number
EDD	electronic data delivery
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FOF	Field Observer Form
FORF	Field Observer Report Form
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
GPS	Global Positioning System
HAL	Mercury Analytical Laboratory
Hg	mercury
ISWS	Illinois State Water Survey
LOTO	lockout tag-out
MDN	Mercury Deposition Network
MOF	Mercury Observer Form
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
OSHA	Occupational Safety and Health Administration
NWS	National Weather Service
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire
WAAS	wide area augmentation system

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting Site Systems and Performance Surveys (system surveys) of National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions, ammonia and mercury. The NADP is comprised of five networks, the National Trends Network (NTN), the Mercury Deposition Network (MDN), the Atmospheric Integrated Research Monitoring Network (AIRMoN), the Atmospheric Mercury Network (AMNet), and the Ammonia Monitoring Network (AMoN). All five networks of the NADP are focused on long-term monitoring and trends. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The purpose of a systems survey is to qualitatively appraise the total measurement system of wet deposition networks: NTN, MDN and AIRMoN. This includes a thorough, on-site evaluation of facilities, equipment, personnel, training, procedures, documentation, site representativeness and reporting aspects of the field operations systems. Field systems survey results are used to ensure that good quality assurance/quality control (QA/QC) practices are being applied as defined in the NADP Quality Management Plan (QMP) and the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program ensures data integrity and assesses data accuracy.

NADP Site Systems and Performance Surveys include:

Verifying that the site conforms to the characteristics as described in the ***NADP Site Selection and Installation Manual*** quality documents found in https://nadp.slh.wisc.edu/lib/manualsSOPs.aspx

- Verifying that the instruments and equipment are sited, installed, maintained, and operated complying with the Occupational Safety and Health Administration (OSHA) regulations.
- Verifying that the instruments and equipment are properly sited, installed, maintained, and operated with respect to network requirements and guidelines.
- Verifying that procedures are in place to ensure that collected data are of sufficient quality to meet the project objectives.
- Verifying that current documentation relating to each component of the measurement system is on-site or easily accessible to the Site Operator.
- Observing and evaluating the Site Operator's proficiency of his/her duties and the understanding of the project goals.

- Recording all information using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms and incorporating photographs in the site files.
- Recording and reporting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing survey results, reports, and documentation to the designated project personnel.

1.1 Typical NADP Site Installations

The networks of the NADP currently consist of approximately 250 NTN sites, 90 MDN sites, four AIRMoN sites, 100 AMoN sites and 22 AMNet sites operating throughout the United States, Canada, Puerto Rico, and the Virgin Islands. The number and location of operational sites varies at any time. A list of active sites and locations can be found at http://nadp.slh.wisc.edu/NADP/networks.aspx.

The program goal is to visit and survey approximately 75 sites per year of the NTN, MDN and AIRMoN networks, and each site in the NADP once every four years. Authorized users can find the current survey schedule by logging into the EEMS server.

Specific equipment at each site can vary, but each site will consist of an approved precipitation gage, an approved precipitation collector, a sample weighing device (NTN and AIRMoN sites), equipment manuals, approved operating procedures, and site supplies. The approved NADP measurement and sampling equipment includes:

Precipitation collector		
	Aerochem Metrics, Inc.	301 and 301 modified
	Loda Electronics Company	2001 and 2001 modified
	N-CON Systems Co., Inc.	Atmospheric Deposition 00-120 and MDN 00-125 sampler
Raingage		
	ETI Instrument Systems, Inc.	NOAH IV
	Hach Environmental, Inc.	OTT NADP Pluvio and OTT Pluvio 2 - Remote Monitoring Module
	Belfort Instrument	5-400 (AIRMoN primary gage) and B5-780
Wind Shield		
	NovaLynx	260-952 or 260-2510 (Alter-Type), or equivalent

1.2 Preliminary Survey Activities

Due to the number and location of the sites in the network, the site systems survey program is a travel intensive project. In order to maintain an efficient schedule and quality product, frequent and concise communication with project personnel is required. Prior to beginning travel, the U.S. Environmental Protection Agency (EPA) Project Officer and NADP QA Manager, must be contacted. At times the Network liaison may also be contacted. Their contact information is listed below:

Tim Sharac	202-343-9180	Sharac.Timothy@epa.gov	EPA Project Officer
Melissa Puchalski	202-343-9882	Puchalski.Melissa@epa.gov	EPA Project Officer
Martin Shafer	608 217-7500	mmshafer@wisc.edu	NADP QA Manager
Michael Olson	608-263-9162	michael.olson@slh.wisc.edu	Program Coordinator
Richard Tanabe	608-263-9077	Richard.Tanabe@slh.wisc.edu	Operations and Equip.

In order to adhere to the schedule set forth in the NADP Site Survey Program QAPP, the above listed personnel must be contacted no less than one month prior to the planned date of the site survey. The initial communication must include the information contained in Table 1 for each planned site survey.

Table 1. Preliminary Site Communication Information

Site Name	Site ID	Survey Date	Previous Survey Date	NADP Network(s)
Site #1				
Site #2				
Site #3				
:				

Information obtained from the NADP PO office in the form of updated database tables should include the information contained in Table 2 below for each site.

Table 2. Initial Site Information

	Existing Information
Site Operator (name, address, phone, e-mail)	
Site Supervisor (name, address, phone, e-mail)	
Site Sponsor contact (name, address, phone, e-mail)	
Precipitation gage (manufacturer, model)	
Collector (manufacturer, model, and serial number)	

Balance (manufacturer, model)	
pH meter (manufacturer, model)	
Conductivity (manufacturer, model)	
Site characteristics (i.e., solar power, remote, etc)	
Known problems (equipment and/or siting related)	
Additional requests (training issues, etc)	
Logistical concerns (i.e., passes or keys required, etc)	

Figure 1 is an example of the initial site information for site WA14 as received from the NADP PO database.

Figure 1. NADP Pre-Audit Site Information

National Atmospheric Deposition Program
Pre-Audit Site Information
NTN Site WA14

Site ID	WA14	Site Name	Olympic National Park-Hoh Ranger Station
Latitude	47.86	County	Jefferson
Longitude	-123.9319	Sponsoring Agency	NPS-ARD
Elevation	176	Operating Agency	NPS-Olympic NP
Start	5/20/1980	Site Owner	NPS
Stop		Map	Owl Mountain
Status	A		

Installed Equipment

Wet/Dry Sampler

Type	ACM
Power	AC
Heated	N
Lid	F
Event Recorder	S

Primary Rainguage

Type	Belfort 5-780
Shield	None
Distance to WD	5.5

Backup Rainguage

Type	8 in cylinder
Distance to WD	1.2

Field Lab

Scale	Ohaus 1119D
pH Meter	Beckman phi 32
pH Electrode	Broadley-James BNC
Cond. Meter	YSI 35
Cond. Cell	YSI 3403

	Supervisor	**Operator**
Name	Bill Baccus	Bill Baccus
Phone	360-565-3061	360-565-3061
Alt Phon		
Fax	360-374-2676	360-374-2676
Email	bill_baccus@nps.gov	bill_baccus@nps.gov
Training		
	Bill Baccus Olympic National Park 600 East Park Avenue Port Angeles, WA 98362-6798	Bill Baccus Olympic National Park 600 East Park Avenue Port Angeles, WA 98362-6798

Funding Agency Representative

Name	Kristi Morris	Kristi Morris National Park Service Air Resources Division 12795 W. Alameda Parkway Lakewood, CO 80228
Phone	303-987-6941	
Alt Phon		
Fax	303-969-2822	
Email	kristi_morris@nps.gov	

After obtaining the site contact information, the Site Operators and Supervisors for each site in the planned trip must be contacted by e-mail at least one month prior the site visit. To accomplish this Site Notification Letters are e-mailed to the Site Operator, Site Supervisor, NADP QA Manager, and EPA PO for each site on the schedule for a particular month. The Site Operators are contacted again by telephone or email at least two weeks prior to the planned site visit.

Discussions with the site personnel will include logistics pertaining to accessing the site, date and time of the planned site survey, any modifications that may have been performed on the site instrumentation, and any operational problems that may exist at the site. All relevant information will be added to the data gathered during the preliminary communication with the site liaisons.

Once the initial communication by e-mail has occurred, the comprehensive information obtained for each site will be compiled and included in a Site Survey File.

1.2.1 Site Survey File

Site Survey Files will be maintained on the EEMS file server. Each Site Survey File will contain the site specific compiled comprehensive information obtained during the previous survey (if applicable) and the preliminary communication and data gathering process described above. The Site Survey File for each site will include correspondence including the letters notifying stakeholders of the upcoming survey, Spot Reports generated after the site survey, photographs taken during the site survey along with any other relevant documentation.

Next, folders are prepared for each of the sites on the schedule. These consist of the complete hardcopy of the SPSQ which includes information from the previous site surveys concerning the Site Information and Siting Criteria. These forms will be used by the Survey Technicians to record all the required information during the site survey.

In the event that the NADP QA Manager requires the Survey Technician to perform additional activities, or troubleshoot a specific problem, any supplies or materials required for this purpose will be gathered and distributed to the Survey Technicians along with the site folders containing the SPSQ.

Upon receipt of the forms and materials, the Survey Technician will inspect the package contents and report any damage or missing articles. The EEMS Survey Team Leader will oversee preparation of the preliminary site survey package and provide the Survey Technician with the required materials to complete the planned surveys. Post-survey information will be included in the Site Survey File following the site visit and survey by the Survey Technician.

1.2.2 Site Survey Materials and Equipment

Each Survey Technician is assigned a set of site survey equipment that includes tools, equipment, routine maintenance items, a field computer with FSSD, and survey supplies required to perform surveys. The Survey Technician is responsible for maintaining the equipment in working order and reporting any problems to the EEMS Survey Team Leader and/or QA Manager so that malfunctioning equipment may be repaired or replaced, as needed. The Survey Technician is also responsible for replenishing field supplies, as needed. The EEMS QA Manager will be responsible for maintaining the required annual certifications for all survey equipment. Certification dates and any required correction factors will be printed and adhered to the corresponding equipment. An electronic copy of each certification will be maintained on the EEMS FTP server which is routinely backed-up. An electronic copy of any equipment certification will be provided to the technician for his records. A hardcopy of each certification will also be maintained at the EEMS office.

2.0 Summary of Methods

General methods used for performing a NADP Site Performance Survey will include the completion of the preliminary survey activities described in the previous sections and then:

- Traveling to the site and challenging or testing each measurement and collection device according to the SOP for that device,
- Recording the observed and collected data on the appropriate form of the SPSQ,
- Performing any routine maintenance, adjustment, or minor repair,
- Repeating the challenge or test of the device if the above affects instrument output,
- Recording the results of the additional challenge or test on the appropriate SPSQ form,
- Entering the recorded data into the FSSD and backing up the files,
- Generating the exit report (Spot Report) of the survey activities from the FSSD as soon as practicable, ideally within 48 hours of completing the survey,
- Transferring the hardcopy recorded data and the electronic FSSD files to the EEMS data management facility,
- Verbally reporting any findings from the survey that could affect data collection to the site liaison with any requests for additional attention or activities to be performed at the site within 24 hours of completing the survey.

2.1 Instrument Specific Methods

The list of approved NADP site equipment and instrumentation is presented in Section 1.1. The preliminary survey activities identify which of the listed types of instrumentation are present at each site. Table 3 identifies the specific SOP for the type of site and equipment or instrumentation type.

Table 3. Specific SOP Required to Performed NADP Site Surveys

SOP Name	SOP Number	Revision Number	Revision Date
NTN Site Systems Survey	SOP-NADP-1010	4	Dec. 2018
MDN Site Systems Survey	SOP-NADP-1020	4	Dec. 2018
AIRMoN Site Systems Survey	SOP-NAND-1030	4	Dec. 2018
Belfort 5-780 Precipitation Gage	SOP-NADP-1400	4	Dec. 2018
OTT NADP Pluvio I or II Precipitation Gage	SOP-NADP-1410	4	Dec. 2018
ETI NOAH IV™ Precipitation Gage	SOP-NADP-1420	4	Dec. 2018
ACM NTN Precipitation Collector	SOP-NADP-1310	4	Dec. 2018
ACM MDN Precipitation Collector	SOP-NADP-1320	4	Dec. 2018
N-CON MDN Precipitation Collector	SOP-NADP-1330	4	Dec. 2018
N-CON NTN Precipitation Collector	SOP-NADP-1340	2	Dec. 2018
Ohaus Mechanical and other Electronic Balance	SOP-NADP-1210	4	Dec. 2018
AIRMoN pH Measurements	SOP-NADP-1220	4	Dec. 2018
AIRMoN Conductivity Measurements	SOP-NADP 1230	4	Dec. 2018

Using this SOP and those presented in Table 3, a systems survey can be performed at any currently operating NADP wet deposition site. As new equipment or instrumentation is approved for use at NADP sites, new methods and procedures will be developed for routine maintenance and systems tests of those instruments. Those methods will be incorporated into this SOP and Table 3.

3.0 Health and Safety Warnings

The NADP Site Performance Survey Program requires travel to various locations and assessing the condition and operation of electrical devices. As such, there are some health and safety warnings and cautions that must be observed.

3.1 Electrical

Most of the sample collection devices, and some of the precipitation gages, are powered by 120 volt AC power. This is the typical household electrical service which powers most common appliances. The same cautions practiced for any device powered by this means should be observed for the site equipment.

In some cases the power may be delivered using extension cords or buried electrical wires. Particular attention should be paid to the manner and condition of the power supply and distribution. No digging or under-ground probing should be conducted without first identifying all buried services.

Prior to removing any instrument electrical service covers or fuses, disconnect the power source to the instrument. This can be accomplished by unplugging the power cord or turning off the circuit breaker and employing a proper "lockout tag-out" (LOTO) procedure, if required by the site sponsor.

3.1.1 Lockout Tag-out

LOTO procedures are intended to protect survey personnel and technicians from electrical hazards while troubleshooting and servicing electrical equipment. If the power supply to the device is not in the direct control of the technician, LOTO procedures should be used to ensure that the power is not supplied to the device during the activities. This is accomplished by locating the source of the power (electrical outlet or circuit distribution panel) and disconnecting the power source. Unplugging the cord or turning the circuit breaker off will then disconnect the power. In rare instances it may be necessary to disconnect the main power supply or main breaker that supplies power to all of the circuits in the distribution panel.

After the power supply has been disconnected access to the panel or outlet must be locked and tagged with a notice for other personnel that service is being conducted on a component of that circuit. This is intended to prevent the circuit from being activated by other personnel that may enter the area and not realize that a technician is working on a device on that circuit.

3.2 Remote Locations

Many of the stations in the NADP wet deposition networks are located in remote areas. Access to the site may be limited to hiking trails. The trails may be mountainous, rugged and steep, or at high elevations. Shelter from inclement weather may not be available at the site location. Caution and care should be exercised to prevent overexertion when accessing these sites. Appropriate clothing and footwear should be worn and adequate fluids should be available for the duration of the site visit.

3.3 Travel and Driving

By far the most dangerous activity undertaken during the site survey program is travel by driving to the site locations. All safety regulations recommended for the operation of motor vehicles must be observed. This includes the use of seatbelts.

All operators must have a valid operator's license and requisite automobile insurance required by both the issuing agency and the contract (or subcontract) clauses.

The consumption of alcohol or other drugs that may cause impairment are not permitted prior to or while operating a motor vehicle.

Extended travel and long working hours can cause stress and fatigue. These conditions can adversely affect one's ability to operate a motor vehicle. Personnel must be aware of stress and fatigue levels and not operate a motor vehicle under these conditions. Personnel are urged to get the necessary rest required to stay alert while driving.

4.0 Personnel Qualifications

This SOP, and those referenced here are intended to be used by experienced field and instrument technicians. All site survey team personnel are experienced field site specialists with many years of direct involvement with deposition monitoring sites. That involvement includes the installation, repair, maintenance, calibration, and operation of precipitation gages, precipitation collectors, meteorological instrumentation, ambient air samplers, and gaseous analyzers.

Additional training will be provided to the survey team as new instruments and equipment are approved for use in the NADP wet deposition networks. Procedures for testing and challenging any new equipment will be developed with the cooperation of the NADP and subcommittees.

4.1 Training

If training is required at any time during the performance of the NADP Site Survey Program due to changes to personnel, training will be provided by Team Survey Leader. All new personnel will be trained by accompanying the Team Survey Leader to as many field sites as necessary to become proficient with the survey procedures.

5.0 Equipment and Supplies

Together with this SOP, the individual instrument SOPs listed in Table 3 and the specific network SOP are required for conducting performance surveys at NADP precipitation collection stations. They are intended to be used by qualified technicians that understand general instrument operation and survey techniques.

5.1 Survey Tools and Materials

In addition to the specific instruments and equipment listed in the individual SOPs, the following materials are required to perform NADP wet deposition network site systems surveys.

- Site Operation Manuals for the different networks
- Site Survey File for each site in the planned trip
- Hardcopy SPSQ forms
- Laptop computer with approved FSSD
- Miscellaneous recordkeeping supplies
- Manufacturer's instruction manuals
- Temperature probe
- Volt meter
- Set of standard weights to challenge the raingages and balance
- Data-logger reader (required for some sites)
- Level with bubble
- Tool bag with essential tools
- Certified survey quality compass
- Wide Area Augmentation System (WAAS) GPS

- Certified range finder
- Miscellaneous measurement devices
- 4.0 mega pixel (minimum) digital camera
- Directional indicator

Manufacturer's manuals and all NADP Site Operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at http://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

Each method used to challenge or test a measurement or collection device deployed at NADP site will be referenced to a carefully calibrated and certified standard. The rationale and development of those procedures is discussed below.

6.1 Standard Weights

Most instrument challenges will be performed on measurement systems at NADP sites through the use of a standard weight to simulate precipitation and then comparing the instrument response to the equivalent precipitation that corresponds to the standard weight. The equivalent precipitation amount is a function of the size of the opening in the particular precipitation gage and the calibration of the gage itself.

In order to accurately determine the equivalent precipitation amount, an accurate measurement of each standard weight must be performed. This will be accomplished at the EEMS facility with a precision electronic balance. EEMS will check the calibration of the balance prior to each use with NIST traceable weights. The balance calibration weights will be maintained at the EEMS facility in a manner that protects their condition and weight.

6.1.1 Instrument Sensitivity to Weight/Mass

The various precipitation gages approved for NADP respond differently to the weight applied to the catch basin. For example the Belfort gages respond with an equivalent precipitation amount of approximately one inch when a weight of approximately 825 grams is added to the bucket.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

This will be the smallest standard weight used for the Belfort gages and is measured to the hundredth of one inch. The electronic ETI Noah IV and OTT NADP Pluvio I &II gages are more sensitive and will be challenged with smaller weights that correspond to precipitation amounts of 0.25 and 0.50 inches.

All weights will be checked and their weight documented at EEMS annually. Using the weight, the corresponding equivalent precipitation amount will be calculated for the intended gage type. The weights will be properly packed and handled in order to preserve their condition during the site survey trips.

6.2 Temperature Checks

Temperature checks are required inside the enclosure of MDN collectors and the ACM sensors. ACM type precipitation collector operation is triggered by a sensor that detects the presence of precipitation. The sensor's internal heater is turned on and heated to evaporate the precipitation following an event so the collector does not remain open exposing the sample.

The temperature of the sensor will be measured by a transfer temperature probe that is calibrated and referenced to a standard. The transfer standard calibration will be performed annually and the results documented and archived on the EEMS server and in hardcopy at EEMS. A copy of the certification for each piece of assigned equipment will be provided to each technician. Certification dates and any required correction factors will be printed and adhered to the corresponding instrument.

6.3 Voltage Checks

The NADP Site Performance Surveys will include various voltage checks of the instruments and equipment. Those checks will be performed using a certified multimeter. The multimeter will be certified annually by an independent organization. Certification documentation will be maintained on the EEMS server and in hardcopy at EEMS.

6.4 Site Information

The purpose of these systems checks is to characterize the site and the surroundings. This is critical for data users in order to evaluate data collected at the site and for comparing that data to that of other sites. The general site information gathered during the preliminary phase of data collection regarding site personnel and equipment is verified during these activities.

The site information is verified by observing the site conditions regarding operating equipment, and interviewing the site personnel and comparing those observations to the data provided in the Site Survey File. Data on the forms in the SPSQ are then accepted or corrected as required. Refer to the Site Information data form included in Appendix A for a complete list of site information data fields. This information will then be entered into the FSSD and after the QA process is complete, will be delivered to the NADP PO. It is anticipated that this information will be updated as necessary by the NADP PO and then provided as part of the preliminary survey information prior to the next survey scheduled for the same site.

6.4.1 Siting Criteria Tools and Procedures

Siting criteria checks and site characterization are accomplished by carefully measuring and documenting both the instrumentation and other objects within a 30 meter radius of the precipitation collector. The measurement tools used by the survey team are included in Section 5.1 Survey Tools and Materials.

Whether the survey is performed with the sample bucket or bottle in place, or during a change out of the sample, the Site Operator is reminded and encouraged to include in the Mercury Observer Form (MOF) or the Field Observer Form (FOF) that the survey took place and the duration of the survey. The following steps are performed during siting criteria systems checks[2]:

1. Determine the location of the collector by positioning the GPS over the lid of the collector in the closed (wet side) position.

2. Determine compliance with the siting criteria for the collector: this is done by placing a compass on a tripod immediately adjacent to and at the same height of the lid of the collector in the closed (wet side) position or, and observing the difference in elevation between the collector and the raingage and whether the 30 degree guideline and the 45 degree rule for trees, buildings, etc. are met. The collector surroundings are noted including distances to the raingage, and backup gage, if present, and observations are recorded on the field forms.

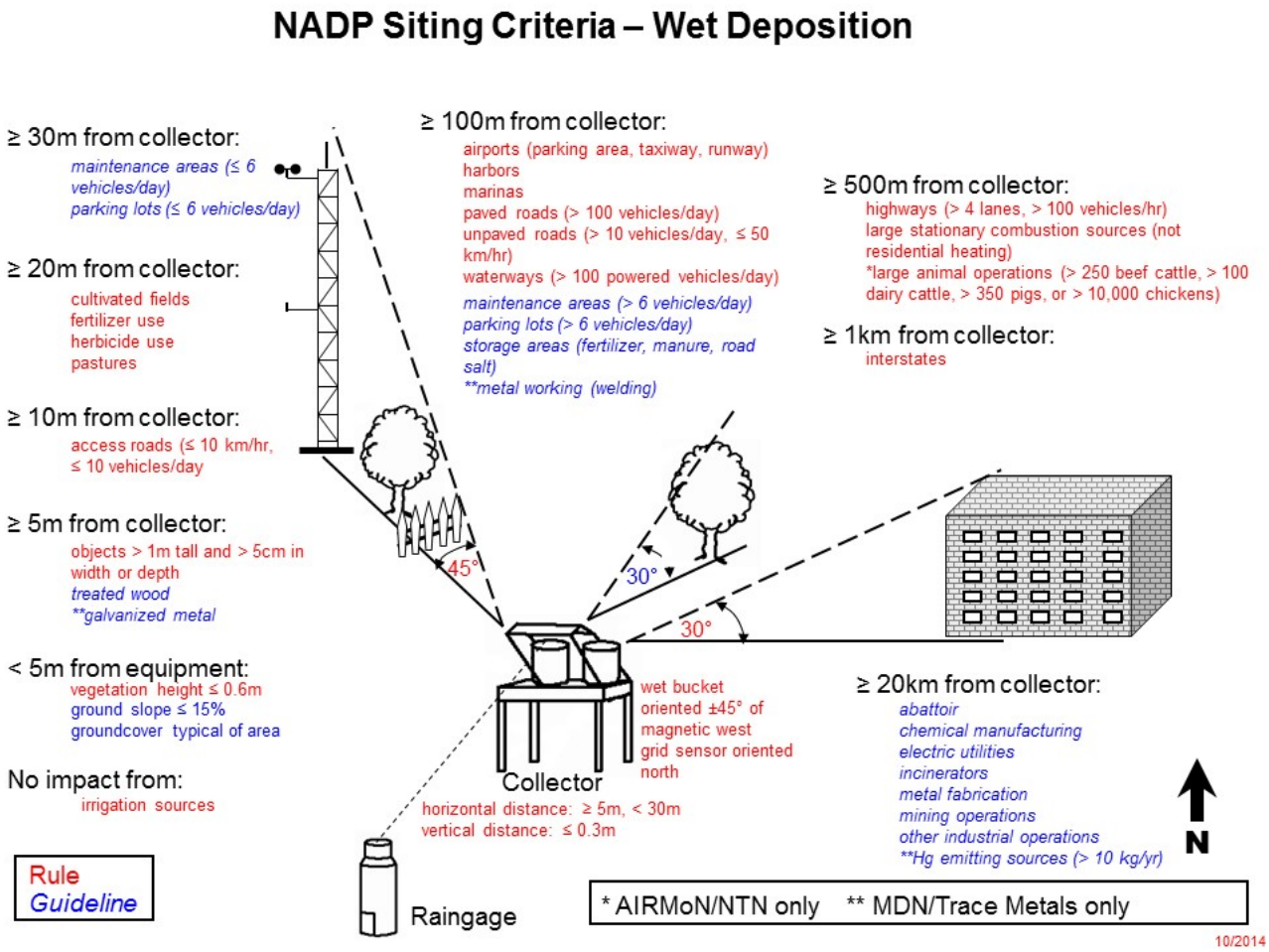
3. Determine compliance for the siting criteria of the raingage by setting the compass next to and at the same height of the raingage and making the same observations as for the collector. These observations are recorded in the SPSQ forms including the condition of the wind shield if one is present.

[2] The order in which the checks are performed may vary depending on the Site Operator's schedule, and the weather among other variables.

4. The Siting Criteria form of the SPSQ should be completed at this time, and any perceived discrepancies between the site's siting criteria and that described in the *NADP Site Selection and Installation Manual* should be commented on.

Siting criteria checks and site characterization are a critical part of the NADP Site Survey Program. Documenting the findings correctly with added comments by the Survey Technician to clarify any findings that are not in agreement with the approved siting criteria are essential in the characterization of the site. Any field on the Siting Criteria form of the SPSQ that is not answered as compliant with the accepted criteria, requires a brief comment "quantifying" the finding. As an example: **30 degree rule for trees met (collector)**. A NO answer will be correct whether there is only one tree just above the 30^{o} cone, or if the collector is surrounded by trees close to the 45^{o} cone. For this reason, the comments by the Survey Technician are essential in describing the impact that any non-compliant siting element may have regarding the sample quality taken as a whole.

Figure 2. Accepted Siting Criteria



Refer to the Siting Criteria form included in Appendix A for a complete list of data fields. Copies of the calibration/certification documentation for the field test equipment can be found at the EEMS FTP Server to which the NADP QA Manager and EPA Project Officer have access.

6.4.2 Site Characterization

In order to ensure that the site is representative and give data users a sense of the site surroundings, the site must be documented by acquiring digital photographs. Using a digital camera of not less than 4.0 mega pixels, perform the following:

1. Install the directional indicator in place on top of the wet bucket, or chimney (for MDN collectors).
2. Take 8 photographs looking toward the cardinal directions of N, NE, E, SE, S, SW, W, and NW from 5 to 10 meters from the collector and take an overview photograph that includes the entire site.

3. Obtain any additional photographs if necessary to adequately document the site, or site equipment and instrumentation condition. Digital photographs of the sites shall follow a consistent naming convention. Following the site survey all site images will be uploaded to EEMS FTP Server where current site images can be found, and to which the NADP QA Manager and the EPA Project Officer have access.

6.5 Routine Maintenance and Minor Repairs

The required maintenance activities are included in the individual instrument SOPs and documented on the SPSQ forms. Any additional maintenance items contained on the SPSQ forms must be performed and documented. Those items will include:

- Assess site power supply and correct any potential issues,
- Inventory site manuals and documentation and advise of deficiencies
- Inventory site supplies, document and report any deficiencies

6.6 Procedures Assessment

Proper techniques and procedures employed by site personnel are essential for maintaining sample quality. The Site Operator's procedures must be evaluated as part of a systems survey to assess the quality of the overall measurement system. Record the evaluation and recommendations (if any) on the Site Information data form of the SPSQ.

Observe the Site Operator performing actual sample handling and processing procedures, or provide the Site Operator with a simulated sample and observe the procedures. Assess the Site Operator's technique with regard to the procedures provided for the particular equipment and NADP network. Provide assistance and training, if necessary, adhering to the procedures detailed in the NADP manuals and QAP.

Evaluate the Site Operator's technique regarding the interpretation of the precipitation chart[3] if that is part of the site procedures. Provide any necessary training as detailed in the ***NADP Quality Management Plan*** (NADP QMP) http://nadp.slh.wisc.edu/lib/qaplans/NADP_QMP.pdf or ***NADP Network Quality Assurance Plan*** (NADP QAP) http://nadp.slh.wisc.edu/lib/qaplans/NADP_Network_Quality_Assurance_Plan.pdf.

Assess the Site Operator's recordkeeping procedures and provide assistance and training as detailed in the NADP QMP and/or QAP documentation.

[3] In the event the site's primary gage is a Belfort raingage.

7.0 Troubleshooting

One function of the NADP Site Survey Program is the routine maintenance and minor repair of the site equipment to continue or restore its operation to the NADP specifications. In order to perform this function some troubleshooting of malfunctioning equipment or instrumentation may be necessary. The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. Table 4 shows the list of items that may be addressed during a site survey.

Table 4. Maintenance Chart

Instrument Condition	Calibrate	Troubleshoot	Clean	Adjust	Replace
ACM-type Collector					
Worn thrust collar	NA	Yes	No	Yes	No
Faulty sensor	NA	Yes	Yes	No	Yes
Poor bucket lid seal	NA	Yes	NA	Yes	NA
Lid tension area	NA	Yes	Yes	Yes	No
Lid liner	NA	Yes	Yes	Yes	Yes
Faulty motor box	NA	Yes	NA	NA	Yes
Improper counter weight	NA	Yes	NA	Yes	Yes
Improperly mounted snow roof	NA	NA	NA	Yes	Yes
Missing or rusted mounting screws	NA	NA	Yes	NA	Yes
Missing chimney insulation (MDN)	NA	Yes	NA	Yes	Yes
Fuses	NA	Yes	NA	NA	Yes
N-CON Collector					
Poor lid seal	NA	Yes	NA	Yes	NA
Lid liner	NA	Yes	Yes	Yes	Yes
Adjust the arm set screws	NA	Yes	NA	Yes	NA
Electronic Raingage					
Connectivity issues	NA	Yes	NA	Yes	NA
Correcting corrosion issues	NA	Yes	Yes	NA	NA
Modify connectivity system	NA	Yes	NA	NA	Yes
Wiring of all collectors to datalogger	NA	Yes	NA	Yes	Yes
Belfort Raingage					
Faulty clock	No	Yes	No	No	Yes

Instrument Condition	Calibrate	Troubleshoot	Clean	Adjust	Replace
Out of tolerance gage	Yes	Yes	Yes	Yes	No
Pen & event marker hang-up	NA	Yes	Yes	Yes	Yes
Low oil in damper	NA	Yes	No	NA	Yes
Pen traverse off time line	NA	Yes	Yes	Yes	No
Improper zero adjust	NA	Yes	Yes	Yes	No
Missing/loose screws	NA	Yes	No	Yes	Yes
Field Laboratory (AIRMoN)					
Poor pH measurement	Yes	Yes	Yes	Yes	No
Poor conductivity measurement	Yes	Yes	Yes	Yes	No
Poor mass measurement	Yes	Yes	Yes	Yes	No

7.1 Site Survey Instrument Function

The tools, instruments, standards, and materials that make up each Survey Technician's equipment set are carefully controlled, tested, calibrated and maintained by the EEMS staff. This process is intended to ensure proper and accurate function when the equipment is used in the field. Should any of the items malfunction during a site survey trip, troubleshooting will be performed in the same manner by the site Survey Technician with the assistance of the EEMS Team Survey Leader and/or QA Manager.

If any field repairs are performed on items in the equipment set, the EEMS QA Manager will determine if the certification of that item and survey results measured by that item are compromised. If necessary, a replacement item will be sent to the Survey Technician to ensure accurate survey results.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition at most of the NADP sites is accomplished by visual observations made by Site Operators and site instrument measurements recorded on hardcopy and electronic media (PDA, and/or flash drives for data acquisition system (DAS) integrated into the precipitation gage.) Some stations still use Belfort precipitation gages and at these sites, the gage data are manually recorded to hardcopy forms by the Site Operator and then sent to the CAL and the HAL with the gage strip chart. Most sites are equipped with electronic precipitation gages and data acquisition is accomplished by Bluetooth or cable transmission to flash drive devices and then electronically sent to the PO. Some sites also employ direct telemetry from the site equipment to the PO.

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto the SPSQ forms. Recorded data will then be entered into the FSSD as described in the following sections. Interface with the electronic precipitation gages is accomplished by using a Campbell Scientific keypad and/or the Site Operator's PDA and recording these results on the SPSQ electronic gage form.

8.1 Post-Site Survey Procedures

The information gathered during the site survey is recorded on the SPSQ form associated with data collection for each measurement process or system. The SPSQ is included in Appendix A.

The recorded data must be entered into the FSSD and used to generate reports and database files that can be used by the EPA, the NADP PO, and other data users. The method and tasks to be completed after recording survey data are described in the following sections.

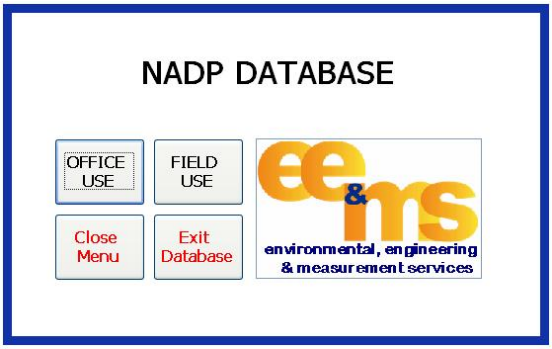
8.1.1 Data Entry

The FSSD is a Microsoft Access® 2010 or later application. The database is a relational set of data tables that are designed to store records of the data recorded during the site survey. Data are entered into the data tables using data entry forms. The forms are similar to the hardcopy forms provided in each SOP. The forms and menus are presented in the following sections.

8.1.1.1 User Type Selection Menu

The first screen viewed when the FSSD is opened is a screen which allows access to either office personnel or field personnel to the corresponding forms, function and repots. Figure 3 shows this first screen.

Figure 3. User Type Selection Menu

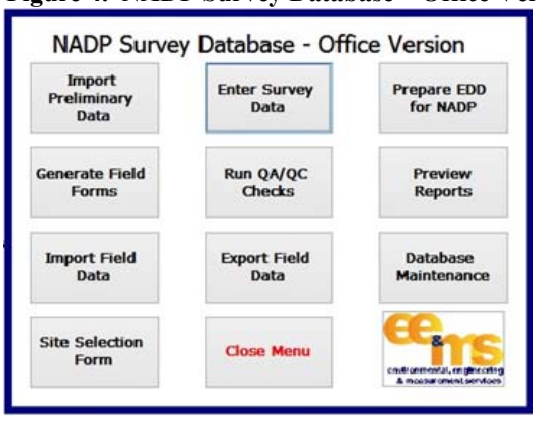


8.1.1.2 Office Version Main Menu

The buttons on the Office Version main menu provide access to reports and forms contained in the database. Figure 4 shows the different options the user can choose from:

- Import Preliminary Data
- Generate Field Forms
- Import Field Data
- Site Selection Form
- Enter Survey data
- Run QA/QC Checks
- Export Field Data
- Preview Reports
- Prepare EDD for NADP
- Database Maintenance

Figure 4. NADP Survey Database – Office Version Main Menu



The Enter Survey Data menu (Figure 5) allows the user to select the site and form for which to enter data. This menu provides the user with the following options:

- Site Selection Form
- Site Information Form
- Siting Criteria Form
- Belfort Gage Form
- Electronic Gage Form
- NWS Stick Gage Form
- ACM Collector Form
- N-CON Collector Form
- Backup Raingage Form
- Field Laboratory Form
- Field Supplies Form
- Site Object Form

Figure 5. Enter Survey Data Main Menu

8.1.1.4 Typical Data Entry Form

From the Enter Survey Data Menu the user can select from a number of forms. The one shown in Figure 7 is the Site Information Form used by field personnel. The station ID, network, site name, operator information and other general information pertaining to the site is included in this form. For the most part these forms consist of a number of questions for which the user must select the most appropriate answer from a drop-down menu. However there are some questions that require a numeric input or a text input that is not a drop-down selection. Those fields highlighted in blue constitute data that is included in the site Spot Report.

Figure 6. Site Information Form (Field Form)

8.1.1.5 Preview Report Menu

From this menu the user can select the site and report from the following options (Figure 8):

- Revised Spot Reports
- Site Survey Reports
- Field Spot Report
- QA Report

Figure 7. Preview Reports Menu

8.2 Electronic Data Acquisition

Electronic data recorded by the measurement devices that utilize those methods will be checked as part of the performance survey. The survey tests will account for the combined error from both the measurement instrument and the internal data acquisition system (DAS).

Where possible the transfer of the electronic data from the internal DAS to the handheld device will be verified as part of the systems survey. The verification will include checks for completeness and accuracy.

8.3 Manual Data Acquisition

For those sites where a Belfort gage is the primary gage, Site Operators are required to interpret the hardcopy charts and calculate the daily and weekly total precipitation on the various network observer report forms. Those procedures will be verified and assessed as part of the systems survey. The calculations performed by the Site Operator will be checked for accuracy as part of the site systems survey.

8.4 Data Entry and Verification

Upon completion of the site performance survey, data recorded on the SPSQ forms will be entered into the FSSD. Overview of the review, verification, and validation processes are described in Sections 10.0 and 11.0.

8.5 Spot Report Generation and Distribution

Following data entry, the Survey Technician will e-mail the relevant database file to the EEMS Project Manager for review and to generate the Portable Document Format (PDF) Spot Report from the FSSD report menu. The Spot Report summarizes the activities performed during the site survey. Required site supplies and any responses that do not meet the criteria appear highlighted in the Spot Report. The report is then distributed to the Site Operator, Site Supervisor, NADP QA Manager, EPA Project Officer, Survey Technician, Survey Team Leader, and the EEMS QA Manager via e-mail. Any comments received by the recipients are resolved and if required, a Revised Spot Report is sent to the same interested parties.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data at the sites. Some sites utilize handheld data devices. EEMS records the version number of the programs running the electronic precipitation gages and PDA, at sites so equipped.

Site survey data will be recorded on SPSQ hardcopy forms and then entered into a database installed on the field laptop computer.

9.1 Field Laptop Computer

The Survey Technician will have PC field laptop computer to be used to record and manage the site survey data. The laptop will be suitable for field use in terms of battery operation, portability, and sturdiness.

9.2 Computer Software

The field computer has a Microsoft Windows® operating system. Microsoft Office® and Microsoft Access® are used to run the FSSD which is the database used to manage the survey results. The FSSD and examples of the types of forms and screens have been discussed in Section 8.0 and subsections.

10.0 Data Management and Records Management

Most of the data and records management procedures have been discussed throughout the previous sections. This section and subsequent subsections describes the management of the final site survey data and Site Survey File at EEMS.

10.1 Field Data Backup

After entering the survey data for each site, data tables will be transmitted to EEMS for backup. This procedure will continue for each site in the survey trip. The data tables will be stored on the EEMS server which is backed up routinely. Prior to the SPSQ hardcopy being sent back to EEMS, the site survey data tables and all other information (digital photos, electronic reports, etc.) will be written to EEMS server via its Virtual Private Network (VPN.) The field computer and external drive will be kept by the Survey Technician for his or her records.

10.2 Data Tracking

As mentioned in Subsection 1.2.2, prior to conducting site visits, the Site Survey File will contain all the preliminary information gathered. As information is received at EEMS following site visits, the information is logged and that record will be added to the Site Survey File.

The Project Manager will oversee the process of receiving the electronic data export from the field and the importation of that data into the duplicate database at EEMS. After the original SPSQ completed hardcopy data forms have been received and logged, the duplicate data entry process will begin.

10.3 Duplicate Data Entry and Reconciliation

As a QC check, duplicate data entry will be performed for all site survey data fields, except for the comment fields. The intention of duplicate data entry is to minimize typographical errors. Theoretically, it is unlikely for two different people to make the same mistake when entering the same data. Therefore by comparing both entries the mistakes made during each entry will be identified. The duplicate entry will be performed at EEMS by personnel other than the site Survey Technician. The entry will be overseen by the QA Manager.

Following the duplicate data entry process both sets of data are automatically compared for differences. Any difference will automatically be flagged for further investigation. The QA Manager will be responsible for reconciling any differences by referring to the original SPSQ hardcopy forms or discussion with the Survey Technician or Site Operator.
QA reports are generated with the records of the differences found and the resolution of the differences. If for any reason a difference cannot be resolved, it will be identified for further action and all actions will be reported in monthly progress reports.

10.4 Final Data Set

After the QA Manager has ensured that all of the steps described above have been performed a final review of the site survey data is performed.

10.4.1 Site Survey Performance Report

A Site Survey Performance Report is generated in PDF format. This report shows the entire questionnaire as entered into the FSSD including comments. The report is reviewed for validity by comparison to the hardcopy SPSQ and the site photos. The QA Manager will be responsible for reconciling any differences identified based on the comparison, or by discussion with the Survey Technician and/or the Site Operator. All entry changes are documented by electronically annotating the Site Survey Report. The annotated Site Survey Report is generated as a PDF file and archived in the Site Survey File on the EEMS FTP Server. The Site Survey File for the completed site will be closed and archived. The file will indicate the Site ID, Network ID, and the date of the survey to allow for retrieval if requested. A new Site Survey File will be initiated at least one month prior to the next scheduled site survey.

Each Site Survey File will become a permanent historical record of site survey information and documentation. These records will be archived on the EEMS FTP Server in folders named with the site ID and subfolders for each survey year using a standard naming convention and will become part of the site survey data management system. The EEMS FPT Server can be accessed by the EPA PO and the NADP QA Manager to retrieve the files.

The naming convention for NADP files was agreed upon by EEMS and the EPA PO and includes the site id, the year, and month that the activity took place. The Site Survey File includes the site documentation photographs, site survey notification, scanned charts, sketches, spot report, and revised spot report (if applicable). The naming convention must be strictly adhered to in order to facilitate data transfer to the NADP PO. Examples of the naming convention are presented in Figures 8 and 9 and are defined as:

- Notification = siteID-Network letter
- Belfort Chart = siteID-Network_YYYY_MM_chart
- QA Sumary = siteID-Network_QA_YYYY_MM
- Spot Report = siteID-Network_Spot_YYYY_MM
- Revised Spot Report = siteID-Network_Spot_YYYY_MM_r#
- Internal QA Operator Response = siteID-Network_Survey
- Site Photos = siteID-Network_YYYYMM_description

Figure 8. Naming Convention, Site Survey File

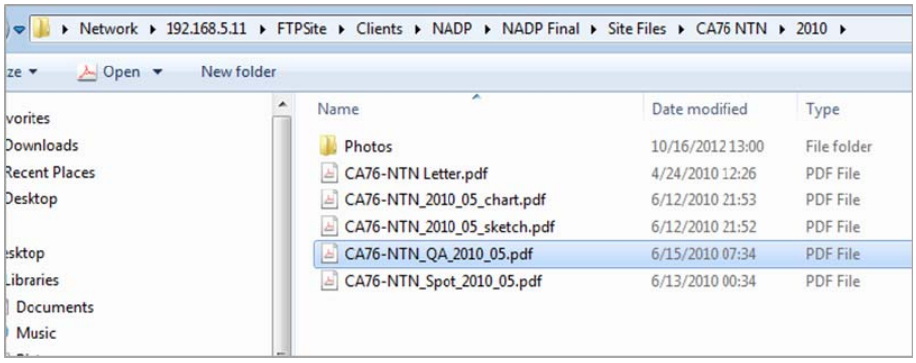
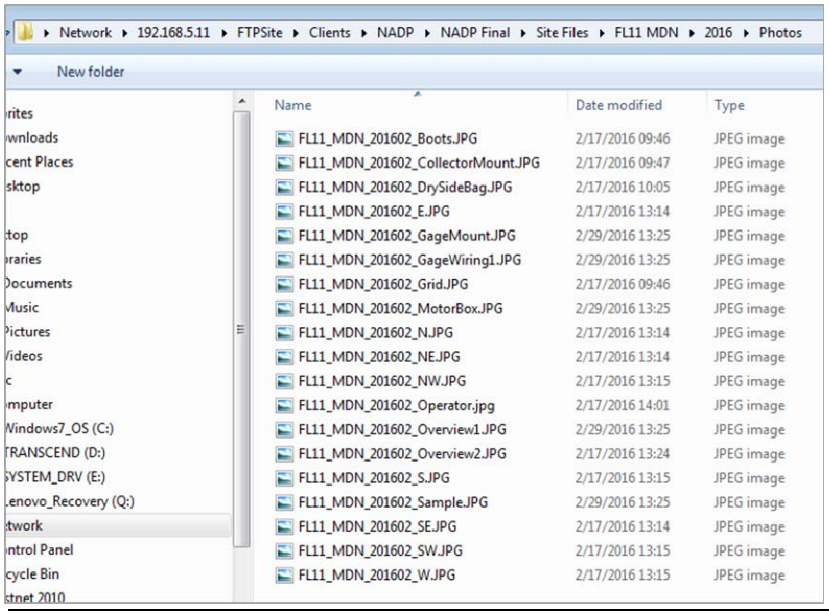


Figure 9. Naming Convention, Photographs Sub-folder



At this stage in the management process, the Project Manager ensures that the database is backed up to an external hard drive on-site and off-site.

10.4.2 Electronic Data Delivery

Electronic Data Delivery (EDD) files are delivered quarterly. The format of the EDD was developed with the assistance of the NADP PO to be suitable for import into the NADP database. The electronic data files contain all of the information included in the Site Survey Performance Report.

11.0 Quality Control and Quality Assurance

EEMS is acutely aware that the NADP Site Survey Program is one QA/QC role of the NADP program. As such, the internal site survey program QA/QC has added importance and consequence since not only data collected for the purpose of the survey, but data collected for the purpose of the NADP are jeopardized if the survey data are not accurate and quality assured.

EEMS personnel and Survey Technicians are aware of the significance of the survey program and the impact of the data collected. They are all experienced professionals and dedicated to the programs of the NADP and EPA Clean Air Markets Division. The following sections describe the quality process that is not only employed for NADP Site Performance Survey procedures, but for all projects at EEMS.

11.1 Review Verification and Vigilance

The NADP Site Survey Program management structure ensures that sufficient review and QA/QC procedures are applied. Before the first site was surveyed, all procedures were documented and reviewed by experts in the field of deposition and precipitation monitoring. The consultants selected to assist with the quality assurance of the documentation and survey program were Dr. Peter Finkelstein and Mr. Scott Dossett.

As described in the previous sections throughout this SOP all data collected are reviewed and verified during the survey and data management process. This begins with the preparation of the survey materials for the site Survey Technician.

The Survey Technician begins the review and verification process by recording the observations and results on SPSQ hardcopy forms and then reviewing the forms while entering the information into the FSSD. This serves as the preliminary review.

Verification and vigilance continue as data are transmitted to EEMS. The duplicate entry procedures verify that the recorded data are correctly entered into the database. This process is overseen and reviewed by personnel that have not collected or entered the data, which provides an independent check. Further checks are performed by EEMS QA Manager by reviewing photographs of the site along with the completed Site Survey Report. Any apparent discrepancies are investigated and resolved.

11.2 Reporting and Accountability

All personnel are informed and encouraged to report any discrepancy or deficiency that may exist in the survey results or site survey procedures. This began with the review of the documentation as described and the incorporation of comments and suggestions. The process will continue as the project goes forward and data are collected. Improvements to the procedures will be presented in reports to management for approval prior to any implementation.

If at any time during the review and verification process any employee or consultant feels that data quality may be compromised due to deficient or inaccurate oversight procedures, they will report the concern and condition to the QA Manager, the Project Manager, and the EPA Project Officer. If the condition is not satisfactorily addressed, the QA Manager has the authority to stop work on the project until the condition is resolved.

As part of verifying that the site survey is useful to Site Operators, at the end of the site survey, EEMS distributes an Internal QA Questionnaire to Site Operators. It questions Site Operators about the logistical execution, and the educational value of the site survey. The Internal QA Questionnaire is presented in Appendix C.

11.2.1 Active Communication

It is the management philosophy of EEMS that quality starts with communication. By actively involving all project participants during regular disussions, all quality concerns are brought forth and addressed. Open communication is also encouraged between EEMS personnel, consultants, NADP personnel, and EPA personnel. The project management will be transparent, with all aspects of the program available for examination by data users, NADP and EPA clients.

All project personnel are reminded that they are accountable. They are encouraged to actively communicate with clients to ensure quality issues are addressed and a quality product is produced.

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Quality Assurance/Quality Control Documentation

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Authorizations

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Revision History

Revision No.	Description	Date	Authorization
0		Sept 2007	
1	Michael Kolian's comments	May 2008	
2	Clarity, remove field database, add electronic precipitation gages	Oct 2016	
3	Change of contract	June 2017	
4	Annual and Contract Update	Dec 2018	

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List of Acronyms and Abbreviations

CAL	Central Analytical Laboratory
CD	compact disc
DAS	data acquisition system
DCN	document control number
EDD	electronic data delivery
EEMS	Environmental, Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FORF	Field Observer Report Form
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
GPS	Global Positioning System
ISWS	Illinois State Water Survey
LOTO	lockout tag-out
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QC	quality control
QAP	quality assurance plan
SOP	standard operating procedure
VPN	virtual private network

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes an overview of the procedures for conducting performance surveys of National Atmospheric Deposition Program (NADP) National Trends Network (NTN) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. The NTN is one of the five networks of the NADP and is focused on long-term trends of precipitation chemistry and estimations of wet atmospheric deposition. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations. More specific instructions are provided in separate SOPs for each measurement system typically found at an NTN station. Those systems include precipitation gages, precipitation collectors, and weighing devices (balance or scales). The individual SOPs are referenced in Section 5.0 Equipment and Supplies of this SOP.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

NTN Site Performance Surveys include:

- Verifying that the site equipment and associated systems are capable of making valid and accurate measurements.
- Verifying that the precipitation collector is operating within the specifications of the NADP Network QAP and capable of collecting valid samples.
- Challenging each measurement device (gage, balance, or scale) with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP Network QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the site equipment to operation within the designated specifications.
- Subsequently re-challenging and/or re-testing the equipment if the above affects instrument operation.

- Documenting the survey results and activities (pre and post-maintenance) using the appropriate form(s) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate form(s) and FSSD.
- Documenting the site equipment and surroundings via photographs. (List of required photographs is provided in Appendix B.)
- Distributing the survey results, reports, and documentation to the designated project personnel.

1.1 Typical NTN Site Installations

The NTN Site Performance Survey program is intended to assess the operation of each site in the network. The network currently consists of approximately 250 sites throughout the Americas and the Caribbean Islands. The number and location of operational sites varies at any time. The list of all NADP sites can be found on the NADP website: http://nadp.slh.wisc.edu/NADP/networks.aspx.

The program goal is to visit and survey approximately 75 site locations per year from the NTN network, and all NTN sites once approximately every four years.

Specific equipment at each site can vary, but each site will consist of an approved precipitation gage, an approved precipitation collector, a sample weighing device, equipment manuals, approved operating procedures, and site supplies. The approved NTN measurement and sampling equipment includes:

- Belfort 5-780 Mechanical Precipitation Gage
- Aerochem Metrics (ACM type) Precipitation Collector
- N-CON Precipitation Collector
- ETI NOAH IV™ Electronic Precipitation Gage
- OTT NADP Pluvio I & II Electronic Precipitation Gage
- Ohaus Mechanical Balance
- Various electronic scales

1.2 Preliminary Survey Activities

Due to the number and location of the sites in the network, the NTN site survey program is a travel intensive project. In order to maintain an efficient schedule and quality product, frequent

and concise communication with project personnel is required. Prior to beginning travel, the U.S. Environmental Protection Agency (EPA) Project Officer, NADP QA Manager, and NADP site support staff must be contacted. Their contact information is listed below:

- Timothy Sharac 202-343-9180 sharac.timothy@epa.gov EPA Project Officer
- Melissa Puchalski 202-343-9882 puchalski.melissa@epa.gov EPA Project Officer
- Martin Shafer 608 217-7500 mmshafer@wisc.edu NADP QA Manager
- Michael Olson 608-263-9162 michael.olson@slh.wisc.edu Program Coordinator
- Richard Tanabe 608-263-9077 Richard.Tanabe@slh.wisc.edu Operations and Equip

In order to adhere to the schedule set forth in the NADP Site Survey Program QAP, the above listed personnel must be contacted no less than one month prior to the planned date of the site survey. The initial communication must include the information contained in Table 1 for each planned site survey.

Table 1. Preliminary Site Communication Information

Site Name	Site ID	Survey Date	Previous Survey Date	NADP Network(s)
Site #1				NTN
Site #2				
Site #3				
:				

Information obtained from the NADP liaisons during the preliminary communication should include the information contained in Table 2 below for each site.

Table 2. Initial Site Information

	Existing Information
Site operator (name, address, phone, e-mail)	
Site supervisor (name, address, phone, e-mail)	
Site sponsor contact (name, address, phone, e-mail)	
Precipitation gage (manufacturer, model)	
Collector (manufacturer, model)	
Balance (manufacturer, model)	
Site characteristics (i.e., solar power, remote, etc.)	
Known problems (equipment and/or siting related)	
Additional requests (training issues, etc.)	
Logistical concerns (i.e., passes or keys required, etc.)	

Figure 1 is an example of the initial site information for site WA14 as received from the NADP PO.

Figure 1. NADP Pre-Audit Site Information

National Atmospheric Deposition Program
Pre-Audit Site Information
NTN Site WA14

Site ID	WA14	Site Name	Olympic National Park-Hoh Ranger Station
Latitude	47.86	County	Jefferson
Longitude	-123.9319	Sponsoring Agency	NPS-ARD
Elevation	176	Operating Agency	NPS-Olympic NP
Start	5/20/1980	Site Owner	NPS
Stop		Map	Owl Mountain
Status	A		

Installed Equipment

Wet/Dry Sampler		Primary Rainguage		Field Lab	
Type	ACM	Type	Belfort 5-780	Scale	Ohaus 1119D
Power	AC	Shield	None	pH Meter	Beckman phi 32
Heated	N	Distance to WD	5.5	pH Electrode	Broadley-James BNC
Lid	F	**Backup Rainguage**		Cond. Meter	YSI 35
Event Recorder	S	Type	8 in cylinder	Cond. Cell	YSI 3403
		Distance to WD	1.2		

	Supervisor	Operator
Name	Bill Baccus	Bill Baccus
Phone	360-565-3061	360-565-3061
Alt Phon		
Fax	360-374-2676	360-374-2676
Email	bill_baccus@nps.gov	bill_baccus@nps.gov
Training		
	Bill Baccus Olympic National Park 600 East Park Avenue Port Angeles, WA 98362-6798	Bill Baccus Olympic National Park 600 East Park Avenue Port Angeles, WA 98362-6798

Funding Agency Representative		
Name	Kristi Morris	Kristi Morris National Park Service Air Resources Division 12795 W. Alameda Parkway Lakewood, CO 80228
Phone	303-987-6941	
Alt Phon		
Fax	303-969-2822	
Email	kristi_morris@nps.gov	

After obtaining the site contact information from the site liaisons, the site operators and supervisors for each site in the planned trip must be contacted at least four weeks prior to the planned site visit.

At least two weeks prior to the planned site survey, the site operator will be contacted again to finalize the logistics pertaining to accessing the site, date and time of the planned site survey, any modifications that may have been performed on the site instrumentation, and any operational problems that may exist at the site. Communication with the site operators is generally carried out by the Survey Technician to provide for the most efficient coordination. If another staff member communicates with a site operator or site sponsor regarding the planned survey, the Survey Technician will be apprised via email or direct communication. The Survey Technician will update an electronic calendar accessible by EEMS Survey Staff. Site specific survey questionnaires will then be generated, printed, and provided to the Survey Technician responsible for conducting the site survey.

1.2.1 Site Survey File

Site Survey Files will be maintained on the EEMS file server. Each Site Survey File will contain the site specific compiled comprehensive information obtained during the previous survey (if applicable) and the preliminary communication and data gathering process described above. The Site Survey File for each site will include correspondence including the letters notifying stakeholders of the upcoming survey. Additional information detailing the Site Survey File is included in Section 10.4.1.

At this step in the site survey procedures, a site survey package will be finalized at EEMS. The site survey package including hardcopy questionnaires will be assembled utilizing the preliminary information gathered for each site. The site-specific forms, as-needed monitor maintenance and repair parts, and survey supplies are inventoried and packed for shipment to the Survey Technician.

Arrangements will be made with the Survey Technician for the shipment of the package to the field. Upon receipt of the forms and materials, the Survey Technician will inspect the package contents and report any damage or missing articles. The EEMS Field Operations Manager will oversee preparation of the preliminary site survey package and provide the Survey Technician with the required materials to complete the planned surveys. Post-survey information will be included in the Site Survey File following the site visit and survey by the Survey Technician.

1.2.2 Site Survey Materials and Equipment

Each Survey Technician is assigned a set of site survey equipment that includes tools, equipment, routine maintenance items, a field computer with FSSD, and survey supplies required to perform

surveys. The Survey Technician is responsible for maintaining the equipment in working order and reporting any problems to the EEMS Field Operations Manager and/or QA Manager so that malfunctioning equipment may be repaired or replaced, as needed. The Survey Technician is also responsible for replenishing field supplies, as needed. The EEMS QA Manager will be responsible for maintaining the required annual certifications for all survey equipment. Certification dates and any required correction factors will be printed and adhered to the corresponding equipment. An electronic copy of each certification will be maintained on the EEMS FTP server which is routinely backed-up. An electronic copy of any equipment certification will be provided to the technician for his records. A hardcopy of each certification will also be maintained at the EEMS office.

2.0 Summary of Methods

General methods used for performing a NTN Site Performance Survey will include the completion of the preliminary survey activities described in the previous sections and then:

- Traveling to the site and challenging or testing each measurement and collection device according to the SOP for that device,
- Recording the observed and collected data on the appropriate form,
- Performing any routine maintenance, adjustment, or minor repair,
- Repeating the challenge or test of the device if the above affects instrument output,
- Recording the results of the additional challenge or test,
- Entering the recorded data into the FSSD and backing up the files,
- Generating the exit report (Spot Report) of the survey activities from the FSSD as soon as practicable, ideally within 48 hours of completing the survey,
- Transferring the hardcopy recorded data and the electronic FSSD files to the EEMS data management facility,
- Verbally reporting any findings from the survey that could affect data collection to the site liaison with any requests for additional attention or activities to be performed at the site within 24 hours of completing the survey.

The specific methods used to complete a challenge or test of the measurement and collection equipment and instrumentation at each site are unique for the type of equipment and the

instrumentation present at the particular NTN site. Specific SOPs have been developed for that purpose.

2.1 Instrument Specific Methods

The list of approved NTN site equipment and instrumentation is presented in Section 1.1. The preliminary survey activities identify which of the listed types of instrumentation are present at each site. Table 3 identifies the specific SOP for the equipment or instrumentation type.

Table 3. Instruments Specific Methods

SOP Name	SOP Number	Revision Number	Revision Date
Belfort 5-780 Precipitation Gage	SOP - 1400	4	Dec 2018
OTT NADP Pluvio I or II Precipitation Gage	SOP - 1410	4	Dec 2018
ETI NOAH IV™ Precipitation Gage	SOP - 1420	4	Dec 2018
ACM NTN Precipitation Collector	SOP - 1310	4	Dec 2018
N-CON NTN Precipitation Collector	SOP - 1340	4	Dec 2018
Ohaus Mechanical and other Electronic Balance	SOP - 1210	4	Dec 2018

Using this SOP and those presented in Table 3, any currently operating NTN site can be surveyed. As new equipment or instrumentation is approved for use at NTN sites, new methods and procedures will be developed to challenge and test that equipment and instrumentation. Those methods will be incorporated into this SOP and Table 3.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of MDN sites are addressed in ***SOP-NADP-1500 Revision 3 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of MDN sites are addressed in ***SOP-NADP-1500 Revision 3 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

Together with this SOP, the individual instrument SOPs listed here are required for conducting performance surveys at NTN designated NADP precipitation collection stations. They are intended to be used by qualified technicians that understand general instrument operation and survey techniques. The following SOPs provide technical guidance and detailed information regarding specific NADP NTN site survey procedures:

- SOP-NADP-1500 – ***NADP Site Systems Survey Standard Operating Procedures, (NADP Installations)***
- SOP-NADP-1400 – ***Belfort Precipitation Gage Standard Operating Procedures, (NADP Installations)***
- SOP-NADP-1410 – ***OTT NADP Pluvio I or II Electronic Gage Standard Operating Procedures, (NADP Installations)***
- SOP-NADP-1420 – ***ETI NOAH IV™ Electronic Precipitation Gage Standard Operating Procedures (NADP Installations)***
- SOP-NTN-1310 – ***ACM NTN Precipitation Collector Standard Operating Procedures (NADP Installations)***
- SOP-NTN-1330 – ***N-CON NTN Precipitation Collector Standard Operating Procedures (NADP Installations)***
- SOP-NADP-1210 – ***Ohaus Mechanical and Various Electronic Balances Standard Operating Procedures (NADP Installations)***

5.1 Survey Tools and Materials

In addition to the specific instruments and equipment listed in the individual SOPs, access to the following materials are required to perform NADP NTN site surveys:

- NADP Network QAP
- Site Survey File for each site in the planned trip
- Hardcopy data forms
- Laptop computer with approved FSSD
- Global Positioning System (GPS)
- Miscellaneous recordkeeping supplies
- Manufacturer's instruction manuals

Manufacturer’s manuals and all NADP site operator SOP and training material can be found at:

http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html[1]. The NADP QAP can be found at: http://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

Each method used to challenge or test a measurement or collection device deployed at NADP NTN site will be referenced to a carefully calibrated and certified standard. The rational and development of those procedures is discussed below.

6.1 Standard Weights

Most instrument challenges will be performed on measurement systems at NTN sites through the use of a standard weight to simulate precipitation and then comparing the instrument response to the equivalent precipitation that corresponds to the standard weight. The equivalent precipitation amount is a function of the size of the opening in the particular precipitation gage and the calibration of the gage itself.

In order to accurately determine the equivalent precipitation amount, an accurate measurement of each standard weight must be performed. This will be accomplished at the EEMS facility with a precision electronic balance. EEMS will check the calibration of the balance prior to each use with NIST traceable weights. The balance calibration weights will be maintained at the EEMS facility in a manner that protects their condition and weight.

6.1.1 Instrument Sensitivity to Weight/Mass

The various precipitation gages approved for NTN respond differently to the weight applied to the catch basin. For example the Belfort gages respond with an equivalent precipitation amount of approximately one inch when a weight of approximately 825 grams is added to the bucket. This will be the smallest standard weight used for the Belfort gages and is measured to the hundredth of one inch. The electronic ETI Noah IV and OTT NADP Pluvio I &II gages are more sensitive and will be challenged with smaller weights that correspond to precipitation amounts of 0.25 and 0.50 inches.

All weights will be checked and their weight documented at EEMS annually. Using the precisely measured weight the corresponding equivalent precipitation amount will be calculated for the

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

intended gage type. The weights will be properly packed and handled in order to preserve their condition during the site survey trips.

6.2 Temperature Checks

ACM type precipitation collector operation is triggered by a sensor that detects the presence of precipitation. The sensor's internal heater is turned on and heated to evaporate the precipitation following an event so the collector does not remain open exposing the sample.

The temperature of the sensor will be measured by a transfer temperature probe that is calibrated and referenced to a standard. The transfer standard calibration will be performed annually and the results documented and archived on the EEMS server and in hardcopy at EEMS. A copy of the certification for each piece of assigned equipment will be provided to each technician. Certification dates and any required correction factors will be printed and adhered to the corresponding instrument.

6.3 Voltage Checks

The NTN Site Performance Surveys will include various voltage checks of the instruments and equipment. Those checks will be performed using a certified multimeter. The multimeter will be certified annually by an independent organization. Certification documentation will be maintained on the EEMS server and in hardcopy at EEMS.

7.0 Troubleshooting

One function of the NADP Site Survey Program is the routine maintenance and minor repair of the site equipment to continue or restore its operation to the NADP specifications. In order to perform this function some troubleshooting of malfunctioning equipment or instrumentation may be necessary. The instructions provided to site operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures.

The list of items that are routinely addressed during a NTN Site Performance Survey is included in Table 6 of the NADP Site Survey Program QAP.

7.1 Site Survey Instrument Function

The tools, instruments, standards, and materials that make up each Survey Technician's equipment set are carefully controlled, tested, calibrated and maintained by the EEMS staff. This process is intended to ensure proper and accurate function when the equipment is used in the field. Should any of the items malfunction during a site survey trip, troubleshooting will be performed in the same manner by the site survey team with the assistance of the EEMS Field Operations Manager and/or QA Manager.

If any field repairs are performed on items in the equipment set, the EEMS QA Manager will determine if the certification of that item and survey results measured by that item are compromised. If necessary, a replacement item will be sent to the Survey Technician to ensure accurate survey results.

8.0 Data Acquisition, Calculations, and Reduction

For this section refer to Section 8.0 of ***SOP-NADP-1500 Revision 3 - NADP Site Systems Survey Standard Operating Procedures.***

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from the ACM MDN Precipitation Collector. Site survey data will be recorded on hardcopy forms and then entered into a database installed on a field laptop computer.

For this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 Revision 3 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 Revision 3 - NADP Site Performance Survey Standard Operating Procedures.***

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Title:	MDN Site Performance Survey Standard Operating Procedures (NADP INSTALLATIONS)
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Authorizations

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List of Acronyms and Abbreviations

CD	compact disc
DAS	data acquisition system
DCN	document control number
EDD	electronic data delivery
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
GPS	Global Positioning System
HAL	Mercury Analytical Laboratory
Hg	mercury
MDN	Mercury Deposition Network
MOF	MDN Observer Form
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QAP	quality assurance project plan
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire
VPN	virtual private network

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes an overview of the procedures for conducting performance surveys of National Atmospheric Deposition Program (NADP) Mercury Deposition Network (MDN) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. The MDN is one of the five networks of the NADP and is focused on long-term trends of precipitation chemistry and estimations of wet atmospheric deposition. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations. More specific instructions are provided in separate SOPs for each measurement system typically found at an MDN station. Those systems include precipitation gages, and precipitation collectors. The individual SOPs are referenced in Section 5.0 Equipment and Supplies of this SOP.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

MDN Site Performance Surveys include:

- Verifying that the site equipment and associated systems are capable of making valid and accurate measurements.
- Verifying that the precipitation collector is operating within the specifications of the NADP Network QAP and capable of collecting valid samples.
- Challenging each measurement device (gage, balance, or scale) with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP Network QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the site equipment to operation within the designated specifications.
- Subsequently re-challenging and/or re-testing the equipment if the above affects instrument operation.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms.

- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Documenting the site equipment and surroundings via photographs.
- Distributing the survey results, reports, and documentation to the designated project personnel.

1.1 Typical MDN Site Installations

The NADP Site Performance Survey program is intended to assess the operation of each site in the network. The MDN network currently consists of approximately 90 sites throughout the United States, Canada and Puerto Rico. The number and location of operational sites varies at any time. A list of active sites and locations can be found on the NADP website: http://nadp.slh.wisc.edu/NADP/networks.aspx.

The program goal is to visit and survey approximately 75 site locations per year from the all the wet deposition networks, and all wet deposition sites once approximately every four years.

Specific equipment at each site can vary, but each site will consist of an approved precipitation gage, an approved precipitation collector, equipment manuals, approved operating procedures, and site supplies. The approved MDN measurement and sampling equipment includes:

- Aerochem Metrics (ACM[1] type) Precipitation Collector
- N-CON MDN Precipitation Collector
- ETI NOAH IV™ Electronic Precipitation Gage
- OTT NADP Pluvio I & II Electronic Precipitation Gage
- Belfort 5-780 Mechanical Precipitation Gage

1.2 Preliminary Survey Activities

The preliminary survey activities are presented in ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures.*** These general procedures apply to all of the wet deposition networks within the NADP**.** The contact information is listed below:

[1] Modified ACM-type collector

Tim Sharac	202-343-9180	Sharac.Timothy@epa.gov	EPA Project Officer
Melissa Puchalski	202-343-9882	Puchalski.Melissa@epa.gov	EPA Project Officer
Martin Shafer	608 217-7500	mmshafer@wisc.edu	NADP QA Manager
Doug Disney	877-622-6960 425-686-1996	DouglasDisney@eurofinsus.com	MDN Liaison
Richard Tanabe	608-263-9077	Richard.Tanabe@slh.wisc.edu	Operations and Equip.

2.0 Summary of Methods

The general methods described in Section 2.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures*** include the methods used for performing a survey at any MDN site. The other SOPs required for an MDN site survey include:

SOP-NADP-1320 - ACM MDN Precipitation Collector
SOP-NADP-1330 - N-CON MDN Precipitation Collector
SOP-NADP-1420 - ETI NOAH IV™ Precipitation Gage
SOP-NADP-1410 - OTT NADP Pluvio I or II Precipitation Gage
SOP-NADP-1400 - Belfort 5-780 Precipitation Gage

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites also apply to MDN sites and are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites also apply to MDN sites and are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

Together with this SOP, the individual instrument SOPs listed in Section 2.0 are required for conducting performance surveys at MDN sites. They are intended to be used by qualified technicians that understand general instrument operation and survey techniques.

5.1 Survey Tools and Materials

In addition to the specific instruments and equipment listed in the individual SOPs, access to the following materials are required to perform NADP MDN site surveys:

- Site Survey File for each site in the planned trip
- Hardcopy SPSQ forms
- Laptop computer with approved FSSD
- Miscellaneous recordkeeping supplies
- Manufacturer's instruction manuals
- Temperature probe
- Voltmeter
- Set of standard weights to challenge the raingage and balance
- Data-logger reader (required for some sites)
- Level with bubble
- Tool bag with essential tools
- Certified survey quality compass
- Wide Area Augmentation System (WAAS) GPS
- Certified range finder
- Miscellaneous measurement devices
- 4.0 mega pixel (minimum) digital camera
- Directional indicator

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[2] The NADP QAP can be

[2] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The methods used to challenge or test the measurement or collection devices at MDN sites are the same as for NADP sites in general. These methods are addressed in Section 6.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

7.0 Troubleshooting

One function of the NADP Site Survey Program is the routine maintenance and minor repair of the site equipment to continue or restore the operation to the NADP specifications. This applies to all sites in the wet deposition networks including MDN sites. Section 7.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures*** provides a chart with the different types of maintenance and minor repairs than may be required.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. This applies to all three wet deposition networks within the program. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP Site Survey Program to collect data at the MDN sites. Site survey data will be recorded on hardcopy SPSQ forms and then entered into a database installed on a field laptop computer. For more on this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures for MDN sites are the same as for other wet deposition networks in the NADP. These procedures are presented in Section 10.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance procedures for MDN sites are the same as for other wet deposition networks in the NADP. These procedures are presented in Section 11.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

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Authorizations

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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
CAL	Central Analytical Laboratory
CD	compact disc
DAS	data acquisition system
DCN	document control number
EDD	electronic data delivery
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FORF	Field Observer Report Form
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
GPS	Global Positioning System
HAL	Mercury Analytical Laboratory
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire
VPN	virtual private network

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes an overview of the procedures for conducting performance surveys of National Atmospheric Deposition Program (NADP) Atmospheric Integrated Research Network (AIRMoN) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. AIRMoN is one of the five networks of the NADP and is focused collecting single-event data to facilitate studies of atmospheric processes and the development and testing of computer simulations of these processes. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations. More specific instructions are provided in separate SOPs for each measurement system usually found at an AIRMoN station. Those systems include precipitation gages, precipitation collectors weighing devices (balance or scales), and conductivity and pH probes. The individual SOPs are referenced in Section 5.0 Equipment and Supplies of this SOP.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

AIRMoN Site Performance Surveys include:

- Verifying that the site equipment and associated systems are capable of making valid and accurate measurements.
- Verifying that the precipitation collector is operating within the specifications of the NADP QAP and capable of collecting valid samples.
- Challenging precipitation gage with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NDAP QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the site equipment to operation within the designated specifications.
- Subsequently re-challenging and/or re-testing the equipment if the above affects instrument operation.

- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Documenting the site equipment and surroundings via photographs.
- Distributing the survey results, reports, and documentation to the designated project personnel.

1.1 Typical AIRMoN Site Installations

The surveys of AIRMoN sites are intended to assess the operation of each site in the network. The network currently consists of approximately 4 sites in the eastern United States. The number and location of operational sites varies at any time. The list of all NADP sites can be found on the NADP website: http://nadp.slh.wisc.edu/NADP/networks.aspx.

Each AIRMoN site is surveyed approximately every four years.

Specific equipment at each site can vary, but each site will consist of an approved precipitation gage, an approved precipitation collector, field laboratory instrumentation, equipment manuals, approved operating procedures, and site supplies. The approved AIRMoN measurement and sampling equipment includes:

- Aerochem Metrics (ACM type) Precipitation Collector,
- N-CON Precipitation Collector,
- ETI NOAH IV™ Electronic Precipitation Gage,
- OTT NADP Pluvio I & II Electronic Precipitation Gage,
- Ohaus Mechanical Balance,
- Various electronic scales,
- Various pH meters,
- Various conductivity meters.

A recent change to the sample collection at AIRMoN sites is the use a special plastic bags that line the wet bucket. The installation of the bag has been reviewed by site operators and these have been trained in the proper sampling method.

1.2 Preliminary Survey Activities

The preliminary survey activities are presented in ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures.*** These general procedures apply to all of the wet deposition networks within the NADP**.** However, for the survey of AIRMoN sites, a sample solution of known pH and conductivity is requested form the NADP QA Manager. This sample solution is used to determine the accuracy of the Site Operator's pH and conductivity measurement instruments.

The contact information is listed below:

Tim Sharac	202-343-9180	Sharac.Timothy@epa.gov	EPA Project Officer
Melissa Puchalski	202-343-9882	Puchalski.Melissa@epa.gov	EPA Project Officer
Martin Shafer	608-217-7500	mmshafer@wisc.edu	NADP QA Manager
Michael Olson	608-263-9162	michael.olson@slh.wisc.edu	Program Coordinator
Richard Tanabe	608-263-9077	Richard.Tanabe@slh.wisc.edu	Operations and Equip.

2.0 Summary of Methods

The general methods described in Section 2.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures*** include the methods used for performing a survey at an AIRMoN site.

However there are specific methods used to complete the challenges or test of the measurement instruments for pH and conductivity which are unique AIRMoN site. The specific SOPs developed for this purpose are:

SOP-NADP-1220 - AIRMoN pH Measurements
SOP-NADP-1230 - AIRMoN Conductivity Measurements

The other SOPs required for an AIRMoN site survey include:

SOP-NADP-1410 - OTT NADP Pluvio I or II Precipitation Gage
SOP-NADP-1420 - ETI NOAH IV™ Precipitation Gage
SOP-NADP-1310 - ACM NTN Precipitation Collector[1]
SOP-NADP-1340 - N-CON NTN Precipitation Collector

[1] Though the title of these SOP refer to NTN sites, these are also applicable to AIRMoN sites since the configuration of the collector is the same for either network.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites also apply to AIRMoN sites and are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites also apply to AIRMoN site and are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

Together with this SOP, the individual instrument SOPs listed in Section 2.0 are required for conducting performance surveys at AIRMoN sites. They are intended to be used by qualified technicians that understand general instrument operation and survey techniques.

5.1 Survey Tools and Materials

In addition to the specific instruments and equipment listed in the individual SOPs, the following materials are required to perform AIRMoN site surveys.

- Site Survey File for each site in the planned trip
- Hardcopy SPSQ forms
- Laptop computer with approved FSSD
- Miscellaneous recordkeeping supplies
- Manufacturer's instruction manuals
- Temperature probe
- Voltmeter
- Set of standard weights to challenge the raingage and balance
- Data-logger reader (required for some sites)

- Level with bubble
- Tool bag with essential tools
- Certified survey quality compass
- Wide Area Augmentation System (WAAS) GPS
- Certified range finder
- Various measurement devices
- 4.0 mega pixel (minimum) digital camera
- Directional indicator
- Solution of known pH and conductivity

Manufacturer's manuals and all NADP Site Operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[2] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The methods used to challenge or test the measurement or collection devices at AIRMoN sites are the same as for NADP sites in general. These methods are addressed in Section 6.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

7.0 Troubleshooting

One function of the NADP Site Survey Program is the routine maintenance and minor repair of the site equipment to continue or restore the operation to the NADP specifications. This applies to all sites in the wet deposition networks including AIRMoN sites. Section 7.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures*** provides a chart with the different types of maintenance and minor repairs than may be required.

[2] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. This applies to all three wet deposition networks within the program. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP Site Survey Program to collect data at the AIRMoN sites. Site survey data will be recorded on hardcopy SPSQ forms and then entered into a database installed on a field laptop computer. For more on this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures for AIRMoN sites are the same as for other wet deposition networks in the NADP. These procedures are presented in Section 10.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

11.0 Quality Control and Quality Assurance

Quality control and quality assurance procedures for AIRMoN sites are the same as for other wet deposition networks in the NADP. These procedures are presented in Section 11.0 of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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List of Acronyms and Abbreviations

ACM	Aerochem Metrics
ATS	Advance Technology Systems, Inc.
CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
ISWS	Illinois State Water Survey
NADP	National Atmospheric Deposition Program
NTN	National Trends Network
PO	Program Office
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the ACM NTN Precipitation Collectors located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The ACM NTN Collector is used to collect the precipitation which occurs during each week of site operation.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

ACM NTN Collector's performance surveys include:

- Verifying that the instrument is capable of collecting a valid, uncontaminated precipitation sample.
- Actuating the precipitation sensor to determine proper operation of the collector lid.
- Performing routine maintenance and/or minor repairs if necessary to return the collector to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the collector.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an ACM NTN Collector's performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs, if necessary;
- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge on the SPSQ form;
- Performing any required routine maintenance, adjustment, or minor repair;
- If required repeating the "as left" or post-maintenance challenge;
- Recording the results of the additional challenge on the SPSQ form;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of the ACM NTN Collector:

- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- ***SOP-NADP-1010 - NTN Site Performance Survey Standard Operating Procedures,***
- Basic hand tools,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals,

- NADP operations manuals (NTN),
- Digital Camera,
- Technicians Equipment:
    1. Compass w/ tripod
    2. Temperature probe
    3. Voltmeter
    4. Standard weights (raingage)
    5. Plastic ties or cord to suspend weights on collectors equipped with a snow roof
    6. Data-logger keyboard
    7. The station PDA, if applicable and available
    8. Sun shade / umbrella
    9. Tape measure (metric & English.)
    10. Directional indicator (N, S, E, W)
    11. Approved lubricant & brake cleaner
    12. Spray bottle w/ water
    13. Paper towels
    14. Level w/ bubble

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: http://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

This method was developed from tested and accepted procedures developed by the Central Analytical Laboratory (CAL) at Illinois State Water Survey (ISWS) and Advanced Technology Systems, Inc. (ATS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

The following steps serve to document the existing condition and operation of the collector and are to be performed prior to conducting any instrument maintenance or adjustment:

1. Take pictures of the collector to document its condition.
2. Record observations concerning the collector' condition, configuration and installation per questions on the SPSQ forms.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

3. Verify and record if the proper sensor is installed on the collector
    - The NTN collector should be equipped with a 7 grid sensor.
4. Perform the rain sensor heater test following these steps:
    - Shade the rain sensor with an umbrella or other suitable device and allow the sensor to equilibrate.
    - Plug the thermocouple into the meter and set the meter to display temperature
    - Record the ambient temperature on the SPSQ forms.
    - Position the thermocouple sensor to ensure a good contact with the sensor plate being careful not to short the sensor grid.
    - Record the surface temperature of the inactivated sensor (the sensor will be warmed if the ambient temperature is below approximately 40°F.).
    - Check and record the voltage at the event recorder terminal on the motor box while the sensor is closed.
    - Short the sensor using a clip or thin shim being careful not to bend the grid. The lid should move from the wet side to the dry side.
    - Activate the min-max temperature logging feature on the meter.
    - Confirm the thermo-couple is positioned to ensure good contact with the sensor plate.
    - Record the maximum sensor temperature reached within a 10 min. interval after the sensor activation.
    - The sensor temperature after 10 minutes should be greater than 50 ^{o}C.
    - If the site is equipped with a Belfort precipitation gage, check to ensure that the recording rain gage event recorder pen is in the up position while rain sensor is shorted.
    - If the sensor is equipped with an electronic precipitation gage, check to ensure that the lid opening is being captured by the rain gage DAS by using the station PDA, the NADP Android App or a Campbell Scientific keyboard.
    - Check and record the voltage at the event recorder terminal on the motor box and rain gage with the collector open.
    - Remove the grid shorting clip or shim. Note: the sensor should be warm to the touch and the collector lid should move back to the wet side.
    - If the sensor fails the temperature test, a replacement sensor should be installed, if available. If a replacement is not available the NADP site support personnel should be contacted to send a replacement from the NED and the site operator should be instructed to install the sensor upon its arrival following the NADP equipment repair/replacement protocol.

5. Check that the collector lid is sealing on the buckets following these steps:
    - Place a few drops of water on the rain sensor to move lid from the wet side to the dry side of the collector.
    - Check to see that the lid seal is making sealing contact with the dry bucket rim and is clean.
    - Blow away any remaining moisture from the rain sensor to activate the lid so that it returns to the wet side.
    - Check to see that the lid seal is making sealing contact with the wet bucket rim.
6. Unplug the precipitation collector from the 120v power. Place a small amount of water on the grid to initiate the lid movement and see if it will operate properly under battery power only.
7. Load test the battery following these procedures:
    - Make sure the motor box and/or charger is unplugged before load testing the battery.
    - Clip the red lead from tester to the positive post of the battery and the black lead to the negative post of the battery.
    - Determine the proper load test setting by reading the cold cranking amps (CCA) listed on the battery label. Note: do not stand over the battery during the load test.
    - If more than one battery is wired together in series, separate the batteries and test individually.
    - Test the battery using the tester's automatic sequence. Watch the meter for battery condition. Record the results on the SPSQ forms.
    - Remove load tester.
    - After the load test, restore wiring, plug motor box and/or charger into the 120v power, if applicable.
8. Check that the correct fuses are installed in the motor box.
    - The fuse holders are mounted on the front of the motor box. A label giving the correct fuse ratings is located on the front of the motor box, too.
9. Test clutch lift of collector using the following steps
    - The collector lid should be on the wet side.
    - Place 2 Belfort calibration weights in the center of the lid.
    - Wet or short the sensor grid to move the lid from the wet side to the dry side. Make note of the movement of the weighted lid. It should move smoothly without disengaging.

- Remove the shorting device or blow off the sensor, the lid should move back to the wet side.
- If the clutch fails the lift test, refer to Section 4.3 of the ***ACM Precipitation Collector Maintenance Manual*** (http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html) for adjustment or replacement of the clutch mechanism.
- If repair or an adjustment is required, re-test the clutch after repair.
- Remove the test weights.

6.2 Maintenance

1. Clean the sensor head to remove any debris that could cause the collector to open unnecessarily.
2. Straighten the sensor grids if bent.
3. Replace fuses, if needed
4. Clean the battery terminals if needed and spray with protectant.
5. Level and secure the collector to the base as needed, if possible.
6. Clean or replace the dry bucket if needed
7. Replace the lid seal if it is torn or not sealing properly due to compression. Lid liners are shipped to the sites upon request by the site operator.
8. Lubricate the alignment arm.
   - Spray the alignment arm with approved brake cleaner to remove any accumulated lubricant.
   - Spray the alignment arm with approved lubricant.

6.3 Post-maintenance Checks

- Confirm that all questions on the ACM NTN Precipitation Collector section of the SPSQ forms are complete.
- Confirm that the measurement and collection equipment has been returned to the "ready to sample" state.
- Instruct the site operator to note the date on which the survey was conducted in the comments section of the Field Observer Report Form.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from the NADP site support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures.***

9.0 Computer Hardware and Software

Computer hardware and software are not used for systems surveys of NADP sites to collect data from the ACM NTN Precipitation Collector. Site survey data will be recorded on hardcopy SPSQ forms and then entered into a database installed on a field laptop computer.

For this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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Authorizations

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List of Acronyms and Abbreviations

ATS	Advance Technology Systems, Inc.
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
HAL	Mercury Analytical Laboratory
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
PO	Program Office
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the ACM MDN Precipitation Collectors located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The ACM MDN Precipitation Collector is used to collect the precipitation which occurs during each week of site operation.

The purpose of a performance survey is to assess the collector's field performance under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the precipitation collection process is operating within the project acceptance criteria as defined in the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

ACM MDN Precipitation Collector's performance surveys include:

- Verifying that the instrument is capable of collecting valid, uncontaminated precipitation samples.
- Actuating the precipitation sensor to determine proper operation of the collector lid.
- Performing routine maintenance and/or minor repairs if necessary to return the collector to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the collector.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an ACM MDN Precipitation Collector performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs,
- Completing the "as found" or pre-maintenance challenge,
- Recording the results of the pre-maintenance challenge on the SPSQ form,
- Performing any required routine maintenance, or minor repair,
- If required based on any effect on the data collected, repeating the "as left" or post-maintenance challenge,
- Recording the results of the additional challenge on the SPSQ form,
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of the ACM MDN Precipitation Collector:

- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***
- ***SOP-NADP-1020 - MDN Site Performance Survey Standard Operating Procedures***
- Basic hand tools
- Laptop computer with approved FSSD

- Miscellaneous recordkeeping supplies
- NADP operations manuals (MDN)
- Digital Camera
- Technicians Equipment:
    1. Temperature probe
    2. Voltmeter
    3. Standard weights (raingage)
    4. Plastic ties or cord to suspend weights on collectors equipped with a snow roof
    5. Data-logger keyboard
    6. The station PDA, if applicable and available
    7. Sun shade/ umbrella
    8. Tape measure (metric & English.)
    9. Spray bottle with water
    10. Paper towels
    11. Level w/ bubble

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: http://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

This method was developed from tested and accepted procedures developed by the Mercury Analytical Laboratory (HAL) and Advanced Technology Systems, Inc. (ATS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

Special Note on Mercury Collector Sensitivity:

It is very important to follow the MDN Project Specific SOP when working around the collector or handling samples from the collector. Dirt and other particles can have mercury absorbed into their surfaces and if any of this material was to accidentally get into the sample bottle, it could significantly contaminate the sample.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

The following steps serve to document the existing condition and operation of the collector and are to be performed prior to conducting any instrument maintenance or adjustment:

1. Take pictures of the collector to document its condition.
2. Record any observations concerning the collector condition, configuration and the installation per the questions on the SPSQ.
3. Verify and record if the proper sensor is installed on the collector.
    - The MDN collector should be equipped with an 11 grid sensor.
4. Perform the rain sensor heater test following these steps:
    - Shade the rain sensor with an umbrella or other suitable device and allow the sensor to equilibrate.
    - Plug the thermocouple into the meter and set the meter to display temperature.
    - Record the ambient temperature on the SPSQ form.
    - Position the thermocouple sensor to ensure a good contact with the sensor plate being careful not to short the sensor grid.
    - Record the surface temperature of the inactivated sensor (the sensor will be warmed if the ambient temperature is below approximately 40°F).
    - Check and record the voltage at the event recorder terminal on the motor box while the lid is in closed position.
    - Short the sensor using a clip or thin shim being careful not to bend the grid. The lid should move from the wet side to the dry side (open position).
    - Activate the min-max temperature logging feature on the meter.
    - Confirm the thermo-couple is positioned to ensure good contact with the sensor plate.
    - Record the maximum sensor temperature reached within a 10 min. interval after the sensor activation.
    - The sensor temperature after 10 minutes should be greater than 50 °C.
    - If the site is equipped with a Belfort precipitation gage, check to ensure that the recording rain gage event recorder pen is in the up position while rain sensor is shorted.
    - If the site is equipped with an electronic precipitation gage, check to ensure that the lid opening is being captured by the rain gage DAS by using the station PDA, the NADP Android App or a Campbell Scientific keyboard.
    - Check and record the voltage at the event recorder terminals on the motor box and rain gage with the collector open.

- Remove the grid shorting clip or shim. Note: the sensor should be warm to the touch and the collector lid should move back to the wet side.
- If the sensor fails the temperature test, a replacement sensor should be installed, if available. If a replacement is not available NADP support personnel should be contacted to send a replacement from the NED and the site operator should be instructed to install the sensor upon its arrival following the NADP equipment repair/replacement protocol.

5. Open the enclosure door and place a temperature standard probe inside so that the probe is placed in an open airflow area. Close the door and let the temperature stabilize before recording the reading. Open the door and quickly record the min/max thermometer reading. Is min/max reading within tolerance ± 5 °F. Record the results on the SPSQ forms.
   - If the temperature within the collector is out of acceptable range (40° to 100°F), record this finding on the SPSQ forms, and adjust the thermostat.
6. Check that the collector lid is sealing on the buckets following these steps:
   - Place a few drops of water on the rain sensor to move lid from wet side to dry side of collector.
   - Check to see that the lid seal is making sealing contact with the dry bucket rim and is clean.
   - Blow away any remaining moisture from rain sensor to activate lid so that it returns to the wet side.

Special Note Regarding Blowing Water Off of the Rain Sensor

The step described above is very important. The sample funnel is now open and exposed. If the technician was to blow the water off the sensor toward the open funnel, there is a great potential for contamination of the sample to occur. If the technician has fillings in his teeth, it is likely that his saliva has detectable concentrations of mercury. Further, there is potential to blow debris/particles toward the open funnel which could also cause contamination. Always blow the sensor off with your back to the open funnel.

   - Check to see that the lid seal is making sealing contact with the wet funnel.
7. Unplug the precipitation collector from the 120v power, put a small amount of water on the grid to initiate the lid movement and see if it will operate properly under battery power only.
8. Load test the battery following these procedures:
   - Make sure the motor box and/or charger is unplugged before load testing the battery.
   - Clip the red lead from tester to the positive post of the battery and the black lead to the negative post of the battery.

- Determine the proper load test setting by reading the cold cranking amps (CCA) listed on the battery label. Note: do not stand over the battery during the load test.
- If more than one battery is wired together in series, separate the batteries and test individually.
- Test the battery using the tester's automatic sequence. Watch the meter for battery condition. Record the results on the SPSQ forms.
- Remove load tester.
- After the load test, restore wiring, if applicable; plug motor box and/or charger into the 120v power, if applicable.

9. Check that the correct fuses are installed in the motor box.
   - The fuse holders are mounted on the front of the motor box. A label giving the correct fuse ratings is also located on the front of the motor box.
10. Test the clutch lift of the collector performing the following steps:
    - The collector lid should be on the wet side.
    - Place 2 Belfort calibration weights in the center of the lid.
    - Wet or short the sensor grid to move the lid from the wet side to the dry side. Make note of the movement of the weighted lid. It should move smoothly without disengaging.
    - Remove the shorting device or blow off the sensor, the lid should move back to the wet side.
    - If the clutch fails the lift test, refer to Section 4.3 of the ACM Precipitation Collector Maintenance Manual http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.)[2] for adjustment or replacement of the clutch mechanism.
    - If repair or an adjustment is required, re-test the clutch after repair.
    - Remove the test weights.

6.2 Maintenance

- Clean the sensor head to remove any debris that could cause the collector to open unnecessarily.
- Straighten the sensor grids if they appear bent.
- Clean the battery terminals if needed and spray with protectant.

[2] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

- Level and secure the collector to the base as needed.
- Replace the lid seal if it is torn or not sealing properly.
- Check the caulk around funnel chimney and re-caulk with 100% silicone, if needed.
- Check the sample bottle lab jack for smooth operation.
- Check the sampler arm boots and recommend replacement if they are cracked or torn.

6.3 Post-maintenance Checks

- Confirm that all questions and tests on the MDN Collector section of the SPSQ are complete.
- Confirm that the measurement and collection equipment has been returned to its "ready to sample" state
- Instruct the site operator to note the date on which the survey was conducted in the comments section of the Mercury Observer Form.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from NADP support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used for systems surveys of NADP sites to collect data from the ACM MDN Precipitation Collector. Site survey data will be recorded on hardcopy SPSQ forms and then entered into a database installed on a field laptop computer. For this

section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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List of Acronyms and Abbreviations

CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
NADP	National Atmospheric Deposition Program
NTN	National Trends Network
OPS	optical precipitation sensor
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the N-CON NTN Precipitation Collector located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The N-CON NTN Precipitation Collector is used to collect the precipitation which occurs during each week of site operation.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

The N-CON NTN Precipitation Collector performance surveys include:

- Verifying that the instrument is capable of collecting a valid, uncontaminated precipitation sample.
- Performing routine maintenance and/or minor repairs if necessary to return the collector to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the collector.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an N-CON NTN Precipitation Collector performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs,
- Completing the "as found" or pre-maintenance challenge,
- Recording the results of the pre-maintenance challenge using the SPSQ forms,
- Performing any required routine maintenance, adjustment, or minor repair,
- If required, and based on any effect on the data collected, repeating the "as left" or post-maintenance challenge,
- Recording the results of the additional challenge on the SPSQ forms,
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of the N-CON NTN Precipitation Collector:

- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- ***SOP-NADP-1010 - NTN Site Performance Survey Standard Operating Procedures,***
- Basic hand tools,

- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- NADP operations manuals (NTN),
- Digital Camera,
- Technicians Equipment:
    1. Voltmeter
    2. Data-logger keyboard
    3. The station PDA, if available
    4. Tape measure (metric & English.)
    5. Paper towels
    6. Level w/ bubble
    7. Loctite

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The method described here was developed from tested and accepted procedures developed by the Central Analytical Laboratory (CAL). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

1. Approach the collector from downwind.
2. If a site operator is onsite, have him/her retrieve the sample in accordance with the NADP NTN Operations Manual, observe the technique used, and record the observations. If a site operator is not present, retrieve the sample in accordance with the NADP NTN Operations Manual.
3. Take pictures of the collector to document its condition.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

4. Record any observations concerning the collector condition, configuration and the installation per the questions on the forms of the SPSQ.
5. Check that the lid liner is making sealing contact with the bucket rim and that it is clean.
6. Pass your hand through the optical precipitation sensor (OPS) 5 times to activate the collector lid. Note: unplug the power cord or use the power switch to stop the collector lid from closing, if needed.
7. The lid should return to cover the bucket within 25 seconds of no interruption through the open beam.

6.2 Instrument Maintenance

1. Clean the OPS with a wet paper towel.
2. Level and secure the collector to the base if needed.
3. Replace the lid liner if it is torn or not sealing properly due to compression.
4. Adjust the sampler lid position if the lid liner is not sealing properly on the bucket rim.
5. Ensure that the splash guard is properly positioned and adjust if necessary.
6. Ensure that the set screws on the motor shafts are tight. Apply Loctite if needed.
7. Check the event recorder operation on the rain gage.

Perform Event Recorder Operation Verification

If the site is equipped with a Belfort rain gage, check to ensure that the Event Recorder was working when you had the NTN N-CON Collector open earlier in this procedure. You should see an ER pen spike at the end of the measuring period on the chart paper. The ER pen should have moved to the open or "Up" position during this time. It should have then returned to the closed or "Baseline" position signifying the lid was closed over the wet side of the collector. If the site is equipped with an electronic precipitation gage, check to ensure that the lid opening is being captured by the rain gage DAS by using the station PDA, the NADP Android App or a Campbell Scientific keyboard. Record the results on the SPSQ forms.

6.3 As Left (Post-maintenance Check)

1. Confirm that all the questions and tests on the NTN Collector section of the SPSQ are complete.

2. Confirm that the measurement and collection equipment has been returned to the "ready to sample" state.
3. Instruct the site operator to note the date on which the survey was conducted in the comments section of the Field Observer Report Form.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from the NADP site support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from N-CON NTN Precipitation Collector. Site survey data will be recorded on SPSQ hardcopy forms and then entered into a database installed on a field laptop computer.

Data and records management procedures are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

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List of Acronyms and Abbreviations

EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSAD	Field Site Audit Database
FSSD	Field Site Survey Database
HAL	Mercury Analytical Laboratory
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
OPS	optical precipitation sensor
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the N-CON MDN Precipitation Collector located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The N-CON MDN (GS 00-125) Precipitation Collector is used to collect the precipitation which occurs during each week of site operation.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

The N-CON MDN Precipitation Collector performance surveys include:

- Verifying that the instrument is capable of collecting a valid, uncontaminated precipitation sample.
- Performing routine maintenance and/or minor repairs if necessary to return the collector to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the collector.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an N-CON MDN Precipitation Collector performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs,
- Completing the "as found" or pre-maintenance challenge,
- Recording the results of the pre-maintenance challenge on the SPSQ form,
- Performing any required routine maintenance, adjustment, or minor repair,
- If required based on any effect on the data collected, repeating the "as left" or post-maintenance challenge,
- Recording the results of the additional challenge on the SPSQ form,
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of the N-CON MDN Precipitation Collector:

- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures ,***
- ***SOP-NADP-1020 - MDN Site Performance Survey Standard Operating Procedures,***
- Basic hand tools,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,

- Manufacturer's instruction manuals,
- NADP operations manuals (MDN),
- Digital Camera,
- Technicians Equipment:
    1. Temperature probe
    2. Voltmeter
    3. Data-logger keyboard
    4. The station PDA, if applicable and available
    5. Tape measure (metric & English.)
    6. Paper towels
    7. Level w/ bubble
    8. Loctite removable threadlocker

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The method described here was developed from tested and accepted procedures developed by the Mercury Analytical Laboratory (HAL). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

Special Note Mercury Collector Sensitivity:
It is very important to follow the MDN Project Specific SOP when working around the collector or handling samples from the collector. Dirt and other particles can have mercury absorbed into their surfaces and if any of this material was to accidentally get into the sample bottle, it could significantly contaminate the sample.

1. Approach the collector from downwind.
2. If a site operator is onsite, have him/her retrieve the sample in accordance with the NADP MDN Operations Manual, observe the technique used, and record the observations. If a site

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

operator is not present, retrieve the sample in accordance with the NADP MDN Operations Manual.

3. Take pictures of the collector to document its condition.
4. Record any observations concerning the collector condition, configuration and the installation per the questions on SPSQ.
5. Open the enclosure door and place the survey transfer standard temperature probe inside so that the probe is placed in an open airflow area. Close the door and let the temperature stabilize. Open the door and quickly record the min/max thermometer reading. The min/max reading should be within ± 10°F of the temperature as measured by the standard. Record the results on the SPSQ.
6. If the temperature within the collector is out of the acceptable range (40° to 100°F), record this finding on the SPSQ and adjust the thermostat.
7. Check that the lid liner is making sealing contact with the funnel rim and that it is clean.
8. Pass your hand through the optical precipitation sensor (OPS) 5 times to activate the collector lid. Note: unplug the power cord or use the power switch to stop the collector lid from closing, if needed.
9. The lid should return to cover the bucket within 25 seconds of no interruption through the open beam.

6.2 Instrument Maintenance

1. Clean the OPS with a wet paper towel.
2. Level and secure the collector to the base if needed.
3. Replace the lid liner if it is torn or not sealing properly due to compression.
4. Adjust the sampler lid position if the lid liner is not sealing properly on the funnel rim.
5. Ensure that the splash guard is properly positioned and adjust if necessary.
6. Ensure that the set screws on the motor shafts are tight. Apply Loctite if needed.
7. Check the sample bottle turn tray for smooth operation.
8. Check the event recorder operation on the rain gage.

Perform Event Recorder Operation Verification

If the site is equipped with a Belfort rain gauge, check to ensure that the Event Recorded was working when you had the MDN N-CON Collector open earlier in this procedure (when removing and deploying your glassware). You should see an ER pen spike at the end of the measuring period on the chart paper. The ER pen should have moved to the open or "Up" position during this time. It should have then returned to the closed or "Baseline" position signifying the lid was closed over the wet side of the collector.

If the site is equipped with an electronic precipitation gauge, check to ensure that the lid opening is being captured by the rain gage DAS by using the station PDA, the NADP Android App or a Campbell Scientific keyboard. Record the results on the questionnaire.

6.3 As Left (Post-maintenance Check)

1. Confirm that all the questions and tests on the MDN Collector section of the SPSQ are complete.
2. Confirm that the measurement and collection equipment has been returned to the "ready to sample" state.
3. Instruct the site operator to note the date on which the survey was conducted in the comments section of the Field Observer Report Form.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from NADP site support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for surveys of NADP instruments will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described in Section 8.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from N-CON MDN Precipitation Collector. Site survey data will be recorded on SPSQ forms and then entered into the FSSD installed on a field laptop computer.

For more information on computer hardware and software see Section 9.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

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Authorizations

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0		Oct 2007	
1	Michael Kolian's comments	May 2008	
2	Clarity, remove field database	Oct 2016	
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Table of Contents

List of Acronyms and Abbreviations

CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the ETI NOAH IV Precipitation Gages located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The ETI NOAH IV Precipitation Gage is used to continuously measure the amount of precipitation by weight which occurs during each week of site operation. The amount is recorded on an integrated Campbell Scientific data logger (DAS).

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

The ETI NOAH IV Precipitation Gage performance surveys include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the gage with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the gage to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the gage.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing a ETI NOAH IV Precipitation Gage performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs, if necessary;
- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge on the SPSQ form;
- Performing any required routine maintenance, adjustment, or minor repair;
- If required repeating the "as left" or post-maintenance challenge;
- Recording the results of the additional challenge on the SPSQ form;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures***.

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of ETI NOAH IV Precipitation Gauges:

- NADP operations manuals (NTN, MDN),
- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures,***
- Compass with tripod,
- Standard calibration weights,

- Basic hand tools,
- Zero residue cleaner and cleaning supplies,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals,
- Digital camera,
- Technicians Equipment:
    1. Voltmeter
    2. Data-logger keyboard
    3. The station PDA, if applicable and available
    4. Tape measure (metric & English.)
    5. Level w/ bubble
    6. Spray bottle w/ water

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

This method described was developed from tested and accepted procedures developed by the Central Analytical Laboratory (CAL) at Illinois State Water Survey (ISWS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward. This method is similar to the method used for the OTT Pluvio raingage. The difference is that the OTT Pluvio raingage operates without optical sensors.

6.1 As Found (pre-maintenance check)

The following steps are to be performed prior to conducting any instrument maintenance or adjustment to document the existing condition and operation of the gage:

1. Take pictures of the gage to document its condition.
2. Record observations concerning the gage's condition, configuration and installation per questions on the SPSQ foms.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

3. If a wind shield is present and prevents access to the gage, remove wind shield.
4. Using the inclinometer on the compass check 45° rule and 30^{o} guidelines for inlet and record results.
5. Note if objects greater than one meter in height are inside the 5 meter radius.
6. Check level of precipitation gage using a bubble level across opening of gage at perpendicular angles and record the results.
7. Measure and record distance from ground to top of precipitation gage.
8. Record what type of rain gage shield is installed at site ("none", "Alter", or "other").
9. During the winter season, check for winterization of precipitation gage, record findings.
10. Establish communication with precipitation gage using PDA or, Android device with Service/Audit Program or, a Campbell Scientific keypad.
11. Record and compare the date and time showing on precipitation gage with GMT
    - The gage time should be adjusted to within 1 minute of GMT (or local time, whichever is used at the site) to conform to procedures from collocated projects.
12. Record program version of the DAS and PDA, if applicable.
13. Remove the inlet orifice from top of the ETI NOAH IV Precipitation Gage. Verify that the orifice is round and inspect the O-ring.
14. Gently lift out the collection chamber, being very careful not to drop it onto the weighing platform (this could damage the load cell).
15. Disconnect the two optics cables from their receptacles in the load plate by pulling gently on the connector, and not the cables.
16. Remove the gage housing from the base by loosening the three screws at the bottom of the housing that secure it to the base plate. Take care not to hold the gage housing by the black emitters and detectors when removing the outer housing from the gage base.
    - Inspect the connectors and receptacles for corrosion.
17. Note the condition of O-ring, and any insect activity, corrosion, or debris visible inside the gage housing. Photograph, if necessary, to document the actual condition.
18. Inspect the base and weighing mechanism.
19. Note if the collection chamber is deformed or leaking.
20. Clean the collection chamber and reinstall it in the gage. Wait until the reading has stabilized, before documenting a zero (baseline) reading. If the gage is winterized, retain the anti-freeze in a separate container for re-installation after the survey.

6.2 Read and Record the Gage Response

1. Carefully place the appropriate weight to simulate 0.25 inch of precipitation in chamber and wait until the reading stabilizes, before recording the reading. Repeat for 0.50 inch, 1 inch, 2 inches, 6 inches, and 10 inches simulated precipitation, recording each reading after it has stabilized. Record all gage responses on the SPSQ form.
2. Record bucket baseline again when complete.
3. If the gage is equipped with a precipitation collector lid-position recording capabilities, and not already completed during the collector testing, test event recording by simulating wet conditions on the precipitation collector. Verify that the event is being recorded by precipitation gage DAS.

6.3 Instrument Maintenance

The following steps are to be performed as routine maintenance of the ETI NOAH IV Precipitation Gage:

1. Clean all parts and base with a soft brush, or canned air, being very careful not to damage the load cell.
2. Correct the level of precipitation gage, if needed.
3. Check battery condition by measuring voltage from the battery while the gage's battery charger is plugged into the power source. Note the reading. Disconnect the charger from the power source, and wait at least 3 minutes before taking an additional voltage reading from the back-up battery. Record the voltage reading. Plug the charger gage back into the power source.
4. If the battery voltage falls below 11.5 volts while the charger is disconnected from the power source, note that a battery replacement is needed on SPSQ form or replace the battery if a spare is available.
5. Clean the connectors on the optical sensors cables, if needed. Apply dialectical grease to the connectors.

6.4 Post-maintenance Checks

1. Carefully reinstall the outer housing by placing the outer housing over the base assembly and carefully sliding it down to the base plate. Align the outer housing by matching the blue alignment dot on the inside of the gage housing to the blue alignment dot on the top plate of the base assembly.

2. Gently reconnect the two optical sensor cables to their appropriate connectors in the load plate. Be careful not to apply too much pressure to thee connectors as they are easily dislodged from the load plate.
3. Reinstall the collection chamber by inserting it carefully down into the gage housing and gently onto the platform. ***Make sure the chamber is not dropped onto the platform as this could cause irreversible damage to the load cell.***
4. Rotate the chamber so that the notch in the chamber lip is lined up with the black line scribed inside of the shield in order to prevent blocking the sensors.
5. Reinstall the inlet ring.
6. If the unit was winterized, re-winterize the collection chamber and confirm that the reading is similar to the original reading.
7. Check the proper operation of the optical sensors.
    - Use the spray bottle to mist the inlet of the gage. Note if the gage DAS indicates the gage is Active (or On.)
    - Confirm that the DAS indication returns to Inactive (or Off) within 2 minutes from the end the mist test.
    - Place a solid object between the two sensors. Note if the gage DAS indicates the gage is Blocked.
    - Confirm that the DAS indication returns to Inactive (or Off) within 2 minutes from the end the blocking test.
8. Exit the communications with the precipitation gage's DAS.
9. Confirm that all questions on the Electronic Raingage section of the SPSQ are complete.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from NADP site support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used during the survey to collect data from the ETI NOAH IV gage. Site survey data will be recorded on hardcopy SPSQ forms and then entered into the FSSD installed on a field laptop computer.

For more information on computer hardware and software see Section 9.0 or ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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Authorizations

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List of Acronyms and Abbreviations

CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PDA	Personal Digital Assistant
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the OTT NADP Pluvio I or II Electronic Precipitation Gages located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The OTT NADP Pluvio Electronic Precipitation Gage is used to continuously measure the amount of precipitation by weight, which occurs during each week of site operation. The amount of precipitation is recorded to an integrated Campbell Scientific datalogger (DAS).

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity, and assess data accuracy.

OTT NADP Pluvio Electronic Precipitation Gage performance surveys include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the gage with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the gage to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the gage.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms.
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an OTT NADP Pluvio Electronic Precipitation Gage performance survey will include:

- Documenting the existing condition on the SPSQ forms, and with digital photographs, if necessary;
- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge on the SPSQ forms;
- Performing any required routine maintenance, adjustment, or minor repair;
- If required, based upon any effect on the data collected, repeating the "as left" or post-maintenance challenge;
- Recording the results of the additional challenge on the SPSQ forms,
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of OTT NADP Pluvio Electronic Precipitation Gage:

- NADP operations manuals (NTN, MDN),
- Site Survey File for the site including a hardcopy of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- Compass with tripod
- Calibration weights specific for this gage type,

- Basic hand tools,
- Zero residue cleaner and cleaning supplies,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals,
- Digital camera,
- Technicians Equipment:
    1. Voltmeter
    2. Data-logger keyboard
    3. The station PDA, if applicable and available
    4. Tape measure (metric & English.)
    5. Level w/ bubble

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The method used to evaluate the performance of the OTT Pluvio raingage is similar to the method used for the ETI NOAH IV gage. The difference is that the OTT Pluvio raingage operates without optical sensors.

6.1 As Found (Pre-maintenance Check)

The following steps serve to document the existing condition and operation of the gage and are to be performed prior to conducting any instrument maintenance or adjustment:

1. Take pictures of the gage to document its condition.
2. Record observations concerning the gage's condition, configuration and installation per questions on the SPSQ forms.
3. If a wind shield is present and prevents access to the gage, remove wind shield.
4. Using the inclinometer on the compass check 45° rule and 30^{o} guidelines for inlet and record results.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

5. Note if objects greater than one meter in height are inside the 5 meter radius.
6. Check level of precipitation gage using a bubble level across opening of gage at perpendicular angles and record the results.
7. Measure and record distance from ground to top of precipitation gage.
8. Record what type of rain gage shield is installed at site ("none", "Alter", or "other").
9. During the winter season, check for winterization of precipitation gage, record findings.
10. Establish communication with precipitation gage using PDA, Android device with Service/Audit Program or, a Campbell Scientific keypad.
11. Record and compare the date and time showing on precipitation gage with GMT
    - The gage time should be adjusted to within 1 minute of GMT (or local time, whichever is used at the site) to conform to procedures from collocated projects.
12. Record program version of the DAS and PDA, if applicable.
13. Remove housing from precipitation gage, note whether or not the housing is mounted correctly and damage-free.
14. Note any insect activity, corrosion, or debris visible inside the housing. Photograph if necessary to document actual condition.
15. Inspect base and weighing mechanism.
16. Read bull's-eye level at base of unit to determine if unit is sitting level.
17. Note if the moving part of weighing mechanism is in contact with the stationary parts.
18. Note if any damage to the weighing mechanism is evident.
19. Note if the collection bucket is deformed.
20. Note if the collection bucket is unstable on the bucket support.
21. Remove the collection bucket, clean bucket and reinstall bucket in gage. Wait until the reading has stabilized before documenting a zero (baseline) reading. If the gage is winterized, retain the anti-freeze is a separate container for re-installation after the survey.

6.2 Read and Record the Gage Response

1. Carefully place the appropriate weight to simulate 0.25 inch of precipitation in bucket and wait until the reading stabilizes before recording the reading. Repeat for 0.50 inch, 1 inch, 2 inches, 6 inches, and 10 inches simulated precipitation, recording each reading after it has stabilized.

2. Record bucket baseline again when complete.
3. If the gage is equipped with precipitation collector lid-position recording capabilities and not already completed during the collector testing, test the event recording by simulating wet conditions on the precipitation collector. Verify that the event is being recorded by precipitation gage DAS.

6.3 Instrument Maintenance

The following steps are to be performed as routine maintenance of the OTT NADP Pluvio Electronic Precipitation Gage:

1. Clean all moving parts and base with a soft brush or canned air, being very careful not to damage the load cell.
2. Correct the level of precipitation gage, if needed, by adjusting the bottom screws on the gage so that the air bubble appears in the marked ring of the bull's-eye level.
3. Check battery condition by measuring voltage from the battery while the gage's battery charger is plugged into the power source. Note the reading. Disconnect the gage power cord from the power source, and wait at least 3 minutes before taking an additional voltage reading from the back-up battery. Record the voltage reading. Plug the charger back into the power source.
4. If the battery voltage falls below 11.5 volts while the gage power cord is disconnected from the power source, note that a battery replacement is needed on SPSQ form or replace the battery if a spare is available.

6.4 Post-maintenance Checks

1. Carefully reinstall the collection bucket and the precipitation gage housing.
2. If unit was winterized, re-winterize the collection bucket and verify the precipitation accumulation output is similar to the original reading.
3. Exit the communications with the precipitation gage's DAS.
4. Confirm that all questions on the Electronic Raingage Section of the SPSQ are complete.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from NADP support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto SPSQ forms. Recorded data will then be entered into the FSSD as described Section 8.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used during the survey of the Ott Pluvio precipitation gage. Site survey data will be recorded on hardcopy SPSQ forms and then entered into the FSSD installed on a field laptop computer.

For more information on computer hardware and software see Section 9.0 or ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

10.0 Data Management and Records Management

Data and records management are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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2	General update	Oct 2016	
3	Contract date change	Jun 2017	
4	Annual and Contract Update	Dec 2018	

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List of Acronyms and Abbreviations

ATS	Advance Technology Systems, Inc.
CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
ISWS	Illinois State Water Survey
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PO	Program Office
QAP	quality assurance plan
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the Belfort 5-780 Precipitation Gages located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The Belfort 5-780 Recording Rain (precipitation) Gage is used to continuously measure the amount of precipitation by weight which occurs during each week of site operation. The amount is recorded to a hardcopy chart located within the gage.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

Belfort 5-780 gage performance surveys include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the gage with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the gage to operation within the designated specifications.
- Subsequently re-challenging and/or retesting the gage.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms.
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing a Belfort gage performance survey will include:

- Documenting the existing condition on the forms provided and with digital photographs, if necessary;
- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge on the SPSQ form;
- Performing any required routine maintenance, adjustment, or minor repair;
- If required repeating the "as left" or post-maintenance challenge;
- Recording the results of the additional challenge on the SPSQ form;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of Belfort gages:

- NADP operations manuals (NTN, MDN),
- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- Compass with tripod,
- Belfort standard calibration weights (12),
- Belfort linearity tool (2),

- Basic hand tools,
- Zero residue cleaner and cleaning supplies,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals,
- NADP Belfort Raingage Calibration document (CAL),
- Miscellaneous recordkeeping supplies,
- Digital Camera,
- Technicians Equipment:
    1. Voltmeter
    2. Tape measure (metric & English.)
    3. Level w/ bubble

Manufacturer's manuals and all NADP site operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP QAP can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

This method was developed from tested and accepted procedures developed by the Central Analytical Laboratory (CAL) at Illinois State Water Survey (ISWS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

The following steps are to be performed prior to conducting any instrument maintenance or adjustment to document the existing condition and operation of the gage:

1. Take pictures of the gage to document its condition.
2. Record observations concerning the gage's condition, configuration and installation per questions on the SPSQ forms.
3. Remove wind shields, gage housing, and bucket to gain access to the instrument.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

4. Mark the chart found in place by gently rocking the drum or moving the pen arm to make a cross on the recorded trace. Remove the chart and notate with the data and time of the survey and initial.
5. Compare the chart time with actual time to ensure it is within ± 6 hours. If the clock time is not within the criterion, check the clock batteries. If the batteries are fine, the clock may need to be replaced.
6. Install a new chart documented with the site ID, "as found check", time and date of the survey, and Survey Technician name.
7. Re-install the bucket onto the bucket platform.
8. Gently rock and advance the chart drum slightly (or move the pen) to record the zero (bucket equivalent weight) on the chart.
9. Gently add each of the 12 Belfort standard weights one at a time and gently rock and advance the chart slightly (or tap the pen) to record the response from each.
10. Note location of the cross-over of the pen at the top of the chart.
11. Engage the pen shifter and remove the drum and chart for review.
12. Remove the bucket.

6.2 Read and Record the Gage Response

Each Belfort standard weight should increase the pen response by 1.00 inch.

To evaluate the gage response record the baseline reading on the Belfort form of the SPSQ. In the *Equivalent Height* column record the first standard equivalent height by adding 1 inch to the baseline reading. Complete the remainder or the column by adding 1 inch to the previous recorded value. The last value recorded should be the 11 plus the baseline value.

Interpret the response of the Belfort gage from the chart and enter the readings obtained from each added weight in the *As Found* column of the SPSQ Belfort form.

The NADP acceptance criterion is ± 0.10 inch response per 1.00 inch weight. If the responses recorded are within criteria then only cleaning and maintenance are required.

6.3 Instrument Maintenance

The following steps are to be performed as routine cleaning and maintenance of the Belfort gage:

1. Check and re-level the gage by placing the level on the Bucket Platform Washer and adjusting the gage as necessary.
2. If pens are not recording properly, clean with alcohol or carburetor cleaner and adjust the tension of the contact with the chart.
3. Clean any debris and dirt from the gage and mechanical movement.
4. Check for and remove corrosion or anything that causes excessive friction or "stickiness" of the mechanism. Generously apply carburetor cleaner and use a soft brush and/or paper towels) to clean the mechanism.
5. Replace any loose or missing locking screws or parts.
6. Check the orientation of the event marker pens, if the station is collocated, the NTN pen should be the upper pen, MDN should be the lower.
7. Verify that the red "zero-adjust" knob has been removed and replaced with a stainless-steel cap screw and locking nut.
8. Check and fill the dashpot reservoir with silicone oil to a level just slightly above the piston when in the upper-most position.

6.4 As Left (Post-maintenance Check)

After performing the maintenance items listed in the previous section, the response of the gage must be re-checked. If the gage was not within acceptance criteria prior to the maintenance, the pre-maintenance check can be repeated after the maintenance to determine if the operation was corrected by the routine maintenance procedures.

If the gage response was within acceptance criteria, and passes the post-maintenance check described below, no adjustments are necessary.

1. Reinstall the chart used for the pre-maintenance check and advance to a new position. Document the position as "post-maintenance"
2. Using the technique described in section 6.1 check four gage responses. (0, 3, 6, 9 inches)
3. If the gage passed the pre-maintenance check and the post-maintenance check, remove the calibration chart and return the sample chart.
4. Reinstall all items removed for the survey and maintenance to the proper operating condition.

6.5 Calibration and Adjustment

If the gage was not within acceptance criteria when checked and maintenance activities did not return it to proper operating condition, then calibration adjustments are required. Section VI of the ***Belfort Instruction Book for Universal Recording Rain Gage Cat. No. 5-780*** provides detailed instructions with drawings. The following steps are performed to calibrate the gage:

1. Remove the event recorder.
2. Reinstall the bucket platform.
3. Back-out the limit screws to allow the mechanism to move through the full range.
4. Center the screws and nuts in the slot lengths of each lever extension.
5. Check spring plate; and adjust so that it is parallel to the frame.
6. Re-install the bucket and 3 Belfort standard weights
7. Adjust pen arm to 3” mark
8. Install 2-calibration linearity tools over pivot screw heads on Z linkage and straight linkage. Loosen the set screws and rotate the pen arm shaft so linearity tool will fit over copper screws, tighten the set screws, then remove both adjustment tools
9. Readjust pen arm to 3” by spring arm knob (gray or brass colored course knob). To move the pen arm down adjust clockwise, to move the pen arm up adjust counter-clockwise.
5. Remove the weights and adjust the pen to slightly above the zero line using the knob and screw on top of the spring being sure to keep the spring bar level. (Note: the pen isn’t adjusted to exactly the zero line so that drift and evaporation can be recorded.)
6. Install weights 1-6, one at a time and note the placement of pen arm which should increase 1” per weight.
7. If pen arm increases LESS than 1” move first traverse extension OUT (lengthen)
8. If pen arm increases MORE than 1” move link IN (shorten)
9. Check the cross over at the top of the 6” line (with 6 weights in the bucket)
10. Adjust crossover by turning screw on Z-linkage (Use small increments.)
    - If pen arm is over the 6” mark, adjust Z- linkage screw clockwise.
    - If pen arm is under the 6” mark, adjust Z- linkage screw counter-clockwise
11. Continue adding weights 6”-12” and watch that the pen arm travel 1” per weight
12. Adjust Extension Arm on Z- linkage as necessary
    - Move extension arm OUT to Increase (lengthen)

- Move extension arm IN to Decrease (shorten)

13. After calibration of the rain gage reinstall event recorder.
14. Check both pen arms for clearance during movement and adjust if needed

If after removing 6 weights, the pen arm will not return to the zero mark, check the Crossover and adjust as necessary.

(NOTE): Calibrating the gage is an iterative process. If the pen arm falls behind or ahead consistent with each weight on 6-12" then one must move the long lever up or down few graduations and recheck. This in turn will take the crossover out of adjustment, requiring a readjustment of the crossover. Recheck the gage response 1-6"/6-12". Make adjustments, as needed by following the steps outlined above.

15. Repeat the procedure described in Section 6.2 to obtain the post calibration checks. The first reading obtained using the bucket with no weights added will be the new baseline. Adding one weight at a time mark the gage readings on the chart.
16. Once all weights have been added one at a time, proceed to interpret the chart readings and complete the Belfort form of the SPSQ. The new baseline is recorded as the first reading of the *As Left* column. Complete the *Post Calibration Equivalent Height* column in the same way the *Equivalent Height* column was completed. Complete the *As Left* column with the readings from the chart.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from NADP support personnel.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for systems surveys of NADP sites will be accomplished by recording the information described in the previous sections onto data SPSQ forms. Recorded data will then be entered into the FSSD. For more on this section refer to Section 8.0 of ***SOP-NADP-1500 Revision 2 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from Belfort precipitation gages.

For this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures..***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 Revision 2 - NADP Site Performance Survey Standard Operating Procedures.***

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Quality Assurance/Quality Control Documentation

Title:	Ohaus Balance and Electronic Top-loading Scale Standard Operating Procedures (NADP INSTALLATIONS)
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Authorizations

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0		Sept 2007	
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2	General update	Oct 2016	
3	Contract Date Change	Jun 2017	
4	Annual and Contract Update	Dec 2018	

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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
ATS	Advance Technology Systems, Inc.
CAL	Central Analytical Laboratory
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
ISWS	Illinois State Water Survey
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the Ohaus balances and electronic scales located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The Ohaus balance or electronic scale is used to calculate the amount of precipitation sample collected on a weekly basis for National Trends Network (NTN) sites, and on an event basis for the Atmospheric Integrated Research Monitoring Network (AIRMoN) sites. This measurement is then used to calculate the concentrations of the ions tested for at the Central Analytical Laboratory (CAL).

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

Performance survey of the Ohaus balances and electronic scales include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the balance or scale with an independent audit standard [traceable to National Institute of Standards and Technology (NIST) or other authoritative standard] to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Performing routine maintenance and/or minor repairs if necessary to return the balance to operation within the designated specifications[1].
- Subsequently re-challenging and/or retesting the balance.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms.

[1] Only the Ohaus triple beam balance is adjusted during the site survey. No adjustments are performed on electronic scales.

- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing an Ohaus balance or electronic scale performance survey will include:

- Documenting the existing condition on the forms provided;
- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge;
- Performing any required routine maintenance, calibration adjustment, or minor repair;
- If required, repeating the "as left" or post-maintenance challenge;
- Recording the results of the additional challenge;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures***.

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of Ohaus balances and electronic scales:

- NADP operations manuals (NTN, and AIRMoN),

- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- ***SOP-NADP-1010 - NTN Site Performance Survey Standard Operating Procedures*** or ***SOP-NADP-1030 - AIRMoN Site Performance Survey Standard Operating Procedures,***
- Site Survey File for the site including the hardcopy of the SPSQ,
- Set of standard weights,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals.

Manufacturer's manuals and all NADP Site Operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[2] The NADP Network Quality Assurance Plan can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

This method was developed from tested and accepted procedures developed by the Central Analytical Laboratory (CAL) at Illinois State Water Survey (ISWS) and Advanced Technology Systems, Inc. (ATS). Refinements to the method have been incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

The following steps are to be performed prior to conducting any instrument maintenance or adjustment to document the existing condition and operation of the balance. (Note: two types of weighing mechanisms are used; Ohaus triple beam mechanical balances and top loading electronic scales).

1. Record observations concerning general condition and type of scale on the SPSQ. If a top loading scale, record its brand and capacity.
2. Check the zero of scale and record in the comments section if an adjustment is needed.
3. Then, if needed, tare the scale before proceeding with survey.

[2] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

4. Place a Belfort standard weight on the scale and record the weight displayed on the Belfort standard weight and the scale response. Repeat the procedure adding one standard weight at a time up to four weights total.
5. If the instrument is out of tolerance, perform the instrument maintenance indicated below and perform the post-maintenance checks.

6.2 Instrument Maintenance

The following steps are to be performed as routine cleaning and maintenance of the mechanical balances:

1. Check that balance is level and free from vibration.
2. Check that the balance is clean. Clean all beam slides with clean cloth and water, if needed. Do not use oil or any lubricant on balance knives or bearings.
3. Check that the magnet faces in the base of the Trig Loop Post Assembly are clean. If debris has accumulated on the magnet faces, clean using a piece of adhesive tape inserted it into the magnet slot where the aluminum damper vane enters. (The tape can be applied sticky side out to a thin, rigid strip such as ruler to facilitate in reaching the magnet faces). The damper vane should be able to move freely when debris is removed.
4. Recheck calibration using procedure in As-Found section.
5. If triple beam mechanical balance does not pass calibration, it will need to be replaced.

The following steps are to be performed as routine cleaning and maintenance of the electronic scales:

1. Check that weighing platform is level, clean, and free from vibration.
2. If electronic scale does not pass calibration, it will need to be replaced or sent to an authorized center for servicing.

6.3 As Left (Post-maintenance Check)

1. Confirm that all questions on the weighing scales section of the SPSQ have been completed.
2. Ensure that the triple beam balance is stored properly. Remove any load from the balance plate and place the slotted masses on the mass rack. Slide one of the poises away from the zero mark to make sure balance is not in equilibrium. This will keep the balance from oscillating and prevent unnecessary wear.

7.0 Troubleshooting

The instructions provided to Site Operators by the NADP PO and the manuals provided by the instrument manufacturers will be utilized to perform the troubleshooting procedures. The Survey Technician may contact the EEMS' Survey Team Leader for assistance and additional support may also be obtained from the CAL instrument technicians.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for the performance surveys of the Ohaus balances and electronic scales will be accomplished by recording the information described in the previous sections onto data forms. Recorded data will then be entered into the FSSD as described in Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from Ohaus balance and electronic scales. Site survey data will be recorded on hardcopy forms (SPSQ) and then entered into a database installed on a field laptop computer.

For additional information refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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Quality Assurance/Quality Control Documentation

Title:	pH Meter Standard Operating Procedures (NADP INSTALLATIONS)
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Authorizations

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2	General update	Oct 2016	
3	Contract Date Change	Jun 2017	
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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
ATS	Advance Technology Systems, Inc.
CAL	Central Analytical Laboratory
DI	deionized
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
ISWS	Illinois State Water Survey
MDN	Mercury Deposition Network
NADP	National Atmospheric Deposition Program
NIST	National Institute of Standards and Technology
NTN	National Trends Network
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the pH meters used at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The pH meter is used at sites in the NADP Atmospheric Integrated Research Monitoring Network (AIRMoN) as part of the field laboratory activities that take place at these network sites.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

The pH meter performance surveys include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the probe with independent audit standard solutions provided by Central Analytical Laboratory (CAL) to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate forms of the Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD).
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing a pH meter performance survey will include:

- Documenting the existing condition on the forms provided;

- Completing the "as found" or pre-maintenance challenge in the SPSQ forms;
- Recording the results of the pre-maintenance challenge in the SPSQ forms;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of the pH meter:

- NADP operations manuals (AIRMoN),
- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- ***SOP-NADP- 1030 - AIRMoN Site Performance Survey Standard Operating Procedures,***
- Solution of known pH and conductivity provided by the CAL,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies,
- Manufacturer's instruction manuals.

Manufacturer's manuals and all NADP Site Operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP Network Quality Assurance Plan can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

6.0 Instrument or Method Calibration and Standardization

The method described here was developed from tested and accepted procedures developed by the CAL at Illinois State Water Survey (ISWS) and Advanced Technology Systems, Inc. (ATS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

The following steps are to be performed prior to conducting any instrument maintenance or adjustment to document the existing condition and operation of the pH probe:

1. Check that probe was stored with electrode bulb wet, in proper storage solution. Note pH 4.01 buffer is an acceptable storage medium. The protective rubber cap or a container filled with the buffer solution should be used for storage.
2. Check pH probe sensor for cracked or broken glass tip. Check the cable and connector for good connection to meter. Check that probe is clean.
3. The Survey Technician should then observe the Site Operator do the following:
    - Rinse probe in deionized water and carefully shake water off probe. Note: do not wipe the probe electrode or the temperature probe as this may generate an electrostatic charge on the probe which can create measurement instability.
    - Insert the probe into a clean container filled with CAL supplied buffer solution. The end of the probe must be completely immersed into the buffer solution. Turn pH meter on. Stir the probe gently. Record pH buffer solution target value and expiration date. Once the meter has stabilized, record the reading. Note: do not re-use buffer solution. If the pH meter reports the temperature measurement, use the buffer solution to check temperature. Insert the temperature transfer standard in with pH probe. After stabilization, record and the reading from temperature transfer standard.
    - If the pH system is within the acceptable limits for pH [2] and temperature as defined in the NADP QAP, rinse probe in deionized water then store probe in proper storage solution and container.

[2] As specified in the sample provided by the CAL.

6.2 Instrument Maintenance

No instrument maintenance is performed by the Survey Technician.

6.3 Calibration and Adjustment

No calibration and/or other adjustments are performed by the Survey Technician.

7.0 Troubleshooting

The role of the Survey Technician for the laboratory activities performed by the Site Operator at AIRMoN sites is that of an observer, and to record the values of the measurement obtained by the Site Operator. No troubleshooting by the Survey Technician is expected.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for the performance surveys of the pH meter will be accomplished by recording the information described in the previous sections onto data forms. Recorded data will then be entered into the FSSD as described in Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from the pH meter. Site survey data will be recorded on SPSQ hardcopy forms and then entered into a database installed on a field laptop computer. For more on this section refer to Section 9.0 Computer Hardware and Software of ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

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Authorizations

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Revision History

Revision No.	Description	Date	Authorization
0		Sept 2007	
1	Michael Kolians'n comments	May 2008	
2	Clarity and remove Field Database	Oct 2016	
3	Contract Date Change	Jun 2017	
4	Annual and Contract Update	Dec 2018	

Previous DN: SOP-EPW07061-1230

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List of Acronyms and Abbreviations

AIRMoN	Atmospheric Integrated Research Monitoring Network
ATS	Advance Technology Systems, Inc.
CAL	Central Analytical Laboratory
DI	deionized
EEMS	Environmental Engineering & Measurement Services, Inc.
EPA	U.S. Environmental Protection Agency
FSSD	Field Site Survey Database
ISWS	Illinois State Water Survey
NADP	National Atmospheric Deposition Program
PO	Program Office
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SOP	standard operating procedure
SPSQ	Site Performance Survey Questionnaire

1.0 Scope and Applicability

This Standard Operating Procedure (SOP) describes the procedures for conducting performance surveys of the conductivity meters located at National Atmospheric Deposition Program (NADP) field stations. The NADP is a cooperative, multi-agency program of monitoring stations designed to measure precipitation chemistry and estimate atmospheric deposition of various pollutant ions and mercury. Various local, state, and federal agencies, as well as universities and other interested groups are responsible for, and contribute to, the operation of the stations.

The conductivity meter is used at sites in the NADP Atmospheric Integrated Research Monitoring Network (AIRMoN) as part of the field laboratory activities that take place at these network sites. It measures the conductivity of the precipitation collected after each precipitation event occurs.

The purpose of a performance survey is to assess the field measurement process under normal operating conditions, "as found", without any special preparation or adjustment of the system. Performance survey results are used to ensure the measurement process and data collection systems are operating within the project acceptance criteria as defined in the NADP Network Quality Assurance Plan (QAP). Proper implementation of a survey (or audit) program will ensure data integrity and assess data accuracy.

The conductivity meter performance surveys include:

- Verifying that the instrument is capable of making valid and accurate measurements.
- Challenging the instrument with and independent audit standard solutions [provided by Central Analytical Laboratory (CAL)] to determine if the device is operating within defined project accuracy goals provided in the NADP QAP.
- Documenting the survey results and activities (pre and post-maintenance) using the appropriate Site Performance Survey Questionnaire (SPSQ) and Field Site Survey Database (FSSD) forms.
- Documenting any condition that affects data quality or that requires additional attention using the appropriate SPSQ and FSSD forms.
- Distributing the survey results, reports, and documentation to the designated project personnel.

2.0 Summary of Methods

General methods used for performing a conductivity meter performance survey will include:

- Documenting the existing condition on the forms provided;

- Completing the "as found" or pre-maintenance challenge;
- Recording the results of the pre-maintenance challenge in the SPSQ forms;
- Recording the results of the additional challenge in the SPSQ forms;
- Entering the recorded data into the FSSD and backing up the files.

3.0 Health and Safety Warnings

The health and safety issues regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

4.0 Personnel Qualifications

Personnel qualification regarding surveys of NADP sites are addressed in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

5.0 Equipment and Supplies

The following tools and materials are required to conduct performance surveys of conductivity meters:

- NADP operations manuals (AIRMoN),
- Site Survey File for the site including hardcopy forms of the SPSQ,
- ***SOP-NADP- 1030 - AIRMoN Site Performance Survey Standard Operating Procedures*** ,
- ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures,***
- Solution of known pH and conductivity provided by the CAL,
- Laptop computer with approved FSSD,
- Miscellaneous recordkeeping supplies.
- Manufacturer's instruction manuals.

Manufacturer's manuals and all NADP Site Operator SOP and training material can be found at: http://nadp.isws.illinois.edu/dl/QAAG/field_operations/main.html.[1] The NADP Network Quality

[1] This link is awaiting an update to point to the correct location on the napd.slh.wisc.edu server.

Assurance Plan can be found at: https://nadp.slh.wisc.edu/lib/qaPlans.aspx.

6.0 Instrument or Method Calibration and Standardization

The method described here was developed from tested and accepted procedures developed by the CAL at Illinois State Water Survey (ISWS) and Advanced Technology Systems, Inc. (ATS). Refinements to the method are being incorporated as the NADP Site Survey Program moves forward.

6.1 As Found (Pre-maintenance Check)

The following steps are to be performed prior to conducting any instrument maintenance or adjustment to document the existing condition and operation of the gauge:

1. Check that conductivity cell was stored properly:
   - Short term: store conductivity cell in deionized (DI) water. Water must be changed frequently to prevent any growth that may cause cell to not function properly.
   - Long term: Rinse cell with DI water and store dry. Cell should be soaked in DI water until cell tip appears black after storing dry.
2. Check conductivity cell for cracked or broken glass cell. Check the cable and connector for good connection to meter. Check that cell is clean.
3. The Survey Technician should then observe the Site Operator do the following:
   - Turn meter on and verify that meter is properly setup according to the manufacturer's manual.
   - Insert probe into a clean container filled with CAL supplied solution. The end of the probe must be completely immersed into the buffer solution. Gently tap and stir the cell to remove any trapped air bubbles. Record conductivity target value and expiration date on the form. Once the meter has stabilized, record the reading on the form. Rinse the conductivity cell with DI water, and gently shake water from cell. Note: the conductivity solution should not be re-used.
   - If the conductivity measured is within the acceptable limits[2], rinse cell in DI or distilled water and then store the cell properly.

[2] As specified on the sample provided by the CAL.

6.2 Instrument Maintenance

No instrument maintenance is performed by the Survey Technician.

6.3 Calibration and Adjustment

No calibration and/or other adjustments are performed by the Survey Technician.

7.0 Troubleshooting

The role of the Survey Technician for the laboratory activities performed by the Site Operator at AIRMoN sites is that of an observer, and to record the values of the measurement obtained by the Site Operator. No troubleshooting by the Survey Technician is expected.

8.0 Data Acquisition, Calculations, and Reduction

Data acquisition for the performance surveys of the conductivity meter will be accomplished by recording the information described in the previous sections on the SPSQ forms. Recorded data will then be entered into the FSSD as described in Section 8.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

9.0 Computer Hardware and Software

Computer hardware and software are not used by the NADP to collect data from the conductivity meter. Site survey data will be recorded on hardcopy SPSQ forms and then entered into the FSSD installed on a field laptop computer. For more information on computer hardware and software see Section 9.0 of ***SOP-NADP-1500 - NADP Site Systems Survey Standard Operating Procedures***.

10.0 Data Management and Records Management

Data and records management procedures are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

11.0 Quality Control and Quality Assurance

Quality control and quality assurance are presented in ***SOP-NADP-1500 - NADP Site Performance Survey Standard Operating Procedures.***

Appendix B

Site Performance Survey Questionnaire

Site Information Field Form

Station ID:

Network:

	On File Value	Updated Value
1. Station name:		
2. Network:		
3. Survey start date/time:		
4. Survey end date/time:		

OPERATOR INFORMATION

5. Operator's name:		
6. Operator's telephone number:		
7. Operator's telephone extension:		
8. Operator's fax number:		
9. Operator's email:		
10. Operator's cell phone number:		

OTHER MONITORING TAKING PLACE	On File Value	Updated Value
11. Does site conduct other environmental data collection		
12. Non - NADP precipitation chemistry		
13. Gas monitoring - SOx / NOx / CO / etc.		
14. IMPROVE		
15. CASTNET		
16. AIRMoN - dry deposition station		
17. PM-10, PM-2.5, TSP		
18. UV-b		
19. SURFRAD		
20. CRN (Climate Reference Network)		
21. NWS (National Weather Service)		
23. NEON (National Ecological Observatory Network)		
22. Other weather monitoring		
24. Specify other weather monitoring program:		

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Backup Raingage Field Form

Station ID:

Network:

1. Type of backup gage within 30 m of NADP collector		TIPPING BUCKET STICK BELFORT NOAH IV OTT OTHER
2. Is the orifice of the collector +/- .3 m of backup raingage		YES NO
3. Distance from collector to backup raingage (meters)		
4. Backup raingage ground cover, 30 m radius		NATURAL ARTIFICIAL NATURAL + ARTIFICIAL
5. 45 degree rule met (backup raingage)		YES NO
6. If backup raingage mounting is Building, is 30 degree rule met		YES NO N/A
7. 30 degree rule for trees met (backup raingage)		YES NO
8. 30 degree rule for buildings met (backup raingage)		YES NO
9. No objects > 1 m height inside 5 m radius (backup raingage)		YES NO
10. No fences > 1 m height inside 2 m radius (backup raingage)		YES NO
11. No vegetation height > 0.6 m within 5 m radius (backup raingage)		YES NO
12. If backup raingage wind shield present, is it installed correctly		YES NO NOT APPLICABLE
13. Backup raingage wind shield type		NONE ALTER TYPE OTHER

14. Backup gage comments:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"

Enter -69 in numerical fields for "UNABLE TO TEST ITEM"

Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Site Supplies Field Form

Station ID:

Network:

Clean Supplies

1. MDN Coolers	
2. Unused buckets in bags, ready to be used	
3. Unused bucket lids in bags, ready to be used	
4. Unused 1-L sample bottles in bags, ready to be used	
5. Unused 250-mL sample bottles in bags, ready to be used (AIRMoN)	

NTN Shipping Boxes

6. Large shipping boxes	
7. Small 1-L bottle boxes	

Used Supplies

8. Wet side used buckets, do not include dry side or discard buckets	
9. Used bucket lids	
10. Used 1-L sample bottles	
11. Used 250 mL sample bottles (AIRMoN)	
12. No used collector and raingage components on hand	YES NO UNABLE TO TEST
13. Sample mailers on hand Black Box w/blue tape	
15. Ice Packs	
14. Temperature blank bottles on hand	

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Supplies Needed

16. Order Site Operations Manual/SOPS	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
17. Order raingage manual	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
18. Order copy of training video	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
19. Order wash bottle	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
20. Order deionized water	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
21. Order disposable towels	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
22. Order 4 ml polystyrene sampling vials	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
23. Order vial style	NONE	SHORT	LONG	NOT APPLICABLE	
24. Order pH 4.0 buffer solution	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
25. Order pH 7.0 buffer solution	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
26. Order specific conductance standard	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
27. Order 4.3 Quality control check sample	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
28. Order electrode fill solution	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
29. Order blank field forms	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
30. Order blank raingage charts	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
31. Order NADP vial holder	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
32. Order NADP vial holder cover	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
33. Order gloves	NONE	SMALL	MEDIUM	LARGE	

34. Comments on supplies needed:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Field Laboratory Field Form

Station ID:

Network:

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1. Does site conduct field chemistry		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
2. Is laboratory temperature controlled		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
3. pH meter simulation test 7.00		
4. pH meter simulation test 4.00		
5. Acceptable conductivity measurement techr		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
6. Target conductivity of audit sample		
7. Measured conductivity of audit sample		
8. Acceptable pH measurement techniques		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
9. Target pH of audit sample		
10. Measured pH of audit sample		
11. Order pH probe		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
12. Good weighing practices		YES NO NOT APPLICABLE MISSING UNABLE TO TEST

	Standard Weight	Scale Response
13. Calibration Std.Wt. (821g)		
14. Calibration Std.Wt. (1643g)		
15. Calibration Std.Wt. (2466g)		
16. Calibration Std.Wt. (3288g)		

17. Are samples stored and shipped properly		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
18. Temperature of blank bottles in refrigerator		

Field Lab Comments:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Belfort Gage Field Form

Station ID:

Network:

1. Is 8 inch orifice round	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
2. Does site have raingage funnel	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
3. Is gage level	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
4. If gage is not level, was it re-leveled	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
5. Is gage stable	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
6. If the gage is not stable, was it stabilized	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
7. Clock operates properly 'as found'	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
8. E.R. solenoid operates properly 'as found'	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
9. No dashpot fluid added	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
10. Order dashpot fluid	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
11. Order raingage ink	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
12. Order replacement pen nibs	0		1	2	3

Standard Weights Added	Equivalent Height	As Found	Post Calibration Equivalent Height	As Left
Baseline gage reading inches				
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				

Enter -39 in numerical fields for items that are "NOT APPLICABLE"

Enter -69 in numerical fields for "UNABLE TO TEST ITEM"

Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

13. Was the 'as found' zero plate set properly	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
14. Was the 'as found' turn over set properly	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
15. Was the 'as found' event recorder set properly	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
16. Order replacement gage	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
17. Has Belfort " RED " knob modification been made	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST

18. Comments on Belfort raingage (include any repairs and adjustments)

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Electronic Raingage Field Form

Station ID:

Network:

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1. Is orifice round	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
2. Is bucket in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
3. Is gage level	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
4. If gage is not level, was it re-leveled	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
5. Is gage stable	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
6. If gage is not stable, was it stabilized	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
7. Baseline gage reading inches					

	Equivalent Height	Electronic Gage
8. 0.25 inch check reading		
9. 0.5 inch check reading		
10. 1 inch check reading		
11. 2 inch check reading		
12. 6 inch check reading		
13. 10 inch check reading		

14. Rain gage operates properly	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
15. Battery voltage					
16. Does battery pass load test	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
17. Battery capacity, amp-hr					
18. Battery in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
19. Order electronic gage battery	YES	NO	NOT APPLICABLE		
20. Does datalogger receive event signals from all collectors	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
21. Does optical sensor respond to "blocking" of light beam	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
22. Does optical sensor respond to mist of water	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

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23. Comments on raingage:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

N-CON Rain Collector Field Form

Station ID:

Network:

1.	Were the correct fuses found	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
2.	Were all fuse problems corrected during survey	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
3.	Is the chimney heated	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
4.	Is collector level	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
5.	If collector is not level, was it re-leveled	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
6.	Is collector stable	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
7.	Was collector stabilized during survey?	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
8.	Lid seal in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
9.	Lid liner in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
10.	Blue clip in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
11.	Fan in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
12.	Cooling fan thermostat in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
13.	Heater in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
14.	Heater thermostat in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
15.	Overflow bucket in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
16.	Graduated cylinder in good condition	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
17.	Indicated temperature on max / min thermometer					
18.	Survey team's temperature reading					
19.	Max / min thermometer in acceptable limits	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
20.	Does sensor respond to a 20-second mist of water	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
21.	Sensor operates properly, no maintenance needed	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST
21.1.	N-CON Collector Serial Number					
21.2.	Arms and motorbox do not require tighting.	YES	NO	NOT APPLICABLE	MISSING	UNABLE TO TEST

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

22. Comments on N-CON type collector:

23. Describe any alterations to collector by site operator:

24. Other adjustments made to collector by survey team:

25. Follow-up corrections needed for collector:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

ACM Collector Field Form

Station ID:

Network:

	On File Value	Updated Value
1. Does collector cycle under battery power		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
2. Has linear actuator been installed		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
3. Were the correct fuses found		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
4. Were all fuse problems corrected during survey		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
5. Battery capacity - cold crank amps		-39 -69 -99
6. Batteries in good condition		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
7. Order replacement ACM battery		YES NOT APPLICABLE NO
8. Battery pass load test		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
9. Precipitation collector Manufacturer		ACM LODA
10. Heated base in winter		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
11. Heated arms in winter		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
12. Heated lid in winter		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
13. Correct counter weight		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
14. Are boots used for lid arms		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
15. Base not enclosed to ground		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
16. Is collector level		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
17. If collector is not level, was collector leveled		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
18. Is collector stable		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
19. If collector is not stable, was collector stabilized		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
20. Number of tie down springs needed (if required)		-39 -69 -99
21. Is drive rod straight		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
22. Was arm alignment lubricated (NTN and AIRMoN)		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
23. Distance ground to top of bucket - meters		-39 -69 -99
24. Dry side bucket is clean		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
25. Dry side bucket or bag is changed		YES NO NOT APPLICABLE MISSING UNABLE TO TEST
26. Does lid seal properly		YES NO NOT APPLICABLE MISSING UNABLE TO TEST

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

27. Lid liner in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

28. Dry bucket holder height (inches) — -39 -69 -99

29. Wet bucket holder height (inches) — -39 -69 -99

30. Blue clip in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

31. Arm boots in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

32. Chimney cap in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

33. Does collector have a motor box inspection door — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

34. Fan in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

35. Cooling fan thermostat in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

36. Heater in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

37. Heater thermostat in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

38. Has flush wall filter mount been installed — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

39. Filter in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

40. Lab jack in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

41. Overflow bucket in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

42. Graduated cylinder in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

43. Indicated temperature on max / min thermometer (oF) — -39 -69 -99

44. Survey team's temperature reading (oF) — -39 -69 -99

45. Max / min thermometer in acceptable limits — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

46. Is 'as found' caulk around chimney in good condition — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

47. Was chimney recaulked by survey team — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

48. Dry side bag installed correctly — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

49. Correct sensor grid type — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

50. Does sensor respond to a drop of water — YES NO NOT APPLICABLE MISSING UNABLE TO TEST

51. Temperature of sensor inactivated (deg. C) — -39 -69 -99

52. Maximum temperature = <10 minutes (deg. C) — -39 -69 -99

53. Time to Maximum temperature = <10 minutes — -39 -69 -99

54. Sensor operates properly — YES NO UNABLE TO TEST

55. Order replacement ACM sensor — YES NO

56. Voltage of motorbox at E.R. terminal (collector closed) — -39 -69 -99

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

57. Voltage of motorbox at E.R. terminal (collector open) | | -39 | -69 | -99

58. Voltage of raingage E.R. terminal (collector open) | | -39 | -69 | -99

59. Clutch lift 2 raingage weights | YES | NO | NOT APPLICABLE | MISSING | UNABLE TO TEST

60. Motorbox operates within acceptable limits | YES | NO | UNABLE TO TEST

61. Order replacement ACM motorbox | YES | NO

Describe any alterations to collector by site operator:

Other adjustments made to collector by survey team:

Follow-up corrections needed for collector:

Comments on ACM type collector:

Comments on ACM type sensor and motorbox:

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

Siting Criteria Field Form

Station ID

Network:

	On File Value	Updated Value
1. Site Type		URBAN SUBURBAN RURAL ISOLATED SPEICAL RESEARCH
2. Is the orifice of the collector +/- .3 m of raingage (elevation)		YES NO
3. Distance from collector to primary raingage (meters)		
4. Raingage mounting		GROUNDLEVEL PLATFORM BUILDING OTHER
5. Height of raingage (meters)		
6. Raingage ground cover, 30 m radius		NATURAL ARTIFICIAL NATURAL && ARTIFICIAL
7. 45 degree rule met (raingage)		YES NO
8. If raingage mounting is Building, is 30 degree rule met		YES NO N/A
9. 30 degree rule for trees met (raingage)		YES NO
10. 30 degree rule for buildings met (raingage)		YES NO
11. No objects > 1 m height inside 5 m radius (raingage)		YES NO
12. No fences > 1 m height inside 2 m radius (raingage)		YES NO
13. No vegetation height > 0.6 m within 5 m radius (raingage)		YES NO
14. Does NADP require a raingage wind shield at this site		YES NO

Enter -39 in numerical fields for items that are "NOT APPLICABLE"
Enter -69 in numerical fields for "UNABLE TO TEST ITEM"
Enter -99 in numerical fields for items with a "MISSING VALUE"

Indicates item included in Spot Report

	On File Value	Updated Value
15. If raingage wind shield present, is it installed correctly		YES NO N/A
16. Raingage wind shield type		NONE ALTER TYPE OTHER
17. Collector mounting		GROUNDLEVEL PLATFORM BUILDING OTHER
18. Height of collector (meters)		
19. Collector ground cover, 30 m radius		NATURAL ARTIFICIAL NATURAL && ARTIFICIAL
20. Collector and sensor oriented properly		YES NO
21. If collector and sensor are not oriented properly, was orientation corrected		YES NO N/A MISSING UNABLE TO TEST
22. 45 degree rule met (collector)		YES NO
23. If collector mounting is Building, is 30 degree rule met		YES NO N/A MISSING UNABLE TO TEST
24. 30 degree rule for trees met (collector)		YES NO
25. 30 degree rule for buildings met (collector)		YES NO
26. No objects > 1 m height within 5 m radius (collector)		YES NO
27. No fences > 1 m height inside 5 m radius (collector)		YES NO
28. No vegetation height > 0.6 m within 5 m radius (collector)		YES NO
29. No sources of treated lumber inside 5 m radius (collector)		YES NO N/A MISSING UNABLE TO TEST

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	On File Value	Updated Value
30. No galvanized metal inside 5 m radius (MDN collector)		YES NO N/A MISSING UNABLE TO TEST
31. No pastures and agricultural activity within 20 m radius		YES NO N/A MISSING UNABLE TO TEST
32. No herbicides, fertilizers or pesticides used within 20 m radius		YES NO
33. Collector snow roof present		YES NO
34. If collector snow roof present, is it present year round		YES NO N/A
35. Roads meet NADP siting criteria		YES NO
36. Waterways meet NADP siting criteria		YES NO
37. Airports meet NADP siting criteria		YES NO
38. Animal operations meet NADP siting criteria (NTN and AIRMoN only)		YES NO N/A
39. Combustion sources meet NADP siting criteria (MDN only)		YES NO N/A
40. Parking lots and maintenance areas meet NADP siting criteria		YES NO
41. Storage areas (fertilizers, road salt, manure, etc) meet NADP siting criteria		YES NO
42. Metalworking operations meet NADP siting criteria (MDN only)		YES NO N/A
43. GPS site latitude - decimal degrees		
44. GPS site longitude - decimal degrees		
45. GPS site altitude - meters		
46. Indicated GPS accuracy - meters		
47. No significant changes to local site conditions within 500 meters of the collector since previous survey		YES NO

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Indicates item included in Spot Report

	On File Value	Updated Value
Comments on siting criteria including recommendations for improvement:		

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Indicates item included in Spot Report

25. Other environmental monitoring?

26. Specify other environmental monitoring program:

OTHER INFORMATION

27. Survey cancelled due to precipitation? YES NO

28. Precipitation during visit? YES NO

29. Date of rescheduled survey: NOT APPLICABLE

30. Ambient temperature - deg. C

31. Does site report daylight savings time on FORF? YES NO

32. EEMS field team leader: ERIC HEBERT SANDY GRENVILLE SCOTTY DOSSETT

POWER SUPPLY

33. Electrical connections are in good condition YES NO NOT APPLICABLE MISSING UNABLE TO TEST

34. Collector connected to a GFCI circuit YES NO NOT APPLICABLE MISSING UNABLE TO TEST

35. Power supply AC DC AC/DC

36. Solar power YES NO NOT APPLICABLE MISSING UNABLE TO TEST

37. Indicate solar output capacity (Watts): -39 -69 -99

38. Solar panel operating properly, no further maintenance is needed YES NO NOT APPLICABLE MISSING UNABLE TO TEST

OPERATOR TECHNIQUE FOR CHANGING SAMPLES

39. Is sampling media quality maintained YES NO NOT APPLICABLE MISSING UNABLE TO TEST

40. Operator is competent YES NO NOT APPLICABLE MISSING UNABLE TO TEST

41. No CAL/HAL follow-up needed with operator on technique/training YES NO NOT APPLICABLE MISSING UNABLE TO TEST

42. Does operator check sensor heater before and after collector opening? YES NO NOT APPLICABLE MISSING UNABLE TO TEST

43. Is recordkeeping adequate YES NO NOT APPLICABLE MISSING UNABLE TO TEST

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Comments on site information:

Feedback from site operator:

Other attendees names and titles:

Comments on site power:

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