



## Project Summary

# Fourth Progress Report : Quality Assurance Support for the National Atmospheric Deposition and National Trends Network Monitoring Activities 1990-1991

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The full report summarizes the quality assurance activities of the NADP/NTN Quality Assurance Manager in 1990 and 1991. The main report documents the accomplishments of the cooperative agreement and makes recommendations for the future operation of the NADP/NTN network. The report summarizes the progress being made by the NADP/NTN monitoring program in implementing its quality assurance plan. The report discusses the validation of field pH measurements, nuances of utilizing the networks  $PO_4$  measurements, and NADP/NTN siting criteria. Results of a laboratory audit and a compendium of network documentation are also presented. This report was submitted in partial fulfillment of Cooperative Agreement No. CR816954-01 by Colorado State University under the sponsorship of the U.S. Environmental Protection Agency (EPA).

*This Project Summary was prepared by EPA's Atmospheric Research and Exposure Assessment Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).*

### Introduction

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) monitoring network is a cooperative atmospheric deposition monitoring effort of local, state, and federal agencies as well as private industry. The program is structured according to guidelines established in the U.S. Department of

Agriculture's (USDA) Cooperative State Research Service's (CSRS) Manual for Cooperative Regional Research (USDA, 1986) and is administered through a Cooperative Agreement between Colorado State University and the USDA-CSRS. Financial support for the program is provided by the program's cooperators and includes significant contributions from the U.S. Geological Survey (USGS), the USDA-CSRS and the EPA. Other administrative entities contribute to the network in proportion to the number of monitoring sites their agency sponsors.

The network was established in mid-1978 as the National Atmospheric Deposition Program (NADP), a CSRS regional research project. In 1983, the NADP assumed responsibility for managing the day-to-day operations of the National Acid Precipitation Assessment Program's (NAPAP) National Trends Network (NTN). This action resulted in the current combined, cooperative monitoring program that is now known as the NADP/NTN monitoring network. The NADP/NTN monitoring network serves both the National Atmospheric Deposition Program and the National Acid Precipitation Assessment Program, and will become a significant part of the wet deposition component of the Environmental Protection Agency's proposed Clean Air Status and Trends Network (CASTNET) monitoring program.

The NADP/NTN operates a network of approximately 200 sites according to a single set of protocols. The sites are distributed throughout the continental United States and include non-conterminous locations in Alaska, Hawaii, American Samoa, and Puerto Rico. Collocated sampling



is also periodically conducted in Canada with both federal and Provincial monitoring programs. Wet-only deposition samples are collected on a weekly basis at each sampling location according to standard procedures. Chemical analysis and data quality coding are conducted at a single laboratory, the Central Analytical Laboratory (CAL) at the Illinois State Water Survey and a centralized data management facility at Colorado State University makes quality assured network data available to scientists and policy-makers approximately 120 days after samples have been collected. Specialized data summaries are also developed at the Colorado State University, NADP Coordination Office to facilitate the use of network data.

Because the NADP/NTN monitoring program both represents and relies on many different public and private agencies to accomplish its goals, it is unique in its structure and mode of operation. For quality assurance, this has meant that responsibility for the development of quality assurance programs is assumed by each of the organizations who have responsibility for managing specific pieces of the network's operations (e.g., CAL, Coordination Office, USGS, EPA). Procedures are reviewed and accepted by the various NADP committees who have oversight responsibility for each network function. This approach has been successful in bringing considerable expertise together to solve network problems for a very low cost. Considerable additional resources would have been required to bring these attributes into a single organization.

### **Accomplishments**

The Quality Assurance Manager reports network activities semi-annually, at each annual and interim meeting of the NADP Quality Assurance Steering Committee. The reports are written and are distributed as a part of the Committee's minutes. The EPA contract officer for the Quality Assurance Support for the National Atmospheric Deposition Program/National Trends Network Monitoring Program Cooperative Agreement is a permanent member of this committee serving as a formal representative of the Agency. The Quality Assurance Manager serves as the secretary for this committee.

The Quality Assurance Manager participates in NADP Technical and Subcommittee meetings (7 meetings); writing, revising, and reviewing NADP/NTN documentation (2 articles, 1 report, 1 poster, and 2 SOPs produced); reviewing agency reports and proposals that utilize NADP/NTN data or documentation; and disseminating quality assurance information to the various NADP

committees and scientists. In addition, the Quality Assurance Manager serves as the chairman of ASTM D22.06 committee on Acidic Deposition and contributes regularly to the Agency-sponsored Annual Ecological Quality Assurance Workshops. The Manager is also active in the Colorado Ingres Users Association. Each of these activities serves as a vehicle for obtaining and documenting the quality assurance activities of the network and for promoting the evaluation and reporting of quality assurance data.

As a direct result of the Quality Assurance Manager's activities, three articles have been published, one report has been submitted to the Agency and one poster was presented at an NADP Technical Committee Meeting. In addition, the Quality Assurance Manager has prepared or assisted in the preparation of five proposals which support NADP activities. These included proposals for the continuation of this quality assurance support and the renewal of the USDA-CSRS National Research Support Project (NRSF) which is the primary funding mechanism of the NADP/NTN monitoring program.

### **NADP/NTN Quality Assurance Plan Implementation**

In 1990 the network adopted a revised quality assurance plan. This new plan is much more detailed than the previous plan (NADP, 1984) and for the first time attempts to couple specific goals and objectives with specific evaluation criteria. In addition to developing the data management and overall assessment chapters of the Plan, the Quality Assurance Manager was instrumental in editing the final version for publication and for incorporating a revision tracking procedure into the document.

A second accomplishment has been the development of a major computer software application that allows data users to evaluate the quality of individual monitoring stations in the context of the goals and objectives set forth in the revised quality assurance plan. This application is the first of a planned series of applications that capitalize upon the centralized quality assurance data that has been incorporated into the network's routine data management activities. The application, known as the Station Quality Assurance Report, provides NADP managers, site personnel, and data users with a report of an individual station's data completeness, representativeness, precision, bias, and temporal comparability for its period of record.

## **Review and Evaluation of NADP/NTN Network Operations**

### **Audit of the Central Analytical Laboratory**

A formal audit of the Central Analytical Laboratory (CAL) was conducted July 10-12, 1990. Significant in this audit was the inclusion of two non-NADP affiliated team members. In previous audits (the last one was in 1986), the audit teams were comprised solely of NADP Network Operations and Data Management and Analysis subcommittee members.

Briefly, no major deficiencies were noted, and progress on previously identified concerns was evident. The CAL staff was noted as continuing to provide the network with high quality analytical and program management services.

### **Informal Review of the Site Visitation Program**

An informal review of the Agency-sponsored Site Visitation Program was conducted jointly by members of the Coordination Office staff and the Research Triangle Institute (RTI) site visitation project personnel February 26-27, 1990. The review provided an opportunity to evaluate the previous round of site visits (round 2) and to discuss ways of improving the quality and timeliness of information gathered in conjunction with the site visitation program.

Other topics discussed included the redefinition of some data entry items passed between the groups, the electronic passing of information, and the feedback mechanisms for all persons involved with the project. As a part of these discussions, the Quality Assurance Manager presented examples of how the site visitation program information was being used by the network and other scientists to evaluate the quality of each site's location and performance.

### **Validation of Field pH Measurements**

Field pH measurements made by the network continue to generate controversy. This is in part due to the increased scrutiny the measurements are receiving since the network began distributing preliminary, semi-validated values to the U.S. Geological Survey for inclusion in their monthly publication, *National Water Conditions*. Efforts to improve the quality of these measurements have included the implementation of a remedial action plan for mediating poor performance in external quality assurance programs and the development of a validation procedure for

including the values in seasonal data summaries.

The external quality assurance, Intersite Comparison Program was expanded to include follow-up letters and site liaison intervention when results of the semi-annual audits were out of compliance with network goals. Previously, out-of-compliance pH measurements were simply noted. With the new procedures, reasons for poor performance can more readily be identified so that corrective action can be initiated by the NADP Coordination Office or the USGS.

Field pH values have not received the same level of validation as laboratory values in network quality assurance procedures. This practice had been previously accepted because of the lack of confidence among network scientists in controlling and documenting measurement quality across all of the network's monitoring stations. However, it has been demonstrated that field measurements could be evaluated confidently utilizing existing NADP/NTN quality assurance information.

## Troubleshooting the Weaknesses and Future Needs of the NADP/NTN Monitoring Network

### *PO<sub>4</sub> Measurement and Reporting Practices*

The Quality Assurance Manager began investigating the network's PO<sub>4</sub> measurement and reporting practices in response to a data user's request for quality assurance documentation for this ion. Results of this investigation were reported to the Network Operations Subcommittee in the spring of 1990 and led to the formation of an *ad hoc* task group to further review the network's policy regarding the measurement and quality assurance reporting of this ion. Perhaps the most interesting observation of the investigation was a marked increase in the number of above detection limit values reported by the network, beginning in 1985. Discussions among task group and committee members have reaffirmed the network's measurement practices but identified weaknesses within the network's reporting practices for the ion.

The task group noted that a more complete reporting of PO<sub>4</sub> should be included in laboratory quality assurance reports, and that current QA reporting practices may be inadequate to meet the needs of many data users. These problems have been overly exacerbated, however, by the lack of an adequate quality caveat explaining the nuances of the NADP/NTN PO<sub>4</sub> data, and by the impartial reporting practices of the network. The following

pieces of information were deemed critical to the correct interpretation of the network's PO<sub>4</sub> data:

1. more than 95% of the PO<sub>4</sub> values reported by the network are below the detection limit of the methodology used (currently 20 µg/L),
2. the precision of the PO<sub>4</sub> values at the detection limit can be expected to be no more than ± 100%,
3. the analytical method's detection limit has been raised three times over the course of the program to reduce costs (3, 9, and 20 µg/L) and the methodology itself has changed from colorimetry to ion chromatography,
4. the prevailing opinion of network scientists is that the usefulness of the PO<sub>4</sub> measurements, even at the earlier detection limit of 3 µg/L, appears to be questionable except for documenting organic contamination, and
5. none of the methods used by the network account for total phosphorus nor do they appear to offer adequate sensitivity in the range of concentrations that would be useful for studying loadings to aquatic systems.

Based upon discussions with a number of scientists on the importance of atmospheric phosphorus measurements, it would appear that there is some interest in obtaining more precise total phosphorus measurements in atmospheric deposition. This interest, however, does not at this time support a change in NADP/NTN network PO<sub>4</sub> methodology. Trends in NADP/NTN PO<sub>4</sub>, though apparent even when detection limits and methodology changes are taken into account, are well within the noise of the measurement process. Current network funding would also not support the implementation of a more precise measurement methodology.

### *Review of NADP/NTN Siting Guidelines*

As a part of a Network Operations Subcommittee initiative, the Quality Assurance Manager reviewed NADP/NTN siting guidelines to consider what changes would be necessary to include monitoring locations that are currently outside of the scope of the NADP/NTN program. These locations might include urban sites, coastal sites (which are almost exclusively near urban sources) and other potentially non-regionally representative sites designed to characterize a sub-regional ecologically or politically important area (e.g., watershed, National Park, etc.). The review pointed out two basic obstacles to expanding the scope of the current siting guidelines, i.e.,

emissions are currently the only regional discriminator recognized in the guidelines, and the guidelines are designed to exclude rather than include sites. Regional guidelines will be especially difficult to develop under an increased scope if they continue to be exclusionary, since many of the guidelines will very likely be mutually exclusive of one other.

### *Equipment Refurbishing/Replacement*

The Quality Assurance Manager participated in three discussions of preventive maintenance/service issues as a part of his NADP subcommittee activities. These included the refurbishing and replacement of rain gages and Aerochem Metrics wet/dry collector parts; the availability of replacement electrodes for field site pH measurements; and the quality of the sampling buckets that are resupplied to sites. The discussions pointed out that while the network has a set of procedures in place that helps to mitigate these problems, it has not adequately addressed the question of the useful life or recall of its primary sampling equipment nor has it adequately resolved its dependency upon a limited number of critical suppliers.

### *Data Management Improvements*

Data Management activities continue to take an ever increasing amount of the Quality Assurance Manager's time. This stems from both the lack of a separate data management quality assurance position in the NADP Coordination Office (as there is with field and laboratory operations) and from the increased amount of QA data now available through the program. Numerous hardware and software enhancements to the basic computer systems used by the NADP/NTN Coordination Office have required additional software scrutiny, and more network quality assurance data is becoming available via electronic media. Both have begun to require significant software maintenance. Application development is also being done by the quality assurance manager as there are no other programming resources available to the Quality Assurance Manager under the current funding limitations.

Over the past reporting period the software of the operating system and data base management systems of the NADP/NTN Coordination Office were upgraded. Spatial analysis software front-ends were rewritten to make these utilities more accessible to project staff, and remedial action tables were upgraded with more fields per record and improved user interfaces. Upgrades of quality assurance data struc-

tures and interfaces are handled by the Quality Assurance Manager. Other system enhancements are tested by the Quality Assurance Manager.

### **Centralized Documentation and Quality Assurance Reporting**

The Quality Assurance Manager's Office continues to serve as a repository for NADP/NTN Monitoring Network documentation. Both internal and external quality assurance information is now received and evaluated on a routine basis. Results of laboratory programs are reported annually by both the Central Analytical Laboratory and by the U.S. Geological Survey. Field operation and data management reporting is more informal, but most information is readily available via the on-line data base management system at the NADP/NTN Coordination Office. Applications continue to be developed (such as the Station Quality Assurance Report) which will allow for the annual reporting of these aspects of the program.

### **Recommendations**

- Staffing levels should be increased to allow for additional support staff to accelerate the rate at which network quality assurance issues can be resolved and to complete already identified quality assurance reporting requirements.
- The QA manager should continue to evaluate, document, and support network data quality and network procedures by preparing and publishing integrated quality assurance reports. These reports should be inclusive of all years of operation through current time.
- Increased support should be made available to expand and accelerate the gathering and data banking of both external and internal quality assurance data that relate directly to the NADP/NTN data set.
- Increased support should be made available to accelerate the development of new quality assurance application software to address additional data quality objectives contained in the NADP/NTN Quality Assurance Plan.
- The Quality Assurance Manager's participation in auditing, document reviews, and scientific meetings and organizations should continue to be supported. These are important windows through which the Quality Assurance Manager can assess the network's operations.
- The Quality Assurance Manager should become more involved with quality assurance planning and coordination of the Agency-sponsored CASTNET program to increase the usefulness of quality assurance information that will be made available to the CASTNET program.

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*Robert L. Lampe is the EPA Project Officer (see below).*

*The complete report, entitled "Fourth Progress Report : Quality Assurance Support for the National Atmospheric Deposition and National Trends Network Monitoring Activities 1990-1991," (Order No. PB92-194000/AS; Cost: \$26.00; subject to change) will be available only from:*

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