Draft Proposal NRSP-003
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Project Title: National Research Support Project 003 - The National Atmospheric Deposition Program (NADP)

Requested Duration: October 1, 2019 to September 30, 2024 (FY20-FY24)

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This proposal seeks renewal of National Research Support Project 003 (NRSP-3) - The National Atmospheric Deposition Program (NADP) for fiscal periods FY15 through FY19 with annual off-the-top support of $50,000.

Section 1. Statement of Issues and Justification

Subsection 2.1. How is the NRSP consistent with the mission? (8,000 characters)

The mission of NRSP-3 (NADP) is to provide quality-assured data and information in support of research on the exposure of managed and natural ecosystems and cultural resources to acidic compounds, nutrients, mercury, and base cations in atmospheric deposition while seeking improvement to its measurement systems and the addition of other chemical and biological species.

NRSP-3 provides a collaborative framework for participating scientists from State Agricultural Experiment Stations (SAES); universities; federal, state, local, and tribal government agencies; national forests and laboratories; environmental institutes; private companies; and other research organizations to cooperate in sponsoring NADP measurement networks. The NADP provides the only regional and national-scale data and information on the amounts, geographic distribution, and trends in chemical deposition by precipitation in North America. The NRSP-3 has demonstrated flexibility and response to the current and future needs of the research community for information on the effects of atmospheric deposition on terrestrial and aquatic ecosystems, biogeochemical cycling, climate change, and human health. NRSP-3 data support informed decisions on air quality issues related to precipitation chemistry and atmospheric deposition. Such information has been invaluable in:

- Documenting the presence and removal of inorganic pollutant gases and aerosols in the atmosphere (i.e., the United States' "chemical climate");
- Documenting how atmospheric chemicals are changing in amount and composition over time;

- Understanding the effects of atmospherically deposited chemicals on agricultural crops, forests, rangelands, surface and ground waters, estuaries, aquatic impoundments, and other natural resources;
- Assessing the accelerated weathering of material and cultural resources resulting from atmospheric chemical deposition;
- Discerning pollutant sources and source distributions and their relationships to deposition (i.e., source-receptor relationships); and
- Evaluating the effectiveness of current Clean Air Act (CAA) legislation and subsequent rules promulgated under the Act, and the impact of atmospheric deposition on water quality requirements set by the Clean Water Act.

Subsection 2.2. How does this NRSP pertain as a national issue? (10,000 characters)

Since its founding as NC-141 in October 1977 by the SAES North Central Region, NRSP-3 has offered a unique opportunity for cooperation among scientists from land-grant and other universities, government agencies, and non-governmental organizations. It provides a framework for leveraging the resources of over 100 different sponsoring agencies to address contemporary and emerging issues of national importance. Figure 1 shows the locations of the 48 NADP sites either sponsored or operated by Agricultural Experiment Stations or located on Agricultural or Forestry Experiment Station properties. Sites are located in all four SAES Regions, with 55% having 30+ year operating records, representing the longest-running record of precipitation chemistry in the world.

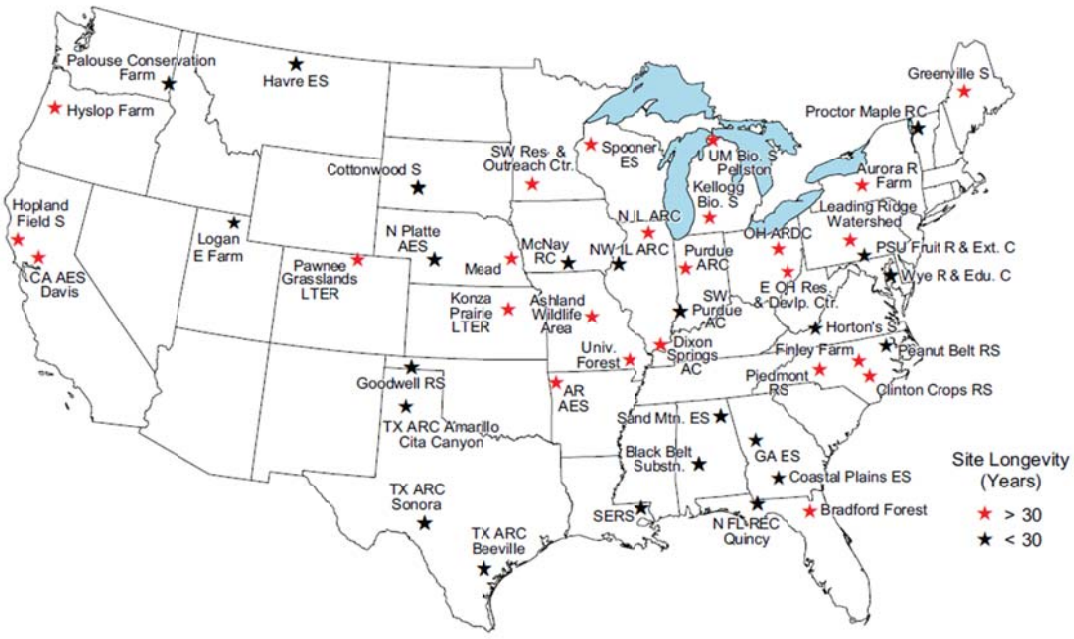

Figure 1. NADP sites currently sponsored and operated by Agricultural Experiment Stations or located on Agricultural or Forestry Experiment Station properties (as of 12/1/2018).

This section provides a historical record of NRSP-3 and its continued evolution over time, demonstrating its continued national and international relevance. In October 1977, the SAES North Central Region established NC-141 to address “Chemical Changes in Atmospheric Deposition and Effects on Agricultural and Forested Land and Surface Waters in the United States” (1). Objectives of this project were to a) “establish an atmospheric deposition network for measuring beneficial nutrients and potentially injurious substances in precipitation and dry particulate matter” and to b) “organize and coordinate research on atmospheric deposition effects.”

The NC-141 initiated the collection of one-week integrated wet-only deposition in 1978, and by 1979 sites represented all four SAES regions. Organizing the efforts were SAES scientists, federal and state agencies, universities, non-governmental organizations, and Canada. Justification for NC-141 was the increasing recognition of the potential for human activities to affect atmospheric chemistry and in turn the nutrient status of terrestrial and aquatic systems. Studies in Europe in the mid-1960s had documented the acidification of the atmosphere (2), and similar adverse effects were expected in the U.S. (3). Formation of the NC-141/NADP was in response to the call by a National Academy of Sciences panel to establish a U.S. network for measuring the spatial extent and intensity of acidic precipitation (4).

By 1982, the NADP had grown to 110 sites. Measurements revealed the spatial extent, intensity, and frequency of acidic precipitation, as well as the relationships between free acidity and its root causes, namely un-neutralized sulfate and nitrate species largely originating from fossil fuel combustion. SAES Directors in all four regions approved Interregional Project 7 (IR-7, 1982-1987), extending the project nationwide.

In 1980, a 10-year program entitled the National Acid Precipitation Assessment Program (NAPAP) was launched “to identify the sources, causes, and processes involved in acid precipitation and to evaluate the effects of acid precipitation” (5). A principal goal was to establish a long-term acid deposition monitoring network (the National Trends Network, NTN), later merged with the existing NADP under IR-7 as NADP/NTN. Eight federal agencies, led by the USGS, supported growth of the NADP/NTN to 203 sites by 1987. New sites were added to represent regional ecological properties (6) and lead one panel to conclude: “The monitoring program and resultant data that is being constructed is perhaps the most significant, long-term, continuous, and comprehensive sampling and analysis program to be undertaken in the environmental sciences” (7).

SAES Directors renewed IR-7 through 1992 and IR-7 scientists participated in NAPAP-funded studies of acidic deposition and its effects on crops, forests, soils, and surface waters. An overarching conclusion of NAPAP research was that chronic chemical loading from atmospheric deposition can result in long-term changes, finding:

- acidic sulfate and nitrate decreased at more than 75 % of NADP sites (1979 to 1987) (8);
- there is no evidence to show that acidic precipitation at ambient U.S. levels is responsible for regional crop yield reductions (9);
- ambient deposition in high-elevation eastern-U.S. forests is thought to alter nutrient status leading to growth reduction, frost intolerance, or decline of these ecosystems (9);
- acidic deposition is expected to cause long-term chemical changes in some soils (9);

- atmospheric sulfate deposition results in some poorly buffered surface waters becoming more toxic (10); and
- acidic deposition increases the corrosion of metals and alloys (11).

During the early 1990s the SAES Directors changed the governance and identified a new class of projects called national research support projects (NRSPs), designed to support, rather than conduct, research. Specifically NRSP's were to collect data that researchers could use to study issues of national significance. The SAES Directors recognized NADP as consistent with the mission of NRSPs, and approved the project as NRSP-3 for the period 1992-1997. SAES support for NADP has continued uninterrupted through 2018.

NRSP-3 expanded in 1995 with the addition of the Atmospheric Integrated Research Monitoring Network (AIRMoN), primarily sponsored by NOAA. AIRMoN measurements are similar NTN, but are on a daily time scale, providing greater resolution for the validation of atmospheric models.

The NADP's Technical Committee approved the Mercury Deposition Network (MDN) in 1996 to address concerns of mercury in precipitation. Research suggested that mercury had entered many of the affected lakes and streams with wet deposition (13). A 13-site pilot network has grown to approximately 100 MDN sites as of 12/2018. Funding support for MDN is predominately from state, local, and tribal governments. The MDN (and its complimentary Atmospheric Mercury Network, AMNet) provide data to quantify ambient mercury, now identified as a health concern in every U.S. state and in many countries.

The AMNet was formed in 2009 to measure continuous gaseous ambient mercury concentrations and their speciation (e.g., elemental, particulate, and oxidized). Such information is crucial for quantifying the total deposition of mercury (wet plus dry deposition) to ecosystems. The AMNet data set allows for source-receptor modeling and assessment of short-term temporal trends. Integrating the MDN and AMNet data sets provides a better understanding of the entire atmospheric mercury cycle. Such information is crucial for understanding mercury inputs to agriculture (ag.) systems (e.g., forests, crops, aquaculture), sensitive ecosystems, and the human food chain.

The Ammonia Monitoring Network (AMoN) was established in 2007 as a special study to measure ambient gaseous ammonia concentrations which are emitted primarily from agricultural sources (e.g., crop fertilization and animal operations). Data from AMoN are useful to agricultural scientists to better understand the emission and impact and dry deposition of ammonia. The AMoN represents the first consistent, long-term regional/national measurements of gaseous ammonia. Should regulations be promulgated to address ammonia emissions from agricultural operations, AMoN measurements will provide a baseline for evaluating subsequent reductions. In recent years, ammonia wet and dry deposition is becoming an important area of research, especially, as some network locations have shown increased deposition values over time.

The long-term high quality measurements provided by NRSP-3 have addressed national needs to evaluate atmospheric deposition trends and the effectiveness of mandated pollutant emissions reductions. The Clean Air Act Amendments of 1990 (CAAA-90) sought "to reduce the adverse effects of acid deposition through reductions in annual emissions of sulfur dioxide (SO_2) and

nitrogen oxides (NO_x)." The Act required monitoring and reporting the effect of these emissions reductions on deposition (12). NTN measurements provided the only basis for evaluating regional scale trends in the sulfate ($SO_4^=$)wet deposition, and as early as 1996 NRSP-3 scientists were able to report that large SO_2 emission reductions had decreased sulfate deposition by as much as 25% in portions of the East (14). These trends have been consistent over time and space (15, 16).

Trends in nitrogen species have not demonstrated the same consistency as sulfate wet deposition. Although nitrate (NO_3^-) concentrations have decreased in Mid-Atlantic and New England states since the mid-1980s, significant increases have occurred in Great Plains and Rocky Mountain states (17-20). Increases in ammonium (NH_4^+) ion over the same period have been nearly as widespread as sulfate decreases (18). These trends are illustrated in NADP year-to-year map animations, available online at http://nadp.slh.wisc.edu/data/animaps.aspx). The increases in nitrate and ammonium, especially in the West, were unexpected. These ammonia trends have continued (20, 21), emphasizing the importance of ag. participation in national-level studies with the predominant source of ammonia originating from agricultural sources.

Below is a brief summary of other contributions of NRSP-3 to the scientific community, demonstrating ongoing national relevance.

- Studies have connected atmospheric nitrogen (N) deposition, primarily from nitrate and ammonium, to estuarine eutrophication and related low dissolved oxygen concentrations and losses of aquatic vegetation (22, 23). Other studies have reported alterations of species richness and diversity of soil flora (24). Increasing N deposition trends in the West have heightened concerns over the potential effects of nutrient additions in alpine and subalpine areas in the Rockies and Cascades (21). Nationally from 1985 to 2012, total wet N deposition did not significantly change, however changes in components (nitrate and ammonium) and regional patterns showed significance changes, in particular, strong increases in ammonium deposition in the Midwest and South were observed (60).

- *Phakopsora pachyrhizi*, commonly called Asian Soybean Rust (ASR, or Soybean Rust, SBR), was first reported in the continental U.S. in November 2004. ASR is an obligate fungal parasite thought to rely on a living host (e.g., legumes such as soybean) for survival (25). ASR spreads through aerial dispersal and deposition of urediniospores, which can be transported hundreds of kilometers before being deposited by precipitation. Under the right conditions, deposited spores can germinate and spread the infection (26). With supplemental support from the Agricultural Research Service (ARS), NADP staff collected and prepared filters containing rain sample residue from eastern U.S. NTN samples over 5 years through 2010 (nadp.slh.wisc.edu/educ/asr/). The filters were sent to the ARS Cereal Disease Laboratory, where they were tested for ASR using Polymerase chain reaction (PCR). Results of these samples have been documented in many studies (26-29) and on the USDA Soybean Rust site (http://sbr.ipmpipe.org/cgi-bin/sbr/public.cgi, see 2007 spore deposition). These studies demonstrate the application of this NRSP in tracking ASR spores to the Midwest (30), and the potential for using NADP to assist in tracking many different airborne pathogens in U.S. agricultural crops.

● NRSP-3 demonstrated its flexibility in responding to new issues following the Fukushima nuclear disaster in March, 2011. The NADP and USGS assessed the wet deposition of radionuclides in NTN and MDN samples to provide information on the geographic extent of radioactive fallout from the incident. Such information was crucial to assess the potential impact on the ag. and human food chains (31, 32).

● NRSP-3 published the "2015 Summary of Critical Load Maps" developed by the CLAD science committee. This report summarized critical loads across the US, describing air pollution impacts on natural systems, specifically surface water and forest ecosystems.

Section 2. Rationale:

Subsection 2.1. Priority Established by ESCOP/ESS (8000 characters)

This section summarizes how NRSP-3 supports objectives in five of the Grand Challenges listed in "A Science Roadmap for Food and Ag. – 2010" (http://escop.ncsu.edu/docs/scienceroadmap.pdf).

Challenge I: We must enhance the sustainability, competitiveness, and profitability of U. S. food and agricultural systems.

The NADP networks support this challenge by measuring the deposition flux of three major agricultural compounds of interest: nitrogen (N), phosphorous (P), and sulfur (S). NADP provides research support by:

- measuring precipitation quality and quantity as it enters an ag. system;
- providing data for fertilizer balance studies (N, P, and S) to crops, soils and water sources;
- providing data for the chemical balance of soils and crops;
- measuring the impact of compounds emitted from ag. systems to deposition in other regions; and
- providing data for energy and fertilizer efficiency studies of agricultural systems by allowing for full mass balance calculations that include atmospheric flux.

Specific examples which also support this challenge include:

- Success in detecting ASR in precipitation samples by demonstrating aerial dispersal and deposition of plant pathogens and the spread of disease. The NADP's combined wet deposition networks represent more than 300 individual sites across the U.S. and select stations in Canada. Sites in Puerto Rico and the Virgin Islands stand as sentinels for detecting pathogens borne in trans-oceanic dust plumes from Africa or South America. Measurements at continental U.S. sites could be used to monitor the seasonal re-entry of pathogens from winter refugia or the spread of diseases to new areas. (See publications 27-29 for recent examples of reports using NADP measurements.) Measurements of plant

pathogens in NADP samples provide a decision-support system for risk-based farm management, informing cropping practices and pesticide application.

- Recent studies have estimated that mercury emissions from fires may represent ~30% of the EPA's national mercury emissions inventory. Emissions from forests dominate agricultural fires on an annual basis, representing one of the largest sources of mercury to the atmosphere (33). Much of the mercury released during fires results from volatilization of legacy mercury held in the organic soil layer. Emissions are highly variable, depending on the temperature and mercury content of these soils. Airborne mercury measurements from the AMNet will help researchers identify mercury from smoke plumes and evaluate mercury emissions and emission factors from fires. These data provide a decision-support system for risk-based management of forests, informing prescribed-burning practices.

- Ammonia has been identified as a priority national research need in the agricultural air quality community (34). Ammonia is a nutrient, and atmospheric deposition of ammonia and ammonium to ecosystems can alter the structure and diversity of native plant communities and contribute to acidification (35). Domestic animals, fertilizers, and crops are important sources of atmospheric ammonia. Their source strength depends on a matrix of physical, chemical, and biological factors; consequently, ammonia emissions are highly variable and have large uncertainties. This has led to a call for a National Air Emissions Monitoring Study to quantify agricultural emissions through mechanistic process-based modeling (36), (http://cobweb.ecn.purdue.edu/~odor/NAEMS/). The NTN and AMoN provide critical data to assess the overall effectiveness of innovative technologies for reducing the impact of agriculture operations on the environment.

Challenge II We must adapt to and mitigate the impacts of climate change on food, feed, fiber and fuel systems in the U.S.

The NADP networks directly measure climate variables, including precipitation amount and intensity, and the chemical climatology of the atmosphere. This quantifies climate change and chemical deposition fluxes to ag. systems. Specifically, NADP:

- measures trends and chemical changes in precipitation, which respond to changes in temperature (affecting atmospheric chemical reactions) and precipitation patterns;
- monitors the deposition of carbonates, which respond to carbon dioxide increases in the atmosphere;
- assesses the impact of ag. operations on physical environment as changes in chemical use (e.g., ammonia, nitrate) impact mass deposition flux in precipitation;
- provides crucial baseline data for agricultural modelers evaluating changes to agriculture in response to a changing climate;
- supports understanding of atmospheric processing chemistry and its impact on climate systems, and
- provides data for adaption strategies (e.g., water and nitrogen needs) in response to climate variation.

Challenge III We must support energy security and the development of the bio-economy from renewable natural resources in the U.S.

The NADP networks measure the chemical climatology of the atmosphere, which impacts the growth of corn and other energy crops. The NADP supports energy security and bio-economy development by:

- quantifying fertilizing chemical components (e.g., N, S, and P)
- identifying infectious agents (e.g., SBR) in precipitation, and measure vector movement to energy crops;
- providing data for the determination of chemical emissions from energy crop farms and energy technology installations (through fertilization efficiency);
- providing data for model studies designed to maximize efficiency in new crop growth strategies;
- measuring chemical inputs that limit or enhance biofuel crop yields; and,
- measuring the input of nutrients to forests, and the input of acids which impact forest lands, soil quality, aquaculture systems, and fish productivity.

Challenge IV We must play a global leadership role to ensure a safe, secure and abundant food supply for the U.S. and the world.

The NADP networks measure the flux of chemical compounds to ag. systems. By knowing what is flowing into these systems, ag. scientists can ensure the safety and maximize the abundance of American ag. production. Specifically, NADP:

- provides precipitation chemistry data to enhance prediction for crop yield, energy efficiency, and the chemical needs of crops;

- provides an organized, centrally-managed standing monitoring program that has demonstrated its flexibility in tracking multiple food safety hazards, pathogens, invasive species, chemical and physical contaminants including national threats (37) such as ASR (27-29); radioactive fallout (31, 32); and other species.

- can be used effectively for the tracking of ag. emissions, leading to improved efficiency of agricultural inputs and reduced emissions.

- In 1996 when MDN was established, 39 states had advisories warning people to limit consumption of fish taken from certain water bodies because of mercury contamination. Today, essentially all states and coastal regions (www.epa.gov/ost/fish). State and federal agencies have issued these advisories because of high levels of methyl-mercury in fish tissue, and research has shown the leading source of mercury entering many of the affected lakes and streams is precipitation (13). MDN data quantify direct mercury inputs to surface water bodies, including fish farms. Combined with AMNet, NADP quantifies

total mercury deposition. The NADP dataset has become an invaluable resource for developing regional and national models and trends studies for changes over time (24, 38-40). Continued measurements will support assessments of mercury emissions reductions, and give insight to changing emission control policies.

- Actively contributes to the global research community through dissemination of network methodology expertise, data interpretation, and impact assessment tools.

- The NADP measured nuclear fallout after the 1986 Chernobyl (37) and 2011 Fukushima radioactive releases (31, 32). This same system can readily respond to future threats to the ag. system of the US.

These results demonstrate NRSP-3 support of research to mitigate losses from invasive (plant pathogen) species and contamination of the human food chain. With nearly 40 years of experience, geographically dispersed monitoring stations, a centrally-organized communications network, and a management infrastructure, the NRSP-3/NADP stands ready to help, if called on to assist in homeland security efforts.

Challenge VI We must heighten environmental stewardship through the development of sustainable management practices.

The NADP networks track regional movement of chemical species into and out of agricultural farms and installations; measure the atmospheric transport of chemicals in crop-growing regions, and provide data for crop studies, soils, and other research. Specific measurements include:

- Quantifying the water cycle (both quality and quantity) through the NADP wet deposition networks;
- Measuring fluxes of chemical compounds to ag. systems and soils;
- Evaluating threats of other agents, including parasites, ag. diseases, etc.;
- Evaluating the interaction between agricultural production practices, their regional and global environmental impact, and support of science-based policy decisions; and
- Measurement of nitrogen deposition, complemented by AMoN's ambient gas-phase ammonia measurements. Such data provide quantification of agricultural ammonia emissions, evaluation of emissions reductions practices in farm fields (e.g., cropping systems, fertilizer applications) and facilities (animal feeding operations, waste management), and estimation of total ammonia/ammonium deposition.
- Through better understating of deposition inputs, informed decisions can be made on agricultural nutrient management and its impact on the environment, economy, and society.

Subsection 2.2: Relevance to stakeholders: (8,000 characters)

NRSP-3 provides a collaborative environment to leverage the fiscal, material, human, and intellectual resources of scientists, educators, and policy-makers from SAES, universities, government agencies, and non-governmental organizations. Stakeholders include:

- sponsors that pay for NADP site costs, site operations, and/or other program activities;

- site operators contributing efforts in sample collection;
- cooperators that provide land access, electricity, laboratory/office space, and/or shipping;
- scientists who use and present NADP data;
- educators who use NADP data in their classrooms or textbooks; and
- students who use NADP data in the classroom, science fair projects, or graduate studies.
- policy makers who use NADP data and information products to make informed decisions on agricultural planning and policy

All program stakeholders are invited to attend twice yearly committee/subcommittee meetings in the spring and fall, typically representing 50 to 75 individuals. Subcommittees receive status and progress reports on network activities, review network operations and documents, consider procedures and equipment changes, propose actions to correct deficiencies and improve operations, and propose and review initiatives for new measurements. The NADP *Quality Management Plan* calls for triennial reviews of each network laboratory and NADP management procedures. Review team members are drawn from subcommittee membership. Other committee roles are discussed in "Management, Budget, and Business Plan."

The Executive Committee seeks to engage stakeholders in NADP activities. Recent interest has led to investigation of critical loads to inform policy (41). Recognizing this need, the Critical Loads AD hoc (CLAD) committee was formed in 2006. This committee has become a full NADP science committee with over 120 members. In 2015 the CLAD published a summary of critical load maps for the US.

In 2011, the Total Deposition Committee (TDEP) was formed to focus on new methods to estimate dry deposition of components (i.e. measurements from AMON and AMNet), integrate these with wet deposition measurements to assess new methods to measure total (wet + dry) deposition. In early 2019, the TDEP plans to publish a comprehensive N deposition white paper on the NADP website.

Stakeholders in the research community include those using archived NADP samples and subsamples to augment routine analyses. Researchers are encouraged to submit simple proposals to NADP for review and support. Researchers are encouraged to attend NADP meetings and present their findings. This has sparked new discussion topics, new research, and potential new NADP measurements. Recent research studies include:

- applying O^{18} and H^{2} measurements to examine the relationship between precipitation and surface and ground water sources (42-44);
- using N^{15} measurements to infer atmospheric NO_x sources (45);
- testing for the presence of potentially hazardous chemicals (31, 32, 46-47);
- investigating organic nitrogen inputs to total deposition; and
- measuring dissolved Si to understand loads to surface waters in the Midwest.

Stakeholder use of NADP data is assessed by recording website activity, requesting program participants to report their activities annually, and performing regular literature searches. This information is summarized annually in SAES-422 reports, Current Research Information System AD-421 reports, and other federal agency reports. Internet disbursement of precipitation chemistry and atmospheric data is the primary route of dissemination for the NADP project.

During the 2018 year, NADP estimated 23,000 comma-delineated data sets were downloaded, including 14,000 from the NTN database. In addition, approximately 57,000 PDF map images and 100,000 map data sets (grid and kmz) were downloaded.

Each year, NADP summarizes research that develops in whole or in part from NADP data. This is done by requesting copies of journal articles and reports from all participants, and by searching digital repositories. During 2018, the NADP's information and data were used in over 208 publications. Publications are compiled on the NADP website (nadp.slh.wisc.edu/lib/bibliography.aspx). These reports are detailed in SAES 422 annual reports.

NADP data are frequently used to inform and evaluate environmental policies and agreements. NADP maps are utilized in materials prepared by the EPA, including nitrogen deposition maps (e.g., http://www.epa.gov/air/clearskies/benefits.html). NADP wet deposition values are compiled in map form to estimate total deposition of S and N at the EPA's CASTNET site (http://epa.gov/castnet/javaweb/totaldep.html). In its evaluations of CAAA-90, the EPA Clean Air Markets Division utilized NADP data in its annual reports (48). Similarly, NAPAP reports to Congress used NADP data in assessing the effects of emissions changes on deposition and deposition changes on aquatic and terrestrial systems (49). The International Joint Commission uses NADP data in its periodic evaluations of the U.S.-Canada Air Quality Agreement (50) and the Canadian government in its independent evaluation of the agreement and acidic deposition assessments (51). Additional regional and state policy assessments, environmental impact statements, and numerous other reports utilizing NADP data are detailed in annual NADP reference lists.

Each year, articles with particular ag. impacts are detailed in the NADP's SAES 422 report. Here is a short synopsis of 3 articles from 2018:

Asao, S., Parton, W. J., Chen, M., & Gao, W., 2018. Photodegradation accelerates ecosystem N cycling in a simulated California grassland. Ecosphere, 9(8), e02370 (57)

The authors used NADP nitrogen deposition data to support the model of litter decay in arid grasslands. The photodegradation in the DayCent-UV model accelerated was shown to decrease C and N cycling and residence times. The acceleration made a greater fraction of system N available for plants, increasing net N mineralization and plant production.

Averill, C., Dietze, M. C., & Bhatnagar, J. M., 2018. Continental-scale nitrogen pollution is shifting forest mycorrhizal associations and soil carbon stocks. Global change biology, 24(10), 4544-4553. (58)

The authors combined nitrogen deposition data with continental-scale US forest data, and showed nitrogen pollution is spatially associated with a decline in ectomycorrhizal vs. arbuscular mycorrhizal trees. The results imply changes in nitrogen deposition may alter the capacity of forests to sequester carbon and offset climate change.

Horn, K. J., Thomas, R. Q., Clark, C. M., Pardo, L. H., Fenn, M. E., Lawrence, G. B., ... & Nordin, A., 2018. Growth and survival relationships of 71 tree species with nitrogen and sulfur deposition across the conterminous US. PloS one, 13(10), e0205296. (59)

The authors apply reported TDEP data to analyze how tree growth and survival for 71 species vary with N and S deposition across the conterminous U.S. The study reveals that the growth and/or survival of the vast majority of species in the analysis were significantly affected by atmospheric deposition. The study's findings can help ecosystem management and policy makers to understand deposition impacts to temperate forests and suggest that N and S deposition have likely altered forest demographics in the U.S.

Special Relevance to SAES Participation Of special note is the particularly important role that SAES and off-the-top funding plays in NADP. The SAES funding provides three very important advantages: (1) it enhances the ability of the SAES to address pressing needs of agriculture, (2) it controls NADP site loss due to lower costs for SAES participation, and (3) SAES funding is heavily leveraged by allowing participation of other federal and state agencies. More specifically:

1. Addressing Pressing Needs of Agriculture. The NADP is addressing highly relevant issues related to nitrogen, ammonia, transport of plant pathogens, and provides a scientific forum for communication about ag. research. At many locations we have a 40-year record of this deposition, and these show trends at many sites (decreasing $SO_4^=$, regional increasing and decreasing NO_3^- and increasing NH_4^+).

2. SAES Monitoring Site Losses. All NADP sites pay a management fee for operations. The SAES funding pays some of this fee for the SAES sites. The remaining costs are borne by the individual SAES. With a loss of NRSP status, the operational costs at all sites would increase significantly and many sites located in the agricultural production areas could shut down. This loss would greatly affect the ability to follow national trends in deposition since many of these SAES sites are the oldest sites in the network: 10 sites have precipitation chemistry records originating in 1978.

3. Federal and State Leveraging. The continued active status of NRSP-3 allows funding contributions from many federal agencies, totaling $1.2 million dollars annually, to flow through the NIFA to the UW-Madison and NADP by cooperative agreement.

Section 3. Implementation

Subsection 3.1. Objectives and Projected Outcomes: (4,000 characters)

The NADP has had three objectives during its existence:

1. to characterize geographic patterns and temporal trends in chemical or biological atmospheric (wet and dry) deposition;
2. to support research activities related to: (a) the productivity of managed and natural ecosystems; (b) the chemistry of surface and ground waters, including estuaries; (c) critical loads in terrestrial and aquatic ecosystems; (d) the health and safety of the nation's food supply; and (e) source-receptor relationships; and
3. to support education and outreach through the development of informational materials and programs aimed at people of all ages.

To achieve these objectives, NADP provides timely deliverables free of charge. Scientists, educators, students, policy-makers, and others are encouraged to access data from the NADP website (http://nadp.slh.wisc.edu/). This site offers on-line retrieval of individual data points, seasonal and annual averages, trend plots, concentration and deposition maps, reports, manuals, educational brochures, and other information about NRSP-3.

Quality-assured data and information from all networks are loaded quarterly into the on-line database system with a lag of ~180 days. Information available from this website and linked database management system constitute the deliverables that support the project objectives. NADP also addresses special request data products, answers scientific questions, and assists users to find related information.

Complementing the on-line data and information are publications such as annual data summaries, annual meeting proceedings and presentations, quality assurance documents (e.g., *QMP*), manuals, informational and educational brochures, and reports. All publications are available online (nadp.slh.wisc.edu/lib/).

Project Assessment and Revision of Objectives: In order to assess the type and amount of research activity supported by NRSP-3, participants are asked to report their program activities and publications that use NADP data annually. Additionally information is obtained from online literature repositories to locate all publications that reference or use NADP data, maps, and other information. These are summarized annual and provided on the NADP website (http://nadp.slh.wisc.edu/lib/bibliography.aspx). More than ~95% of these publications are peer-reviewed journal articles and reports, as well as masters and PhD theses and dissertations covering a vast range of research areas. The balance includes informational pieces, such as newspaper reports, etc. Over the last three complete years (2016-2018), publications listed have numbered 248, 213, and 208 publications, respectively. This demonstrates that NRSP-3 is achieving the primary function of NRSPs, namely to support research (and NADP's Objective #2).

Objective (1) was changed during the 2002-06 funding period to "chemical or biological atmospheric (wet and dry) deposition." This objective now explicitly mentions wet and dry deposition, including the (biological) deposition of plant pathogens, such as ASR spores. Current networks to measure air concentrations of ammonia and mercury make possible the estimation of dry deposition fluxes, building new research support capacity. Research activities under objective (2) were amended to address emerging interest in critical loads and the health and safety of the nation's food supply. Including the health of food supplies embraces the work being done to understand mercury sources that have led to advisories in 49 states to limit fish consumption, and also embraces the work being done to track SBR, a disease that can drastically reduce yields in unprotected soybean crops. Objective (3) articulates what is already being done (see summary in Integration and Documentation of Research Support). These points show that the NRSP-3 is adjusting to our current understanding and adapting to new needs (e.g., ambient ammonia monitoring, ASR pathogen transport, radioactive fallout from Fukushima, etc.).

Subsection 3.2. Management, Budget, and Business Plan: (16,000 characters)

Project Management and Business Plan Project management is described in the *National Atmospheric Deposition Program Governance Handbook*, available at http://nadp.slh.wisc.edu/lib/brochures/nadpGovernanceHandbook.pdf. This handbook describes the roles and responsibilities of the members of the Program Office, areas of responsibility, etc. It additionally describes the role of each committee, subcommittees, and membership. Each role is briefly summarized here:

The NADP Program Office (PO), located at the Wisconsin State Laboratory of Hygiene (WSLH) at the UW-Madison, is responsible for promoting long-term NADP operations that comply with the operational procedures and quality-assurance standards set by the Executive Committee (EC), with guidance from its subcommittees. The PO manages day-to-day operations. The PO responsibilities include:

1. Securing site support, chemical analytical, and data validation services for NADP measurement programs;
2. ensuring measurement programs produce consistent quality-assured data;
3. managing the NADP databases and website;
4. publishing annual map summaries, data reports and other miscellaneous documents;
5. providing support for committee and subcommittee meetings; and
6. coordinating special studies.

The NADP Coordinator is the PO Director and works in parallel with the principal investigator of the cooperative agreements between NADP sponsors and the UW-Madison. At least three times a year, the Coordinator reports to the EC on the status and progress of PO and NADP activities.

Budgeting is done on a federal fiscal year basis. The Coordinator reports on the fiscal status of the project to the Budget Advisory Committee (BAC), which is responsible for financial planning. The BAC reviews the Coordinator's report and the Coordinator's income and expenditure plans for the upcoming fiscal year. The BAC makes its budget recommendations to the EC, which has budget approval authority. BAC membership consists of elected and ex-officio members. The WSLH develops an annual budget that is reviewed and approved by the WSLH Board of Directors, applying a high degree of oversight on the program. As part of the review, the NADP PO develops a balanced budget based on projected income and expenditures and a detailed cost analysis. This approved budget is then presented to the BAC. The budget is continually reviewed by PO and CAL mangers to ensure operations remain within the approved budget.

The EC is responsible for making budgetary decisions and ensuring program continuity and balance. It provides technical and administrative guidance to the PO. The EC receives input and recommendations from the BAC on budgetary matters and the Quality Assurance Advisory Group on quality assurance matters. It also receives input and recommendations from two standing technical subcommittees:

- The Network Operations Subcommittee (NOS), which oversees field-siting criteria and laboratory and sample collection protocols, and evaluates equipment and recordkeeping methods;
- The Ecological Responses and Outreach Subcommittee (EROS), which provides input on data user needs, and initiates and develops programs and products to promote the program and increase participation.

The EC acts on recommendations and sets program policies and procedures. EC membership consists of four elected officers, the elected chairs of each of the technical subcommittees, the BAC co-chair, and an SAES representative, all of whom have voting privileges. Membership also includes ex-officio non-voting members, such as the SAES Regional Administrative Advisors, the NIFA program manager, etc. Membership in the technical subcommittees is open and the rosters range from 40 to 60 per committee. Summaries of EC minutes are provided on the web (http://nadp.slh.wisc.edu/committees/minutes.aspx), along with all subcommittee's minutes.

As mentioned in the "Relevance to Stakeholders" section, the EC has continued to look for ways to engage new participation in its technical subcommittees and annual meetings. In 2006 the Program Chair formed the CLAD as a new "Science Committee" to provide a venue for discussing current and emerging issues regarding the science and application of critical loads. This action has been rewarded with substantial new participation of agencies and individuals. CLAD membership now totals approximately 120.

Both the EC and EROS, which seeks ways to promote the program, have struggled to increase participation from land-grant university scientists. The AMON network along with the SBR project has had some success in stimulating new interest from this group. Specific sessions at recent annual NADP symposia have had sessions devoted to agricultural and ammonia issues. Full meeting records since 2007 can be found on the web (http://nadp.slh.wisc.edu/conf/) including abstracts and selected presentations.

Project Budget: NRSP-3 provides the authority and framework for combining the resources of many and diverse sponsors in support of NRSP-3. Project support is divided into monies administered by the UW-Madison Research and Sponsored Programs (RSP) and the monies and in-kind support for operating NADP site subscribers. Cooperative funds administered by RSP provide the resources for the PO to perform duties and obligations required to satisfy the six responsibilities listed above. Subscriber support site operations including cost of sample collection, transportation and electricity to run the site, sample shipping, and land access and office space. Support for site operations is not administered by WSLH but is provided through an agreement described in the "NADP Shared Services and Responsibilities" document.

Three funding streams provide support for the PO: (1) SAES off-the-top monies, (2) a cooperative agreement between the USDA-NIFA and UW-Madison RSP, and (3) agreements between individual SAES, universities, government agencies, or non-governmental organizations and the WSLH. The USDA-NIFA/ UW-Madison RSP cooperative agreement combines the support of six federal agencies (BLM, NOAA, NPS, USDA-Forest Service, USGS, and ARS),

along with USDA, each having an interagency agreement with the USDA-NIFA. Each individual (type 3) agreement funds one or more sites.

Eight NTN sites are sponsored by SAES through individual agreements between land-grant universities and the UW and 22 are operated by SAES representatives. Two AMoN sites are supported through the NIFA cooperative agreement. Support for the other NADP sites at SAES facilities come either from federal agencies through the NIFA/UI cooperative agreement or from state agencies through type 3 agreements. Hatch funds provide off-the-top support and the land-grant university support of SAES sites. Since these funds can pay only direct program costs and under the NRSP-3 are combined with funds from other sources, all PO support, no matter the source, pays only direct program costs. Indeed, the USDA-NIFA/UI cooperative agreement stipulates that monies be used only for direct costs and not for facilities and services. Total FY18 support from these three funding streams was $3.1M. From FY15 to FY19, off-the-top support remained constant at $50,000. Therefore, over the years SAES funds have been highly leveraged into an internationally successful NRSP.

NRSP-3 off-the-top monies provide partial support of the Program Coordinator. Since this position spearheads day-to-day outreach to new stakeholders and development of innovative data products that support new research interests, we propose a level NRSP-3 budget of $50,000 per year for the FY20-FY24 renewal period.

The NRSP-3 funding model has enabled project growth and diversification of funding sources (see previous section). With the addition of the MDN in 1996, the number of individual (type 3) agreements has more than doubled. MDN support comes largely from state, local, and tribal government agencies in states confronting a growing number of health advisories because of mercury-contaminated fish. PO outreach efforts have been successful in enlisting new MDN support from these agencies. MDN is currently at 100 sites, most in the U.S., several in Canada (6 sites), and within Tribal Nations (13 sites). The renewed effort to expand the MDN is planned for the coming years as the NADP Executive Committee directed the PO to investigate and pursue the transfer of the mercury analytical lab from Eurofins/Frontier in Seattle, WA to the WSLH as a method of cost saving and increased QA oversite of MDN analytical results. The NTN is currently at 265 sites. In order for the network to maintain its size and potentially grow the program must contain costs and gain efficiencies in network operations. All funding support leads to reduce per site fees, and thus encourages additional involvement in NADP.

The NRSP-3 committees and PO continue to look for ways the project can serve regional and national needs. Establishing the CLAD is an example of engaging new scientific participation. Partnering with USDA-ARS to use NADP samples for detecting ASR spores in precipitation opens new possibilities for supporting research in the transport and deposition of airborne plant pathogens. Initiating the AMON has demonstrated the viability of cost-efficient passive sampling methods for measuring ambient ammonia, and is responding to the national need to better understand ammonia sources, atmospheric cycling, and deposition. This network shows a strong potential for future growth. The WSLH has developed a plan to implement a strategic planning meeting during the NADP Spring meetings. The goal is to identify and address the needs of NADP stakeholders, supporters, and data users. Some suggested ideas to be discussed include: future deployments of sensor technology, development of improved data products for users,

identifying future analytes of concern, and identify the infrastructure and coordination needs of NADP to support and expand external research. **These and other efforts remain true to the vision that NRSP-3/NADP will remain one of the nation's premier research support projects, serving science and education and supporting informed decisions on air quality issues.**

Subsection 3.3. Integration and Documentation of Research Support: (5,000 characters)

Academic Programs: Data and information on the NADP website have become an important resource for educators at virtually every level. Users indicate that 50% access the site for educational purposes and the balance for research from academic institutions, with significant growth since 1998 (38% education). In 2012, total data downloads were identified as follows: 40% from federal and state agencies, 36% from universities, 16% from K-to-12 schools, and 6% from other individuals or organizations. A more recent review of usage has not been conducted due to constraints associated with the recent PO and CAL transition to UW-Madison; however, we expect current usage to be similar to past values.

NADP data are typically used in 5 to 10 theses/dissertations each year. Over the last 10 years, authors have used NADP data, figures and maps in undergraduate textbooks in biology, chemistry, environmental sciences, and related areas (54, 55). The NADP willingly supplies high quality graphics and data free of charge for these efforts. Secondary-level students continue to access on-line brochures, data and maps for use in science fair projects and classroom exercises.

The NADP partnered with Dr. Robert Hudson and the UI College of Agricultural, Consumer and Environmental Sciences to develop a 2.5-hour installment of Natural Resources and Environmental Sciences Watersheds and Water Quality class and its video series for online education. The video was a description of the NADP, explanations of acid rain and its impacts.

NADP staff has been involved in extension work with Native American organizations concerning mercury, motivated by the high tribal fish consumption levels. NADP continues to contribute to the Institute of Tribal Environmental Professionals, National Tribal Air Association, and Tribal Air Monitoring Support Center.

NADP works with partnering universities to support external funding for research, for example the program has recently supported Dr. Godfrey A. Uzochukwu at North Carolina A&T State University (NC A&T), proposal for a Capacity Building Grant (CBG) Program for fiscal year FY2019 to strengthen institutional teaching and education capacities needed to advance environmental sciences and waste management in the College of Agriculture and Environmental Sciences (CAES) at NC A&T. The goals of the proposal: 1) to strengthen institutional teaching and educational capacities in environmental sciences, 2) to provide hands-on field experiences for students who attend minority serving institutions in programs that utilize STEM principles to solve complex human problems in food, agriculture and natural resources, 3) to increase recruitment and retention of underrepresented groups, including women, in STEM, 4) to enhance environmental science literacy and public education on complex environmental issues and also integrate social and behavioral sciences into environmental sciences, and 4) to support

experiential learning in field research environmental internships, strongly coincide with the mission of the NAD).

Partnerships: The NADP partnership with the ARS Cereal Disease Laboratory at the University of Minnesota to quantify SBR in precipitation samples continued through 2011. This project was previously described in the National Relevance section.

During 2010 to 2012, the NADP has adopted a new method for developing maps by improving the precipitation data that goes into our wet deposition products. The NADP now uses the PRISM (Parameter-elevation Regressions on Independent Slopes Model) precipitation data to augment routine NADP measurements. PRISM incorporates point measurement data (from 7000 precipitation gages), a digital elevation model, and expert knowledge of complex climatic extremes to estimate precipitation, all on a 4x4 km grid spacing. PRISM data sets are recognized as being of very high-quality and are supported by the USDA Natural Resources Conservation Service, USDA Forest Service, and the NOAA Office of Global Programs. This new partnership has resulted in greater spatial resolution in NTN and MDN map products.

The program has established collaborations with numerous external monitoring and research organizations including partnering with the 2015 Acid Rain conference, and establishing cooperation between the IMPROVE/CSN monitoring networks, and developing plans to support QA intercomparisons with the National Ecological Observatory Network (NEON).

The AMON and AMNet were developed at the request of stakeholders and to address the needs of the ag. research community. In both cases, these newer networks have brought in new site and funding partners, and new researchers. AMON is of particular interest to SAES scientists. Both networks have been discussed in other sections of this report.

In previous years, the NADP has brought in two new partner acid deposition networks: the New York Atmospheric Deposition Monitoring Network and the Pennsylvania Atmospheric Deposition Monitoring Network. In each case, the independent state networks determined that partnering with the national network was preferential to independent status. Both networks historically measured the same analytes as NTN and are now fully integrated into the NADP. In 2018, the PO has been in contact with other independent deposition sites to identify common goals and assess the value of integration into the program.

Support Nationwide Research: NADP data users are located in every state and data is actively downloaded by international researchers. The NADP is located in the majority of US states and in Canada, Puerto Rico, and the Virgin Islands, and we collaborate with nations including Mexico, Japan, China, South Korea, and Taiwan. The AMON has 100 sites in 39 states and Canada (including all 4 SAES regions), with preliminary gaseous ammonia measurements extending back to 2007 and official network measurements beginning in 2010. The number of active data users and monitoring sites provide indications of the breadth of support and continued interest in NRSP-3, and recognition that NADP is responsive to emerging needs of researchers and policy-makers. The breadth of reports and journal articles using or citing NADP data demonstrates the nationwide, indeed international, use of NADP data.

Researchers continue to value data that addresses acidic deposition issues in eastern states. There is emerging interest in the Rockies, Cascades, Sierras, and other sensitive high-elevation ecosystems in the West, driven partially by CLAD representatives. Researchers continue to utilize NTN's nutrient deposition data in nitrogen-limited montane ecosystems as well as estuaries and coastal watersheds. Researchers value MDN's mercury deposition data to investigate the cause of widespread mercury contamination of fish and piscivores. Finally, researchers need ambient gaseous ammonia data from AMoN to understand atmospheric nitrogen deposition and the relationship of ammonia emissions to air quality. **The NRSP-3/NADP has effectively supported these and other research activities and proposes to continue this support.**

Subsection 3.4. Outreach, Communications and Assessment: (15,000 characters)

Audience: The NRSP-3 mission is to provide quality-assured data and information on atmospheric deposition for use by scientists, educators, students, policy-makers, and the public. **The NRSP-3/NADP has effectively supported outreach, and routinely assesses the impact of these activities through quantifiable metrics.**

The NADP website provides on-line access to virtually all project data and information, including educational and informational brochures. All data from all networks is freely available to all interested users through the website. Download web statistics have been presented previously. User statistics, described in "Relevance to Stakeholders" show the continual growth in the number of registered users and data downloads, two indicators of the importance and relevance of the data.

In its role of assessing project performance, the NRSP-3 EC charged the PO with updating the website to improve the organizational layout, facilitate data and map accessibility, enhance communications, and modernize the "look and feel." NADP has received beneficial feedback through its EROS subcommittee to best structure the materials to meet the needs of stakeholders. In the past, a new website design has been put in place, including new sections featuring:

- Education, with new materials for classrooms at the 4th to 6th grade and senior high level;
- New Issues section that details some of the innovative measurements being done (e.g., Fukushima, new networks, and a new mercury litterfall partnership with USGS scientists); a
- Committees section, where mission statements and topics of discussion, minutes, and related materials are located; a
- Publications section, including all NADP standard operating procedures, minutes and presentations from meetings, etc.); and a
- News section, where NADP can highlight new happenings with the network.

Engagement of Stakeholders: Stakeholder involvement in committee and subcommittee activities at twice yearly meetings is described in "Relevance to Stakeholders." In addition, members participate in triennial laboratory and quality management reviews, where they provide recommendations for improvement. Committees and subcommittees identify emerging scientific needs and interests. For example, the AMoN and AMNet originated with committee discussions. As mentioned in "Management, Budget, and Business Plan," the committees continually seek

increase participation from land-grant university scientists, especially at annual technical meetings.

Measuring Accomplishments: Methods to measure program outputs, accomplishments, and impacts have been described in previous sections of the proposal and include:

1. An annual request to all program participants to send a list of accomplishments and publications utilizing NADP data to the NPO
2. routine searches of scholarly repositories, journal articles and professional reports;
3. compilations of Web user statistics;
4. identification of NADP data use in policy-related documents and websites, e.g., NAPAP reports, NRC reviews, government agency reports and websites;
5. participation in NADP meetings; and
6. routine program reviews.

Many of these have been discussed in other parts of this proposal.

Communication Pieces: The NADP's principal data product is its annual map summary report, which provides a summary of annual highlights and map products. This summary is distributed at scientific meetings and is mailed to all program participants. An online version is available on the NADP website to students, educators and the general public. Additional publications are available on the NADP website and in print form:

1. ***Welcome to NADP***, which describes the program to "newcomers," encourages their involvement, and is regularly updated with upcoming meeting dates
2. ***Monitoring Mercury Deposition,*** which describes the mercury problem and promotes the MDN
3. ***Nitrogen in the Nation's Rain***, which describes nutrient deposition and potential problems from excess nutrients (***El Nitrogeno en la Lluvia Nacional***, is provided as a Spanish translation)
4. ***Inside Rain***, which describes atmospheric deposition and the NADP
5. ***Ammonia Monitoring Network (AMoN) Fact Sheet,*** which describes issues related to gaseous ammonia, and provides an overview of methods and measurements in the AMoN,
6. ***NADP's Governance Handbook***, providing the structure and operation of NADP's officers, committees, and organization
7. ***Critical Loads - Evaluating the Effects of Airborne Pollutants on Terrestrial and Aquatic Ecosystems,*** which is a basic primer of the critical loads issue and the NADP's scientific role.

Recent articles in the general interest literature include:

- The July, 2012 issue of *Earth Magazine,* feature the cover story "**Acid Rain: A Science Policy Success Story**" describing the progress made over the past 30 years on the acidic precipitation problem. The 7-page article featured the network and results of the NADP, site pictures, laboratory pictures, and map products of the NADP.
- The April 2013 issue of *New York Conservationist*, featured an article entitled "**Understanding Acid Rain**", including an 8-page "for kids" pullout, the NADP and the

work of NY State Department of Environmental Protection. The issue provided an ideal outreach/education tool for young scientists (4^{th} to 6^{th} grade).

- The July, 2018 online issue of LIVESCIENCE feature the story "**Acid Rain: Causes, Effects and Solutions"**, which quoted content for the NADP website describing the impact of acid rain on natural and built ecosystems.

Distribution of Results: As described in previous sections of this proposal, NADP data are distributed primarily via the NADP website, which offers easy-to-use on-line retrieval of data in multiple formats. During the 2018 year, NADP estimated 23,000 comma-delineated data sets were downloaded, including 14,000 from the NTN database. In addition, approximately 57,000 PDF map images and 100,000 map data sets (grid and kmz) were downloaded.

Every year, a scientific symposium is held where presenters summarize the results of their scientific studies, using NADP data. The FY17 Fall Scientific Meeting was held in in San Diego, CA between October 30 - November 3, 2017 and 130 attendees, eight oral sessions, 34 oral presentations, and 25 posters. The meeting was highlighted by a presentation from Dr. Lynn Russell, Professor of Climate, Atmospheric Science and Physical Oceanography – Scripps Institute of Oceanography, UC San Diego. The Fall FY18 Meeting and Symposium was held in Albany, NY and had over 151 attendees. This meeting was highlighted by a keynote address by Dr. Gene Likens, the Cary Institute of Ecosystem Studies, describing the early observation of acid rain in North America and the link between the combustion of fossil fuels and an increase in the acidity of precipitation.

Section 4. Project Participation: NIMSS Appendix E

This table is the official participation list from the NIMSS system, detailing the SAES scientists who have officially participated in NRSP-3. Additionally, NRSP-3 welcomes "non-official" participants outside of the SAES system, as detailed previously in this proposal.

Participant Name	Station / Name
Anastasio, C.	California -Davis : University of California, Davis
Auvermann, Brent	Texas AgriLife Research
Boyer, Elizabeth W	Pennsylvania - Pennsylvania State
Collett, Jeff	Colorado - Colorado State University
Dahlgren, Randy A.	California -Davis : University of California, Davis
David, Mark B.	Illinois - University of Illinois
DeGaetano, Arthur T.	New York -Ithaca : Cornell University
Flitcroft, Ian D	Georgia - University of Georgia

Gillies, Robert R	Utah - Utah State University
Griffin, Curt	Massachusetts - University of Massachusetts
Griffis, Timothy	Minnesota - University of Minnesota
Kobe, Richard	Michigan - Michigan State University
Martin, Randy	Utah - Utah State University
Nzokoupa, Pascal	Michigan - Michigan State University
Olson, Mike	Wisconsin - University of Wisconsin
Paw U, K. T.	California -Davis : University of California, Davis
Scaglia, Guillermo	Louisiana - Louisiana State University
Schimelfenig, Todd	Nebraska - University of Nebraska
Suyker, Andrew	Nebraska - University of Nebraska

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NRSP-3, The National Atmospheric Deposition Program (NADP) - MRF FUNDING A Long-term Monitoring Program in Support of Research on the Effects of Atmospheric Chemical Deposition										
DESCRIPTION	**Proposed FY20**		**Proposed FY21**		**Proposed FY22**		**Proposed FY23**		**Proposed FY24**	
	Dollars	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**
Salaries	37,600	0.6	37,600	0.6	37,600	0.6	37,600	0.6	37,600	0.6
Fringe Benefits	12,400		12,400		12,400		12,400		12,400	
Total Wages (Salary and Fringe)	50,000		50,000		50,000		50,000		50,000	
Supplies & Services	0		0		0		0		0	
Maint. & Repairs	0		0		0		0		0	
Communication	0		0		0		0		0	
Travel & Training	0		0		0		0		0	
Rent & Capital Equip. Dep.										
TOTAL	50,000	0.6	50,000	0.6	50,000	0.6	50,000	0.6	50,000	0.6
OTHER SOURCES OF FUNDING **Other: EPA, USGS, ARS, USFS, US Park Service, BLM, NOAA, States, Tribes, Canada, Industry, NGOs, etc.**										
DESCRIPTION	**Proposed FY20**		**Proposed FY21**		**Proposed FY22**		**Proposed FY23**		**Proposed FY24**	
	Dollars	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**	**Dollars**	**FTE**
Salaries	1,305,000	22	1,305,000	22	1,305,000	22	1,305,000	22	1,305,000	22
Fringe Benefits	486,000		486,000		486,000		486,000		486,000	
Total Wages (Salary and Fringe)	1,792,000		1,792,000		1,792,000		1,792,000		1,792,000	
Supplies & Services	966,000		966,000		966,000		966,000		966,000	
Maint. & Repairs	106,000		106,000		106,000		106,000		106,000	
Communication	5,000		5,000		5,000		5,000		5,000	
Travel & Training	55,000		55,000		55,000		55,000		55,000	
Rent, Overhead & Capital Equip. Dep.	191,000		191,000		191,000		191,000		191,000	
TOTAL	3,115,000	22	3,115,000	22	3,115,000	22	3,115,000	22	3,115,000	22

Section 6. Appendix G: Budget

Project Title: NRSP003 - The National Atmospheric Deposition Program (NADP)

Requested Duration: October 1, 2019 to September 30, 2024 (FY20-FY24)

Budget & Narrative

In support of the NRSP-3 application, we present the following budget and narrative description. The MRF funding will be used for salary support for one person at the Program Office of the National Atmospheric Deposition Program. This support for the Program Coordinator will go towards the management of the project, and support the positions most responsible for carrying out the outreach and communication mission of the NRSP. This funding will provide approximately one half of the salary and benefits for this employee. The FY20 salary figure represents salary for the Program Coordinator, based on current FY19 salary. Other non-salary funding is not being requested.

The “Other Sources” table also contains a few assumptions and requires further explanation. These values include all funding categories listed (industry, federal agencies, grants/contracts, and SAESs). Therefore, this table represents the total project budget minus the MRF funding (approximately 2% of the total budget). This budget begins with the approved 2020 budget value. With these assumptions, annual values are estimated for the next five funding years.

Additional categories were added to this table to demonstrate itemized costs important to this project. The total wages (fringe plus salary) are reported based on the assumption that the HAL laboratory will be transferred to WSLH. The total FTE represent all projected PO, CAL and HAL personnel required to successfully operate the program; supplies and services include all contractual services and the supplies for PO, CAL, and HAL including printing and laboratory supplies to operate during the project period; maintenance and repair includes equipment upkeep and repairs, communication include the cost of office communication including operation of the site liaison 800 number; travel and training includes costs associated with the spring and fall meetings as well as cost for outreach such as at national conferences; rent and overhead cover the small cost of building rent and depreciation on equipment, and overhead associated with WSLH support including NADP subscriber billing and IT.

NRSP Peer / Proposal Review

The following statement defines the mission of the National Research Support Projects (NRSP's):

"The activity of an NRSP focuses on the development of enabling technologies, support activities (such as to collect, assemble, store, and distribute materials, resources and information), or the sharing of facilities needed to accomplish high priority research, but which is not of itself primarily research."

Based on this mission statement, please rate the proposed NRSP using the following criteria:

	Circle One
Mission:	
Consistency with the mission of an NRSP	**Excellent**
Relevance	
Addresses and supports a high priority national issue	**Excellent**
Demonstrates clear/tangible benefits to the scientific community as a whole	**Excellent**
Clearly identified sponsoring "stakeholders" / beneficiaries	**Excellent**
"Stakeholder" involvement in project development, project activities, review and/or management plans	**Excellent**
Technical Merit	
Overall technical merit (sound scientific approach, achievable objectives, appropriate scope of activity)	**Excellent**
Potential for significant outputs (products) and outcomes and/or impacts	**Excellent**

Implementation Plan	
Benchmarks for success clearly identified	**Good**
Management structure that adequately coordinates efforts of multiple participants	**Excellent**
Well developed business plan that links multiple sources of funding and leverages limited off the top research funds	**Excellent**
Funding plan that develops alternative funding sources to reduce off-the-top funding in future years	**Good**
Efforts integrated with extension and/or academic programs	**Excellent**
Outreach, communication and assessment plan that communicates the program goals, accomplishment and outcomes/impacts.	**Excellent**

Comments	This is a stellar national research support project, and an excellent proposal that systematically documents the group's many past and expected future accomplishments. The committee has many active members, outstanding and highly relevant productivity in terms of outputs, outcomes and extending value to educational, research, extension and management stakeholders at multiple levels. My rating of 'merely' good under the *Funding Plan…* category above is only because of the written specification that it "…reduce off-the-top funding in future years." NRSP3 continues to demonstrate leveraging of greater than 25:1, at an off-the-cost far below that of other NRSP programs; it does not need to plan for reducing costs to the SAES system. I'm highly supportive of this proposal, and of the NRSP3 program itself.
Recommendation	**Approve**

NRSP Peer / Proposal Review

The following statement defines the mission of the National Research Support Projects (NRSP's):

"The activity of an NRSP focuses on the development of enabling technologies, support activities (such as to collect, assemble, store, and distribute materials, resources and information), or the sharing of facilities needed to accomplish high priority research, but which is not of itself primarily research."

Based on this mission statement, please rate the proposed NRSP using the following criteria:

	Circle One
Mission:	
Consistency with the mission of an NRSP	**Excellent**
Relevance	
Addresses and supports a high priority national issue	**Excellent**
Demonstrates clear/tangible benefits to the scientific community as a whole	**Excellent**
Clearly identified sponsoring "stakeholders" / beneficiaries	**Excellent**
"Stakeholder" involvement in project development, project activities, review and/or management plans	**Good**
Technical Merit	
Overall technical merit (sound scientific approach, achievable objectives, appropriate scope of activity)	**Excellent**
Potential for significant outputs (products) and outcomes and/or impacts	**Excellent**

Implementation Plan	
Benchmarks for success clearly identified	**Excellent**
Management structure that adequately coordinates efforts of multiple participants	**Excellent**
Well developed business plan that links multiple sources of funding and leverages limited off the top research funds	**Excellent**
Funding plan that develops alternative funding sources to reduce off-the-top funding in future years	**Excellent**
Efforts integrated with extension and/or academic programs	**Fair**
Outreach, communication and assessment plan that communicates the program goals, accomplishment and outcomes/impacts.	**Good**

Comments	Overall I am impressed with the proposal and the attention to linking NADP to the SAES system. The new leadership has expressed a strong interest in linking with us and it is reflected in the proposal. This interest is further illustrated through the recent formation of a NCDC project on ammonium deposition in agricultural systems. The program also aligns well with several Grand Challenges and ESCOP priorities. The leadership has shown its skill in managing complex situations by successfully completing the relation to Wisconsin. I believe this success bodes well for the future of NADP and the relationship with SAES. A goal for the coming years may be to strengthen ties to the Extension system.
Recommendation	**Approve**

NRSP Peer / Proposal Review

The following statement defines the mission of the National Research Support Projects (NRSP's):

"The activity of an NRSP focuses on the development of enabling technologies, support activities (such as to collect, assemble, store, and distribute materials, resources and information), or the sharing of facilities needed to accomplish high priority research, but which is not of itself primarily research."

Based on this mission statement, please rate the proposed NRSP using the following criteria:

	Circle One
Mission:	
Consistency with the mission of an NRSP	**Excellent**
Relevance	
Addresses and supports a high priority national issue	**Excellent**
Demonstrates clear/tangible benefits to the scientific community as a whole	**Excellent**
Clearly identified sponsoring "stakeholders" / beneficiaries	**Excellent**
"Stakeholder" involvement in project development, project activities, review and/or management plans	**Excellent**
Technical Merit	
Overall technical merit (sound scientific approach, achievable objectives, appropriate scope of activity)	**Excellent**
Potential for significant outputs (products) and outcomes and/or impacts	**Excellent**

Implementation Plan	
Benchmarks for success clearly identified	**Excellent**
Management structure that adequately coordinates efforts of multiple participants	**Excellent**
Well developed business plan that links multiple sources of funding and leverages limited off the top research funds	**Excellent**
Funding plan that develops alternative funding sources to reduce off-the-top funding in future years	**Excellent**
Efforts integrated with extension and/or academic programs	**Good**
Outreach, communication and assessment plan that communicates the program goals, accomplishment and outcomes/impacts.	**Good**
Comments	Mission: National program of importance to agriculture and natural resources production, management, and scientific understanding. Relevance and Technical merit: NRSP-3 meets 5 of the 7 AES Grand Challenges Roadmap. NSRP-3 provides data trends and baselines for evaluating climate change. Informs policy on atmospheric deposition impacts on health of water, land, and forests. Open access of data to stakeholders. Sound science, analysis, and peer review. Plans: Goals are clear and appropriate. Modest budget request ($50K/year through FY24) leveraged to $3.1MM with six federal partners. Relocation to UW-Madison completed. Expansion efficiencies underway. Outreach has improved.
Recommendation	**Approve**

NRSP Peer / Proposal Review

The following statement defines the mission of the National Research Support Projects (NRSP's):

"The activity of an NRSP focuses on the development of enabling technologies, support activities (such as to collect, assemble, store, and distribute materials, resources and information), or the sharing of facilities needed to accomplish high priority research, but which is not of itself primarily research."

Based on this mission statement, please rate the proposed NRSP using the following criteria:

	Circle One
Mission:	
Consistency with the mission of an NRSP	**Excellent - Good - Fair - Unacceptable**
Relevance	
Addresses and supports a high priority national issue	**Excellent - Good - Fair - Unacceptable**
Demonstrates clear/tangible benefits to the scientific community as a whole	**Excellent - Good - Fair - Unacceptable**
Clearly identified sponsoring "stakeholders" / beneficiaries	**Excellent - Good - Fair - Unacceptable**
"Stakeholder" involvement in project development, project activities, review and/or management plans	**Excellent - Good - Fair - Unacceptable**
Technical Merit	
Overall technical merit (sound scientific approach, achievable objectives, appropriate scope of activity)	**Excellent - Good - Fair - Unacceptable**
Potential for significant outputs (products) and outcomes and/or impacts	**Excellent - Good - Fair - Unacceptable**

Implementation Plan	
Benchmarks for success clearly identified	Excellent - Good - Fair - Unacceptable
Management structure that adequately coordinates efforts of multiple participants	Excellent - Good - Fair - Unacceptable
Well developed business plan that links multiple sources of funding and leverages limited off the top research funds	Excellent - Good - Fair - Unacceptable
Funding plan that develops alternative funding sources to reduce off-the-top funding in future years	Excellent - Good - Fair - Unacceptable
Efforts integrated with extension and/or academic programs	Excellent - Good - Fair - Unacceptable
Outreach, communication and assessment plan that communicates the program goals, accomplishment and outcomes/impacts.	Excellent - Good - Fair - Unacceptable
Comments	The proposal is compelling and highlights the quality, value, and impact of NAPP. There is some adjustment likely in its new administrative home.
Recommendation	Approve – Approve with Revision – Disapprove