

# Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

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## PROGRAM SOLICITATION

NSF 16-524



**National Science Foundation**

Directorate for Geosciences

Directorate for Engineering

Directorate for Computer & Information Science & Engineering

Directorate for Mathematical & Physical Sciences

Directorate for Social, Behavioral & Economic Sciences

Directorate for Education & Human Resources

Office of International Science and Engineering

Office of Integrative Activities



**National Institute of Food and Agriculture**

**Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 22, 2016

## IMPORTANT INFORMATION AND REVISION NOTES

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Any proposal submitted in response to this solicitation should be submitted in accordance with the revised NSF Proposal & Award Policies & Procedures Guide (PAPPG) ([NSF 16-1](#)), which is effective for proposals submitted, or due, on or after January 25, 2016. Please be advised that proposers who opt to submit prior to January 25, 2016, must also follow the guidelines contained in [NSF 16-1](#).

## SUMMARY OF PROGRAM REQUIREMENTS

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### General Information

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**Program Title:**

Innovations at the Nexus of Food, Energy and Water Systems (INFEWS)

**Synopsis of Program:**

Humanity is reliant upon the physical resources and natural systems of the Earth for the provision of food, energy, and water. It is becoming imperative that we determine how society can best integrate across the natural and built environments to provide for a growing demand for food, water and energy while maintaining appropriate ecosystem services. Factors contributing to stresses in the food, energy, and water (FEW) systems include increasing regional and social pressures and governance issues as result of land use change, climate variability, and heterogeneous resource distribution. These interconnections and interdependencies associated with the food, energy and water nexus create research grand challenges in understanding how the complex, coupled processes of society and the environment function now, and in the future. There is a critical need for research that enables new means of adapting to future challenges. The FEW systems must be defined broadly, incorporating physical processes (such as built infrastructure and new technologies for more efficient resource utilization), natural processes (such as biogeochemical and hydrologic cycles), biological processes (such as agroecosystem structure and productivity), social/behavioral processes (such as decision making and governance), and cyber elements. Investigations of these complex systems may produce discoveries that cannot emerge from research on food or energy or water systems alone. It is the synergy among these components in the context of sustainability that will open innovative science and engineering pathways to produce new knowledge and novel technologies to solve the challenges of scarcity and variability.

The overarching goal of INFEWS is to catalyze the well-integrated interdisciplinary research efforts to transform scientific understanding of the FEW nexus in order to improve system function and management, address system stress, increase resilience, and ensure sustainability. The NSF INFEWS initiative is designed specifically to attain the following goals:

1. Significantly advance our understanding of the food-energy-water system through quantitative and computational modeling, including support for relevant cyberinfrastructure;
2. Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability;
3. Enable research that will lead to innovative system and technological solutions to critical FEW problems; and
4. Grow the scientific workforce capable of studying and managing the FEW system, through education and other professional development opportunities.

This activity enables interagency cooperation on one of the most pressing problems of the millennium - understanding interactions across the food, energy and water nexus - how it is likely to affect our world, and how we can proactively plan for its consequences. It allows the partner agencies - National Science Foundation (NSF) and the United States Department of Agriculture National Institute of Food and Agriculture (USDA/NIFA) and others - to combine resources to identify and fund the most meritorious and highest-impact projects that support their respective missions, while eliminating duplication of effort and fostering collaboration between agencies and the investigators they support.

NSF and USDA/NIFA are interested in promoting international cooperation that links scientists and engineers from a range of disciplines and organizations to solve the significant global challenges at the nexus of food, energy and water systems. Proposals including international collaboration are encouraged when those efforts enhance the merit of the proposed work by incorporating unique resources, expertise, facilities or sites of international partners. The U.S. team's international counterparts generally should have support or obtain funding through other non-NSF sources.

*Below are the members of the INFEWS Working Group responsible for internal oversight of this solicitation. All questions regarding proposal submissions should be directed to [INFEWSquestions@NSF.GOV](mailto:INFEWSquestions@NSF.GOV) or the program officers on the track teams responsible for the different tracks. See program description for descriptions of the different tracks. A complete list of the program officers on these track teams can be found on the program website [www.nsf.gov/geo/ere/ereweb/infews-contacts.jsp](http://www.nsf.gov/geo/ere/ereweb/infews-contacts.jsp).*

#### **Cognizant Program Officer(s):**

*Please note that the following information is current at the time of publishing. See program website for any updates to the points of contact.*

- Thomas Torgersen, Co-Chair, Directorate for Geosciences, telephone: 703-292-4738, email: [ttorgers@nsf.gov](mailto:ttorgers@nsf.gov)
- JoAnn Lighty, Co-Chair, Directorate for Engineering, telephone: 703-292-9763, email: [jlighty@nsf.gov](mailto:jlighty@nsf.gov)
- David Corman, Directorate for Computer & Information Science & Engineering, telephone: 703-292-8754, email: [dcorman@nsf.gov](mailto:dcorman@nsf.gov)
- Alan Tessier, Directorate for Biological Sciences, telephone: 703-292-7198, email: [atessier@nsf.gov](mailto:atessier@nsf.gov)
- Carol Bessel, Directorate for Mathematical & Physical Sciences, telephone: 703-292-4906, email: [cbessel@nsf.gov](mailto:cbessel@nsf.gov)
- Robert O'Connor, Directorate for Social, Behavioral & Economic Sciences, telephone: 703-292-7263, email: [roconnor@nsf.gov](mailto:roconnor@nsf.gov)
- David Campbell, Directorate for Education & Human Resources, telephone: 703-292-5093, email: [dcampbel@nsf.gov](mailto:dcampbel@nsf.gov)
- Lara Campbell, Office of International Science and Engineering, telephone: 703-292-7049, email: [lcampbel@nsf.gov](mailto:lcampbel@nsf.gov)
- Audrey Levine, Office of Integrative Activities, telephone: 703-292-7374, email: [alevine@nsf.gov](mailto:alevine@nsf.gov)
- Rachel Melnick, USDA/NIFA, telephone: 202-401-4980, email: [rmelnick@nifa.usda.gov](mailto:rmelnick@nifa.usda.gov)
- Bruce Hamilton, Directorate for Engineering, telephone: 703-292-7066, email: [bhamilto@nsf.gov](mailto:bhamilto@nsf.gov)
- Patrick Harr, Directorate for Geosciences, telephone: 703-292-8523, email: [pharr@nsf.gov](mailto:pharr@nsf.gov)

#### **Applicable Catalog of Federal Domestic Assistance (CFDA) Number(s):**

- 10.310 --- USDA-NIFA Agriculture and Food Research Initiative
- 47.041 --- Engineering
- 47.049 --- Mathematical and Physical Sciences
- 47.050 --- Geosciences
- 47.070 --- Computer and Information Science and Engineering
- 47.074 --- Biological Sciences
- 47.075 --- Social Behavioral and Economic Sciences
- 47.076 --- Education and Human Resources
- 47.079 --- Office of International Science and Engineering
- 47.083 --- Office of Integrative Activities (OIA)

## **Award Information**

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**Anticipated Type of Award:** Standard Grant or Continuing Grant

**Estimated Number of Awards:** 22 to 40

Projects may be submitted to Tracks 1, 2 or 3 as Category 1 projects (greater than \$1,000,000 to no more than \$3,000,000) or Category 2 projects (less than or equal to \$1,000,000). Track 4 project submissions will only be considered as Category 2 effort.

Estimated Number of Awards:

Track 1: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 2: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 3: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 4: 1 to 4 awards only as small (Category 2) awards

NSF and USDA/NIFA funds will be used to support Tracks 1-4. Some projects and/or subawards may be funded directly by USDA/NIFA.

**Anticipated Funding Amount:** \$50,000,000

The total amount available for this solicitation is \$50,000,000. Of this amount, NSF anticipates contributing approximately \$45,000,000 and USDA/NIFA anticipates contributing approximately \$5,000,000. This plan is subject to the availability of funds.

The tracks have been initially allocated as:

1. \$16,000,000 to \$22,000,000 for Track 1, FEW System Modeling;
2. \$9,000,000 to \$15,000,000 for Track 2, Visualization and Decision Support for Cyber-Human-Physical Systems at the FEW Nexus;
3. \$12,000,000 to \$18,000,000 for Track 3, Research to Enable Innovative Solutions; and
4. \$1,000,000 to \$4,000,000 for Track 4, Education and Workforce Development.

Projects may be submitted to Tracks 1, 2 or 3 as Category 1 projects (greater than \$1,000,000 to no more than \$3,000,000) or Category 2 projects (less than or equal to \$1,000,000). Track 4 project submissions will only be considered as Category 2 effort.

This is an interagency partnership between NSF and USDA/NIFA, therefore meritorious proposals may be funded by one or more agencies at the option of the agencies, not the proposer. For proposals selected for funding entirely by USDA/NIFA, PIs will be asked to withdraw their proposal from NSF and resubmit it to USDA/NIFA in accordance with instructions given by the cognizant USDA/NIFA Program Officer. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

## Eligibility Information

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### Who May Submit Proposals:

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For proposals to be considered for funding under USDA/NIFA : Eligible applicants for the grant program implemented under INFEWS include: (1) State agricultural experiment stations; (2) colleges and universities (including junior colleges offering associate degrees or higher); (3) university research foundations; (4) other research institutions and organizations; (5) Federal agencies, (6) national laboratories; (7) private organizations or corporations; (8) individuals who are U.S. citizens, nations, or permanent residents; and (9) any group consisting of 2 or more entities identified in (1) through (8). Eligible institutions do not include foreign and international organizations. Award recipients may subcontract to organizations not eligible to apply provided such organizations are necessary for the conduct of the project.

### Who May Serve as PI:

There are no restrictions or limits for the allowable organizations listed above. Federal agencies and federally funded research and development centers (FFRDCs) can only participate as subawardees. FFRDCs and federal agency scientists cannot serve as lead PI. Non-NSF sponsored FFRDCs are required to provide a letter of support from their agency.

### Limit on Number of Proposals per Organization:

There is no limit on the number of proposals per organization. However, there is a limitation on the number of submissions per scientist as noted below.

### Limit on Number of Proposals per PI or Co-PI: 2

An individual may appear as PI, co-PI, other senior personnel, or consultant on no more than two proposals submitted in response to this solicitation. This limitation includes proposals submitted by a lead organization or any subaward submitted as part of a proposal. Please be advised that if an individual's name appears, in any capacity, on more than TWO proposals, all submittals after the first two proposals (based on the time-stamp) will be returned without review.

**Please note: All materials should be submitted to NSF. NSF will share all submitted materials with USDA/NIFA.**

## Proposal Preparation and Submission Instructions

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### A. Proposal Preparation Instructions

- **Letters of Intent:** Not required
- **Preliminary Proposal Submission:** Not required
- **Full Proposals:**

- o Full Proposals submitted via FastLane: NSF Proposal and Award Policies and Procedures Guide, Part I: Grant Proposal Guide (GPG) Guidelines apply. The complete text of the GPG is available electronically on the NSF website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg).
- o Full Proposals submitted via Grants.gov: NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov Guidelines apply (Note: The NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide))

## B. Budgetary Information

- **Cost Sharing Requirements:**

Inclusion of voluntary committed cost sharing is prohibited.

- **Indirect Cost (F&A) Limitations:**

**For awards made by USDA/NIFA:** Section 715 of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) limits indirect costs on NIFA awards to 30 percent of the total Federal funds provided (or 42.857 percent of total direct costs) under each award. Similar language may be included in the FY 2016 appropriation, therefore, when preparing budgets, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. See Part V section 7.9 of the NIFA Grants.gov Application Guide for further indirect cost information.

- **Other Budgetary Limitations:**

Not Applicable

## C. Due Dates

- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 22, 2016

## Proposal Review Information Criteria

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### Merit Review Criteria:

National Science Board approved criteria. Additional merit review considerations apply. Please see the full text of this solicitation for further information.

## Award Administration Information

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### Award Conditions:

Additional award conditions apply. Please see the full text of this solicitation for further information.

### Reporting Requirements:

Additional reporting requirements apply. Please see the full text of this solicitation for further information.

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## I. INTRODUCTION

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Humanity is reliant upon the physical resources and natural systems of the Earth for the provision of food, energy, and water. It is becoming imperative that we determine how society can best integrate across the natural and built environments to provide for a growing demand for food, water and energy while maintaining appropriate ecosystem services. Factors contributing to stresses in the food, energy, and water (FEW) systems include increasing regional, social, and political pressures as result of land use change, climate variability, and heterogeneous resource distribution. These interconnections and interdependencies associated with the food, energy and water nexus create research grand challenges in understanding how the complex, coupled processes of society and the environment function now, and in the future. There is a critical need for research that enables new means of adapting to future challenges. The FEW systems must be defined broadly, incorporating physical processes (such as built infrastructure and new technologies for more efficient resource utilization), natural processes (such as biogeochemical and hydrologic cycles), biological processes (such as agroecosystem structure and productivity), social/behavioral processes (such as decision making and governance), and cyber elements. Investigations of these complex systems may produce discoveries that cannot emerge from research on food or energy or water systems alone. It is the synergy among these components in the context of sustainability that will open innovative science and engineering pathways to produce new knowledge and novel technologies to solve the challenges of scarcity and variability.

The overarching goal of INFEWS is to catalyze the well-integrated interdisciplinary research efforts to transform scientific understanding of the FEW nexus in order to improve system function and management, address system stress, increase resilience, and ensure sustainability. The NSF INFEWS initiative is designed specifically to attain the following goals:

1. Significantly advance our understanding of the food-energy-water system through quantitative and computational modeling, including support for relevant cyberinfrastructure;
2. Develop real-time, cyber-enabled interfaces that improve understanding of the behavior of FEW systems and increase decision support capability;
3. Enable research that will lead to innovative system and technological solutions to critical FEW problems; and
4. Grow the scientific workforce capable of studying and managing the FEW system through education and other professional development opportunities.

This activity enables interagency cooperation on one of the most pressing problems of the millennium—understanding of the interactions across the food, energy and water nexus -- how it is likely to affect our world, and how we can proactively plan for its consequences (see "[America's Future: Environmental Research and Education for a Thriving Century](#)"). It allows the partner agencies -- National Science Foundation (NSF) and the United States Department of Agriculture National Institute of Food and Agriculture (USDA/NIFA) and others - to combine resources to identify and fund the most meritorious and highest-impact projects that support their respective missions, while eliminating duplication of effort and fostering collaboration between agencies and the investigators they support.

## II. PROGRAM DESCRIPTION

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### General Requirements

**Systems Approach:** The INFEWS program defines FEW systems as inclusive of physical processes (such as built infrastructure and new technologies for more efficient resource utilization), natural processes (such as biogeochemical and hydrological cycles), biological processes (such as agroecosystem structure and productivity), social and behavioral processes (such as decision making and governance), and cyber-elements. The INFEWS program also recognizes that FEW systems may appropriately be defined at a wide range of temporal and spatial scales; locally to globally.

Although each proposal does not need to examine all processes listed in the previous paragraph, **proposals submitted to the INFEWS program must define the FEW systems intended for study. The FEW systems description should identify the systems boundaries and the primary food and energy and water component systems.** Successful proposals will define appropriate feedback mechanisms and dynamics among the FEW system components to be studied. Proposals should also identify how the research will account for exogenous inputs to the system, where relevant. Proposals should justify their approach.

**Integration across Disciplines:** Proposals submitted to the INFEWS program must demonstrate meaningful integration across disciplines to address the principal objectives outlined below and should go beyond existing approaches that can be addressed within the individual disciplines and usual core-program co-funded research opportunities at NSF and NIFA. Although many disciplinary challenges remain in FEW systems research, this solicitation intends this program to bridge significant existing gaps between disciplinary foci and to foster new lines of research that emerge only in an interdisciplinary context.

In order to ensure a sufficiently broad interdisciplinary approach, **INFEWS proposals must incorporate science from three or more intellectually distinct disciplines that, in aggregate, represent scientific areas typically supported by three or more of the participating NSF directorates or two (or more) directorates and USDA/NIFA.** (USDA/NIFA research goals derive from the basic sciences/engineering much akin to NSF. However, some differences may be perceived. USDA/NIFA may be invoked as a "discipline" if the research focus represents a topical area that is uniquely distinct from disciplines typically supported by NSF Directorates. The FEW Context Statement (see below) should carefully elaborate on the specific differences between NSF and USDA/NIFA "discipline"). See also Frequently Asked Questions at the end of the solicitation.

Proposals must document that the proposed research is truly interdisciplinary, that the respective components are fully integrated and necessary for the successful execution of the proposed project, and that the research team contains sufficient expertise to carry out all dimensions of the research plan. **Plans for integration of the respective research components must be fully outlined in the proposal.**

**Leverage existing investments:** INFEWS projects should take advantage of previous and operational federal infrastructure investments in data management, software and modeling, computing resources, environmental observatories and centers, and social, economic and administrative data of NSF and other agencies. A variety of computational infrastructure, including software

(modeling, data analysis, knowledge discovery, visualizations, decision support systems, science gateways, etc.), sensors, networks, data systems, and computing hardware is available and may be utilized and shared by individual researchers, groups, centers, universities and national laboratories, and communities as appropriate.

In addition, pursuing INFEWS and INFEWS-related research topics and projects may require that novel capabilities be added to existing shared cyberinfrastructure to be successful. This solicitation also seeks potential investments that would introduce new capabilities and novel cyberinfrastructure approaches to addressing the scientific challenges inherent in INFEWS research, leading to previously unattainable results.

**Partnerships:** INFEWS research has natural linkages to federal agencies and a wide spectrum of other stakeholders. Whenever appropriate, **partnerships are encouraged between universities; research centers; federal agencies and national labs; state, local, and tribal governments; and private organizations.** Such partnerships should be considered for improved definition of underlying scientific problems such that effective and impactful approaches may be developed.

NSF and USDA/NIFA are interested in promoting international cooperation that links scientist and engineers from a range of disciplines and organizations to solve the significant global challenges at the nexus of food, energy and water systems. Proposals including international collaboration are encouraged when those efforts enhance the merit of the proposed work by incorporating unique resources, expertise, facilities or sites of international partners. The U.S. team's international counterparts generally should have support or obtain funding through other non-US-federal sources.

**Categories and Requirements:** INFEWS will accept two sizes of proposals.

Category 1, or large, proposals with total budgets in the range of greater than \$1 million to no more than \$3 million dollars.

Category 2, or small, proposals cannot exceed a maximum budget of \$1 million. Track 4 will only accept Category 2 proposals. Proposals submitted to Track 4 with a budget that exceed \$1 million will be returned without review.

### **INFEWS Tracks**

This solicitation outlines four tracks of research: (1) FEW System Modeling; (2) Visualization and Decision support for Cyber-Human-Physical Systems at the FEW Nexus; (3) Research to Enable Innovative Solutions; and (4) Education and Workforce Development. A proposal may be submitted to ONLY ONE track. Proposals submitted to more than one track and proposals that fail to specify a track will be returned without review.

#### **Track 1: FEW System Modeling**

Track 1 aims to significantly advance understanding of FEW systems with advanced modeling that investigates the functioning of coupled biotic, abiotic, engineered and social systems. The goal is to define and understand the couplings/linkages, feedback mechanisms and processes among the FEW systems components and to elucidate the factors that influence resilience, thresholds and criticalities. Track 1 projects should articulate clear hypotheses and/or describe what anticipated theoretical advancements will likely emerge from the modeling efforts. These projects should enable innovative perspectives and advances in understanding and modeling complex systems processes. Development of advanced computational methods and effective means for incorporation of large quantities of disparate data, as implemented in new and novel software and tools, is also appropriate.

Projects might use a wide variety of different systems analyses and modeling approaches to explore the functional dynamics of FEW systems. Some projects might integrate across models from multiple disciplinary domains, including, but not limited to agricultural, behavioral, computational, cultural, ecological, economic, energy, engineering, geospatial, hydrological, mathematical, political and social. Projects might also explore disparate types of datasets in order to develop new understandings of FEW relationships, systems and their dynamics. Some of the proposed projects may address additional cyberinfrastructure capabilities that could include advanced computational infrastructure supporting advanced modeling, and/or data integration across multiple scales (including the possibility of real-time sensing)

Systems chosen for study must be examined to define/quantify spatially heterogeneous FEW systems responses to various internal and external driving factors that occur on both short and long timescales. FEW systems operation must be investigated under the influence of single and multiple driving factors. FEW models should allow for investigation of system resiliency, attempt to identify thresholds, and explore system response to variability among critical parameters singly, in combination, or at extreme values.

INFEWS and INFEWS-related research topics and projects may also require novel capabilities to existing shared cyberinfrastructure to be successful. Track 1 projects may introduce new capabilities and novel computing cyberinfrastructure approaches to address the scientific challenges inherent in INFEWS research, leading to previously unattainable results. Here, the emphasis will be upon extending existing, shared cyberinfrastructure resources (at the campus, regional, or national level) to specifically address the computational cyberinfrastructure challenges associated with the proposed INFEWS research. Proposers responding with advanced cyberinfrastructure focus should strongly consider proposing under category 1.

Proposed Track 1 project/models must be designed to assess (a) the model's generalizability through either site-to-site comparisons or within site comparisons at multiple time/space scales, or (b) the model's ability to evaluate minimization-of-risk with respect to FEW services, the components/couplings that define threshold and resilient FEW systems behavior and the impact of mitigation and adaptation with respect to minimization-of-risk. Alternately, projects where advanced cyberinfrastructure is the focus, must assess performance and strategic potential of the new cyberinfrastructure, as well as its ability to enable INFEWS research advances.

#### **Track 2: Visualization and Decision Support for Cyber-Human-Physical Systems at the FEW Nexus**

Cyber-human-physical systems (CHPS) integrate decision making at different spatial and temporal scales with sensing, computation, and networking measurements of the social, natural, physical and built worlds. From this perspective, INFEWS represents CHPS on a grand scale that is tightly woven between the physical and the human fabrics. Each FEW system is a large CHPS with human interaction influencing system outcomes. Track 2 seeks to develop the core system science needed to understand the interactions between these diverse but closely coupled components that operate at multiple temporal and spatial scales.

CHPS research for the FEW systems nexus will necessitate the research, design, and implementation of new analytic algorithms that will (a) support real-time management, near-real time decision making, and longer term planning; and (b) provide a science basis to aid in policy generation for decision making on week to decadal timescales and across multiple closely integrated systems. Aggregation of multiple data sources and integration of analysis into a comprehensive framework for decision making in the FEW context is required. Finally, all these capabilities must exist within a secure and resilient environment that provides appropriate levels of data privacy. This track seeks open, accessible computing environments and infrastructures to enable suitable response times. Research challenges include, but are not limited to:

- New methods, and data science algorithms for integrating multiple, heterogeneous, and high-volume FEW data from physical, ecological, engineered, and social sources that facilitate the extraction of actionable information

- Innovative, open and scalable computing architectures capable of supporting effective resource management and human decision making
- Modeling approaches and algorithms that can capture FEW component interactions at multiple temporal and spatial scales and support cyber-human-physical system resource management.
- New approaches to verify cyber-human-physical system behaviors
- Visualization tools for multi-scale and multi-user data and model interpretation and analysis as well as decision support
- Security for multiple levels of the FEW system and their interactions

### Track 3: Research to Enable Innovative System Solutions

FEW systems are facing multiple stresses, including – but not limited to – increasing global populations, rapid land use change, shifting social, economic and governance norms, and escalating climate variability. Heterogeneous resource distribution and access, increasing resource scarcity, degraded resource quality, diminished ecosystem services also challenge long term FEW system sustainability. Track 3 projects will develop and examine innovative solutions that address specific FEW system challenges and aim to enhance FEW systems resilience and sustainability. Track 3 research may explore sustainable management solutions, examine the drivers of resource consumption, and study the means of extending resources via methods such as reducing, recycling, recovery, and reuse - among other topics.

Track 3 projects must take a systems approach in designing potential solutions. Projects should demonstrate how the envisioned solution will contribute to a healthy balance across sectors and places, and how these might vary over time and across scales. Solutions may increase stress at certain scales, or during an initial adjustment period, but may prove to reduce key stressors in a broader context or over longer time horizons. Proposers should be cognizant that solutions often imply increased resource investments across differing cultural and legal contexts, and, therefore have the potential to increase systems level stresses and other unintended consequences. Hence, the proposed approaches must identify and use appropriate systems (performance) metrics in the context of FEW systems.

Specific areas of interest include, but are not limited to:

- Efficient Use of Resources:** One goal of Track 3 is to address production, consumption and waste. Scientific and engineering solutions to improve FEW systems efficiencies should be coupled with new knowledge of how ecological, economic, social, and physical systems interact.
- Conversion and/or Reuse of Waste Materials:** New devices, sensors, catalysts, nanomaterials, smart filters, and processes may be required to detect, remove, destroy or convert compounds of concern from waste streams, or to turn waste constituents into valuable primary or secondary products. A FEW systems approach to these problems may also reveal uses for 'waste' that do not require complete reversion back to pristine conditions. In addition to the technical aspects, human factors will be especially important in the decision-making process regarding incentives and obstacles to the conversion and/or reuse of waste materials.
- System Sustainability:** INFEWS aims to encourage research on innovative strategies for appropriate management of natural and physical systems. Questions of use, access, and governance will likely be important in this context. Spatial incongruities between the natural and political boundaries of the various component systems and temporal mismatches between decision-making timeframes and system response and dynamics may also need to be addressed. Sustainability solutions might incorporate physical sciences, biological sciences, computer sciences, institutional, economic, behavioral, and technical components.

### Track 4: Education and Workforce Development

The goal of Track 4 projects is to develop a cadre of citizens, scientists and engineers capable of thinking across Food-Energy-Water disciplines and systems. This will demand a new workforce and challenge academic institutions to produce citizens, graduates and professionals who have the interdisciplinary and problem-solving framework to meet this demand. The advanced knowledge gained from this program will need education and outreach efforts to effectively reach decision-makers.

Track 4 proposals could have a topical theme or could be aligned with an INFEWS Track (1, 2, or 3). Following requirements indicated in the solicitation introduction above, each proposal should identify the systems and the primary food and energy and water components that will be the focus. Proposal teams for each Track-4 proposal must include scientific areas supported by three or more NSF directorates, including education research, or two NSF Directorates and NIFA.

Track 4 Education and workforce development projects can be addressed with suitable proposals in two ways as noted below.

**Track 4a:** NSF (principally, but not exclusively) plans to make a limited number of Track 4 awards to support virtual resource centers. The students affiliated with the resource centers will be able to engage in interdisciplinary research, while developing expertise in their primary field. In addition, by providing resources and opportunities to connect graduate students across INFEWS awards, the project personnel may teach research methods, data analysis, modeling, visualization, decision-support and other synergistic activities that would benefit the FEW community that can enhance research efforts and strengthen collaborations. Most importantly, Track 4a projects will nurture and prepare interdisciplinary scientists towards careers that can contribute to solving the complex global challenges at the FEW nexus.

Track 4a projects will provide opportunities for graduate students working on INFEWS awards to collaborate, network, share resources (e.g. research methods, recent publications, etc.), and exchange advice and mentoring across individual projects. The resource centers will serve as repositories of research results and virtual hubs for webinar learning, online courses, and resource tools. Faculty affiliated with the resource centers will oversee the center's activities and provide guidance and mentoring to participants. While the primary audience is graduate students specifically served by INFEWS projects, webinars and other materials will be made available to other interested academics. Participation of graduate students conducting relevant research at other institutions will also be encouraged. A yearly graduate student symposium is envisioned.

**Track 4b:** USDA/NIFA (principally but not exclusively) intends to support proposals that produce citizens of all ages who are INFEWS thinkers capable of making informed decisions and able to work with diverse teams and audiences. USDA/NIFA (principally but not exclusively) requests proposals for education and outreach efforts beyond the traditional university setting. Informal education institutions may develop or augment activities to enhance the public's ability to understand the complex environmental, biological, engineering and social information related to the nexus of food, energy, and water systems to aid informed decisions. This outreach can include, but need not be limited to, programs and tools to help decision makers, such as communities, water managers, farmers, ranchers, land managers, and foresters, improve management decisions and implementation and best management practices.

### III. AWARD INFORMATION

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**Anticipated Type of Award:** Continuing Grant or Standard Grant

**Estimated Number of Awards:** 22 to 40

Projects may be submitted to Tracks 1, 2 or 3 as Category 1 projects (greater than \$1,000,000 to no more than \$3,000,000) or Category 2 projects (less than or equal to \$1,000,000). Track 4 project submissions will only be considered as Category 2 effort.

Estimated Number of Awards:

Track 1: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 2: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 3: 6 to 12 as a combination of large (Category 1) awards and small (Category 2) awards

Track 4: 1 to 4 awards only as small (Category 2) awards

NSF and USDA/NIFA funds will be used to support Tracks 1-4. Some projects and/or subawards may be funded directly by USDA/NIFA.

**Anticipated Funding Amount:** \$50,000,000

The total amount available for this solicitation is \$50,000,000. Of this amount, NSF anticipates contributing approximately \$45,000,000 and USDA/NIFA anticipates contributing approximately \$5,000,000. This plan is subject to the availability of funds.

The tracks have been initially allocated as:

1. \$16,000,000 to \$22,000,000 for Track 1, FEW System Modeling;
2. \$9,000,000 to \$15,000,000 for Track 2, Visualization and Decision Support for Cyber-Human-Physical Systems at the FEW Nexus;
3. \$12,000,000 to \$18,000,000 for Track 3, Research to Enable Innovative System Solutions; and
4. \$1,000,000 to \$4,000,000 for Track 4, Education and Workforce Development.

Projects may be submitted to Tracks 1, 2 or 3 as Category 1 projects (greater than \$1,000,000 to no more than \$3,000,000) or Category 2 projects (less than or equal to \$1,000,000). Track 4 project submissions will only be considered as Category 2 effort.

This is an interagency partnership between NSF and USDA/NIFA, therefore meritorious proposals may be funded by one or more agencies at the option of the agencies, not the proposer. For proposals selected for funding entirely by USDA/NIFA, PIs will be asked to withdraw their proposal from NSF and resubmit it to USDA/NIFA in accordance with instructions given by the cognizant USDA/NIFA Program Officer. Subsequent grant administration procedures will be in accordance with the individual policies of the awarding agency.

### IV. ELIGIBILITY INFORMATION

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**Who May Submit Proposals:**

Proposals may only be submitted by the following:

- Universities and Colleges - Universities and two- and four-year colleges (including community colleges) accredited in, and having a campus located in, the US acting on behalf of their faculty members. Such organizations also are referred to as academic institutions.
- Non-profit, non-academic organizations: Independent museums, observatories, research labs, professional societies and similar organizations in the U.S. associated with educational or research activities.
- For proposals to be considered for funding under USDA/NIFA : Eligible applicants for the grant program implemented under INFEWS include: (1) State agricultural experiment stations; (2) colleges and universities (including junior colleges offering associate degrees or higher); (3) university research foundations; (4) other research institutions and organizations; (5) Federal agencies, (6) national laboratories; (7) private organizations or corporations; (8) individuals who are U.S. citizens, nations, or permanent residents; and (9) any group consisting of 2 or more entities identified in (1) through (8). Eligible institutions do not include foreign and international organizations. Award recipients may subcontract to organizations not eligible to apply provided such organizations are necessary for the conduct of the project.

**Who May Serve as PI:**

There are no restrictions or limits for the allowable organizations listed above. Federal agencies and federally funded research and development centers (FFRDCs) can only participate as subawardees. FFRDCs and federal agency scientists cannot serve as lead PI. Non-NSF sponsored FFRDCs are required to provide a letter of support from their agency.

**Limit on Number of Proposals per Organization:**

There is no limit on the number of proposals per organization. However, there is a limitation on the number of submissions per scientist as noted below.

**Limit on Number of Proposals per PI or Co-PI: 2**

An individual may appear as PI, co-PI, other senior personnel, or consultant on no more than two proposals submitted in response to this solicitation. This limitation includes proposals submitted by a lead organization or any subaward submitted as part of a proposal. Please be advised that if an individual's name appears, in any capacity, on more than TWO proposals, all submittals after the first two proposals (based on the time-stamp) will be returned without review.

**Please note: All materials should be submitted to NSF. NSF will share all submitted materials with USDA/NIFA.**

#### **Additional Eligibility Info:**

If one participating unit constitutes an FFRDC and/or another US government agency, expenses associated with participation of those scientists should be consolidated into a single subaward (for each agency). Should the proposal be successful, the full FFRDC financial commitment must be met by the FFRDC or agency; therefore FFRDC and agency submissions should be cleared in advance with the relevant agency and the submission should be supported by an email or letter of commitment from that agency (provided in Supplementary Documents).

Please note: All materials should be submitted to NSF. NSF will share all submitted materials with USDA/NIFA.

Individual researchers and researchers at ineligible organizations may be included on proposals from eligible institutions through subawards or as consultants.

For proposals to be considered for possible funding by USDA/NIFA: Eligible applicants for the grant program implemented under INFEWS include: (1) State agricultural experiment stations; (2) colleges and universities (including junior colleges offering associate degrees or higher); (3) university research foundations; (4) other research institutions and organizations; (5) Federal agencies; (6) national laboratories; (7) private organizations or corporations; (8) individuals who are U.S. citizens, nationals, or permanent residents; and (9) any group consisting of 2 or more entities identified in (1) through (8). Eligible institutions do not include foreign and international organizations.

Federal Agencies and FFRDCs should also be aware of the specific Indirect cost (F&A) Limitations for awards made by USDA/NIFA.

Projects involving USDA FFRDCs or National Laboratories will only be considered for co-funding by NSF if they are collaborative efforts that involve non-federally funded institutions. Proposals from FFRDCs must obey NSF budget guidelines and may not include costs already covered by federal funds. To facilitate possible interagency funding of such collaborations, an institution other than the USDA FFRDC facility must serve as the lead institution.

As a general rule, projects funded by USDA/NIFA will follow normally operational USDA/NIFA guidelines for agencies and FFRDCs; projects funded under this solicitation by NSF will follow normally operational NSF guidelines for agencies and national laboratories (GPG I-E.7). Under exceptional circumstances, research or education projects at other Federal agencies or FFRDCs that can make unique contributions to the needs of researchers elsewhere or to other specific NSF objectives may receive NSF support. This generally means that other federal agencies and/or FFRDCs should not be the lead organization and specific budgetary restrictions apply per NSF.

## **V. PROPOSAL PREPARATION AND SUBMISSION INSTRUCTIONS**

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### **A. Proposal Preparation Instructions <**

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**Full Proposal Preparation Instructions:** Proposers may opt to submit proposals in response to this Program Solicitation via Grants.gov or via the NSF FastLane system.

- Full proposals submitted via FastLane: Proposals submitted in response to this program solicitation should be prepared and submitted in accordance with the general guidelines contained in the NSF Grant Proposal Guide (GPG). The complete text of the GPG is available electronically on the NSF website at: [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=gpg](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=gpg). Paper copies of the GPG may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov). Proposers are reminded to identify this program solicitation number in the program solicitation block on the NSF Cover Sheet For Proposal to the National Science Foundation. Compliance with this requirement is critical to determining the relevant proposal processing guidelines. Failure to submit this information may delay processing.
- Full proposals submitted via Grants.gov: Proposals submitted in response to this program solicitation via Grants.gov should be prepared and submitted in accordance with the NSF Grants.gov Application Guide: A Guide for the Preparation and Submission of NSF Applications via Grants.gov. The complete text of the NSF Grants.gov Application Guide is available on the Grants.gov website and on the NSF website at: ([http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=grantsgovguide](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=grantsgovguide)). To obtain copies of the Application Guide and Application Forms Package, click on the Apply tab on the Grants.gov site, then click on the Apply Step 1: Download a Grant Application Package and Application Instructions link and enter the funding opportunity number, (the program solicitation number without the NSF prefix) and press the Download Package button. Paper copies of the Grants.gov Application Guide also may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

See Chapter II.C.2 of the GPG for guidance on the required sections of a full research proposal submitted to NSF. Please note that the proposal preparation instructions provided in this program solicitation may deviate from the GPG instructions.

**The following instructions supplement or deviate from the guidance in the GPG and NSF Grants.gov Application Guide:**

**Multi-Institutional Proposals:** Any proposals involving multiple institutions must be submitted by the lead institution with all other institutions included via subawards. See GPG Chapter II.D.5.a. Simultaneous submission of proposals from different institutions (as described under GPG Chapter II.D.5.a) will not be accepted.

**Please note: All materials should be submitted to NSF. NSF will share all submitted materials with USDA/NIFA and other participating agencies.**

#### **Title of Proposal**

Submissions will have a title beginning with "INFEWS/T1", "INFEWS/T2", "INFEWS/T3", "INFEWS/T4" depending upon the specific track to which the proposal is submitted (proposals may be submitted to only one track). These lead characters should be followed by any other indicators if appropriate. The title should state clearly and succinctly the focus of the project.

#### **Co-Review:**

PIs may not request co-review by other tracks or programs.

#### **Biosketches:**

Biosketches of all PIs, co-PIs, senior personnel and consultants listed anywhere in the proposals (including on subawards) should be provided in 'Biographical Sketches' section of the lead organizations proposal and must adhere to NSF guidelines (refer to GPG Chapter II.C.f for detailed Biosketch preparation instructions). Do not place any biosketches in Supplementary Documents.

#### **Special information and Supplementary Documentation:**

**Management Plan** (up to 3 pages; submit as a Supplementary Document): The management plan should describe the management, communication and administrative structure with sufficient detail to demonstrate the capability for conducting the proposed work. The Management Plan should identify the roles and responsibilities of all named participants and should include an appropriate Gantt Plot describing how the tasks will be integrated over the course of the project.

#### **FEW Context Statement (up to one page, placed in the Supplementary Documents):**

The context statement will briefly summarize key elements of the proposal and should contain the following information:

- the persuasive reasons why the research is to be undertaken and how the work will significantly enhance knowledge of FEW systems.
- an explanation and definition of the food and energy and water systems the work is addressing and why the overall system to be studied is of importance.
- definition of the (at least) three science components from three or more intellectually distinct disciplines that, in aggregate, represent scientific areas typically supported by three or more of the participating NSF directorates or two (or more) directorates and USDA/NIFA (USDA/NIFA may serve the role of a "discipline" if the research focus represents a topical area that is uniquely distinct from disciplines typically supported by NSF Directorates.)

Proposals missing this context statement or proposals that include a context statement exceeding one page in length will be returned without review.

**Postdoctoral Researcher Mentoring Plan (PRMP, up to 1 page):** Proposals that request funding to support postdoctoral researchers at any of the participating institutions must include a description of the disciplinary and cross-disciplinary mentoring activities that will be provided for such individuals. Only one one-page PRMP is allowed per proposal even if multiple postdoctoral researchers from different institutions are involved. Thus the PRMP will be an additional means of providing cross-disciplinary mentoring across institutions and the project as a whole.

**Data Management Plan (DMP, up to 2 pages):** The DMP should describe how the project will use and contribute to centralized efforts for data management including model-run output where applicable. The following information should be provided:

1. The types of data, samples, physical collections, software, and other materials to be produced in the course of the project;
2. The standards to be used for data and metadata format and content (where existing standards are absent or deemed inadequate, this should be documented along with any proposed solutions or remedies); in all cases existing publicly accessible data bases should be utilized wherever it is appropriate;
3. Policies for access and sharing including provisions for appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements;
4. Policies and provisions for re-use, re-distribution, and the production of derivatives;
5. Plans for archiving data, samples, and other research products, and for preservation of access to them;
6. The data management plan is considered an integral part of the project and therefore subject to reviewer, panel, and program evaluation. Successful applicants will be expected to address data management issues in annual and final project reports.

#### **Results from Prior Research:**

"Results from Prior Research" (NSF research) must be provided for all named participating scientists as a single document of up to four pages and is to be included in Supplementary Documents. Thus, "Results from Prior NSF Research" is not required to be placed into the 15 page project description. "Results of Prior NSF Research" is a requirement of all NSF submitted proposals. Instructions for what is to be included in "Results from Prior Research" are provided in the GPG.

#### **Letters of Collaboration:**

Applicants wishing to document collaborative arrangements or other types of commitments must submit letters of collaboration (as Supplementary Documents). All letters of collaboration must be included at the time of the proposal submission. Letters of support that solely convey a sense of enthusiasm for the project or highlight research team qualifications are not permitted.

**INFEWS strongly recommends the use of a template for letters of collaboration or letters of commitment. If one of these templates or very similar text is not used, the text provided by the letter's author must be equally brief and to the point. Inclusion of longer letters may result in the PIs being forced to remove such letters (with no other changes to the proposal permitted) or in NSF's returning the proposal without review.**

*Suggested template for a letter of collaboration from an individual:*

To: NSF INFEWS Program

From: \_\_\_\_\_ [Insert the name of the individual collaborator or name of the organization and name and position of the official submitting this letter]

By signing below or by transmitting this message electronically, I acknowledge that I am listed as a collaborator on the proposal

titled " \_\_\_\_\_," [Insert proposal title] with \_\_\_\_\_ [Insert the PI's name] as the Principal Investigator.

I agree to undertake the tasks associated with me as described in the project description and the management plan of this proposal.

Signed: \_\_\_\_\_ [Insert the signature or name of the author of this letter]

Organization: \_\_\_\_\_ [Insert the name of the organization the letter's author is representing or with which the author is associated]

Date: \_\_\_\_\_ [Insert the date when the letter is signed or transmitted]

*Suggested template for a letter of collaboration from an organization:*

To: NSF INFEWS Program

From: \_\_\_\_\_ [Insert the name of the individual or name of the organization and name and position of the official submitting this letter]

By signing below or by transmitting this message electronically, I acknowledge that I or my organization is listed as providing resources for the project described in the proposal titled " \_\_\_\_\_," [Insert proposal title] with \_\_\_\_\_ [Insert the PI's name] as the Principal Investigator.

I commit to provide or make available the resources designated in the project description of the proposal and the specific subaward that seeks support for this project.

Signed: \_\_\_\_\_ [Insert the signature or name of the author of this letter]

Organization: \_\_\_\_\_ [Insert the name of the organization the letter's author is representing or with which the author is associated]

Date: \_\_\_\_\_ [Insert the date when the letter is signed or transmitted]

*Suggested template for an International or Industrial Partner letter of collaboration:*

To: NSF INFEWS Program

From: \_\_\_\_\_ [Insert the name of academic institution, company or other organization, including sub-division or department]

By signing below or by transmitting this message electronically, I acknowledge that \_\_\_\_\_ [Insert name of Agency] is listed as providing resources or performing tasks for the project described in the proposal titled " \_\_\_\_\_," [Insert proposal title] with \_\_\_\_\_ [Insert the PI's name] as the lead Principal Investigator.

I commit to provide or make available the resources designated in the project description and management plan of the proposal that seeks support for this project. Specifically, I acknowledge that \_\_\_\_\_ [the signer's institution] will provide \_\_\_\_\_ [briefly list or describe personnel time, facilities, materials, or other resources that will be provided]. I anticipate that \_\_\_\_\_ [signers institution] will benefit from this collaboration by \_\_\_\_\_ [or through; discuss briefly the benefits of this collaboration beyond financial compensation, which is expected to be none or minimal for international and industrial partners].

Signed: \_\_\_\_\_ [Insert the signature or name of the author of this letter]

Organization: \_\_\_\_\_ [Insert the name of the organization the letter's author is representing or with which the author is associated]

Date: \_\_\_\_\_ [Insert the date when the letter is signed or transmitted]

**Conflicts of Interest Matrix Table** (created as a spreadsheet and uploaded as a pdf in the Single Copy Documents section):

Proposals must include a table with the names of all individuals associated (named) with the projects, including international participants. The table must also include the individuals' conflicts of interest (COIs). Conflicts to be identified are (1) Ph.D. thesis advisors or advisees, (2) collaborators or co-authors, including postdoctoral researchers, for the past 48 months, and (3) any other individuals with whom or institutions with which the senior personnel (PI, co-PIs, and any named personnel) have financial ties, including advisory committees (please specify type). If submitting via Grants.gov, complete the information and attach as a PDF file (see Field 5, Additional Single Copy Documents, on the NSF Grant Application Cover Page). The COI matrix must include the information according to the following template (Please provide COI matrix alphabetized by Column A then Column C):

- Column A: PI, coPI or Senior Personnel or consultant on project or any individual or organization providing a letter of collaboration (last name, first name).
- Column B: Institution of PI, coPI or senior personnel on project
- Column C: name of person with whom there is a conflict for the person in column "A" (last name, first name)
- Column D: institution of person in column "C"
- Column E: type of COI

**Project Personnel Table** (PIs, coPIs, senior personnel, consultants as well as any project advisory committee members) for Proposal (Single Copy Documents section):

Each proposal should submit ONE participant list for their PROJECT. These individuals should be identified as to their responsibility in the Management Plan and should have an NSF style biosketch included within the "Biosketch" portion (also known as "Biographical Sketches") of the proposal. The table should include the names of all individuals associated (named) with the project including international participants according to the following template.

- Column A: PI, coPI, Senior Personnel or consultant on project (last name, first name).
- Column B: Institution of PI, coPI, senior personnel, or consultant on project.

**Other Considerations:** Where appropriate, investigators are encouraged to work in association with existing projects, observational networks, experimental watersheds, long-term ecological research sites or research centers, or testing and evaluation facilities, whether supported by NSF or other agencies, such as USEPA, USGS, USDA/NIFA, ARS or NOAA. In such proposals, the project description should make clear how the proposed work differs from and augments activities already supported. A letter stating the

specifics of cooperation or support from the ongoing activity for the proposed project should be included as Supplementary Documents.

## B. Budgetary Information

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### Cost Sharing:

Inclusion of voluntary committed cost sharing is prohibited.

### Indirect Cost (F&A) Limitations:

**For awards made by USDA/NIFA:** Section 715 of the Consolidated and Further Continuing Appropriations Act, 2015 (Pub. L. 113-235) limits indirect costs to 30 percent of the total Federal funds provided by NIFA (or 42.857 percent of total direct costs) under each award. Similar language may be included in the FY 2016 appropriation, therefore, when preparing budgets, you should limit your request for the recovery of indirect costs to the lesser of your institution's official negotiated indirect cost rate or the equivalent of 30 percent of total Federal funds awarded. See Part V section 7.9 of the NIFA Grants.gov Application Guide for further indirect cost information.

### Budget Preparation Instructions:

If one participating unit constitutes an FFRDC and/or another US government agency, expenses associated with participation of those scientists should be consolidated into a single subaward (for each agency). Should the proposal be successful, the full FFRDC financial commitment is to be met by the FFRDC agency. It is thus necessary that FFRDC submissions should be cleared in advance with the relevant agency and the submission should be supported by an email confirmation from that agency (in the Supplementary Documents section).

Budgets submitted must include AT LEAST one person trip per year to the DC area over the lifetime of the project to represent the project at the annual INFEWS PI meeting. Budget for more than one PI meeting trip or travel by more than one project participant is allowed.

## C. Due Dates

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- **Full Proposal Deadline(s)** (due by 5 p.m. submitter's local time):

March 22, 2016

## D. FastLane/Grants.gov Requirements

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### For Proposals Submitted Via FastLane:

To prepare and submit a proposal via FastLane, see detailed technical instructions available at: <https://www.fastlane.nsf.gov/a1/newstan.htm>. For FastLane user support, call the FastLane Help Desk at 1-800-673-6188 or e-mail [fastlane@nsf.gov](mailto:fastlane@nsf.gov). The FastLane Help Desk answers general technical questions related to the use of the FastLane system. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this funding opportunity.

### For Proposals Submitted Via Grants.gov:

Before using Grants.gov for the first time, each organization must register to create an institutional profile. Once registered, the applicant's organization can then apply for any federal grant on the Grants.gov website. Comprehensive information about using Grants.gov is available on the Grants.gov Applicant Resources webpage: <http://www.grants.gov/web/grants/applicants.html>. In addition, the NSF Grants.gov Application Guide (see link in Section V.A) provides instructions regarding the technical preparation of proposals via Grants.gov. For Grants.gov user support, contact the Grants.gov Contact Center at 1-800-518-4726 or by email: [support@grants.gov](mailto:support@grants.gov). The Grants.gov Contact Center answers general technical questions related to the use of Grants.gov. Specific questions related to this program solicitation should be referred to the NSF program staff contact(s) listed in Section VIII of this solicitation.

**Submitting the Proposal:** Once all documents have been completed, the Authorized Organizational Representative (AOR) must submit the application to Grants.gov and verify the desired funding opportunity and agency to which the application is submitted. The AOR must then sign and submit the application to Grants.gov. The completed application will be transferred to the NSF FastLane system for further processing.

Proposers that submitted via FastLane are strongly encouraged to use FastLane to verify the status of their submission to NSF. For proposers that submitted via Grants.gov, until an application has been received and validated by NSF, the Authorized Organizational Representative may check the status of an application on Grants.gov. After proposers have received an e-mail notification from NSF, Research.gov should be used to check the status of an application.

## VI. NSF PROPOSAL PROCESSING AND REVIEW PROCEDURES

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Proposals received by NSF are assigned to the appropriate NSF program for acknowledgement and, if they meet NSF requirements, for review. All proposals are carefully reviewed by a scientist, engineer, or educator serving as an NSF Program Officer, and usually by three to ten other persons outside NSF either as *ad hoc* reviewers, panelists, or both, who are experts in the particular fields represented by the proposal. These reviewers are selected by Program Officers charged with oversight of the review process. Proposers are invited to suggest names of persons they believe are especially well qualified to review the proposal and/or persons

they would prefer not review the proposal. These suggestions may serve as one source in the reviewer selection process at the Program Officer's discretion. Submission of such names, however, is optional. Care is taken to ensure that reviewers have no conflicts of interest with the proposal. In addition, Program Officers may obtain comments from site visits before recommending final action on proposals. Senior NSF staff further review recommendations for awards. A flowchart that depicts the entire NSF proposal and award process (and associated timeline) is included in the [GPG](#) as Exhibit III-1.

A comprehensive description of the Foundation's merit review process is available on the NSF website at: [http://www.nsf.gov/bfa/dias/policy/merit\\_review/](http://www.nsf.gov/bfa/dias/policy/merit_review/).

Proposers should also be aware of core strategies that are essential to the fulfillment of NSF's mission, as articulated in *Investing in Science, Engineering, and Education for the Nation's Future: NSF Strategic Plan for 2014-2018*. These strategies are integrated in the program planning and implementation process, of which proposal review is one part. NSF's mission is particularly well-implemented through the integration of research and education and broadening participation in NSF programs, projects, and activities.

One of the strategic objectives in support of NSF's mission is to foster integration of research and education through the programs, projects, and activities it supports at academic and research institutions. These institutions must recruit, train, and prepare a diverse STEM workforce to advance the frontiers of science and participate in the U.S. technology-based economy. NSF's contribution to the national innovation ecosystem is to provide cutting-edge research under the guidance of the Nation's most creative scientists and engineers. NSF also supports development of a strong science, technology, engineering, and mathematics (STEM) workforce by investing in building the knowledge that informs improvements in STEM teaching and learning.

NSF's mission calls for the broadening of opportunities and expanding participation of groups, institutions, and geographic regions that are underrepresented in STEM disciplines, which is essential to the health and vitality of science and engineering. NSF is committed to this principle of diversity and deems it central to the programs, projects, and activities it considers and supports.

## A. Merit Review Principles and Criteria

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The National Science Foundation strives to invest in a robust and diverse portfolio of projects that creates new knowledge and enables breakthroughs in understanding across all areas of science and engineering research and education. To identify which projects to support, NSF relies on a merit review process that incorporates consideration of both the technical aspects of a proposed project and its potential to contribute more broadly to advancing NSF's mission "to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes." NSF makes every effort to conduct a fair, competitive, transparent merit review process for the selection of projects.

### 1. Merit Review Principles

These principles are to be given due diligence by PIs and organizations when preparing proposals and managing projects, by reviewers when reading and evaluating proposals, and by NSF program staff when determining whether or not to recommend proposals for funding and while overseeing awards. Given that NSF is the primary federal agency charged with nurturing and supporting excellence in basic research and education, the following three principles apply:

- All NSF projects should be of the highest quality and have the potential to advance, if not transform, the frontiers of knowledge.
- NSF projects, in the aggregate, should contribute more broadly to achieving societal goals. These "Broader Impacts" may be accomplished through the research itself, through activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. The project activities may be based on previously established and/or innovative methods and approaches, but in either case must be well justified.
- Meaningful assessment and evaluation of NSF funded projects should be based on appropriate metrics, keeping in mind the likely correlation between the effect of broader impacts and the resources provided to implement projects. If the size of the activity is limited, evaluation of that activity in isolation is not likely to be meaningful. Thus, assessing the effectiveness of these activities may best be done at a higher, more aggregated, level than the individual project.

With respect to the third principle, even if assessment of Broader Impacts outcomes for particular projects is done at an aggregated level, PIs are expected to be accountable for carrying out the activities described in the funded project. Thus, individual projects should include clearly stated goals, specific descriptions of the activities that the PI intends to do, and a plan in place to document the outputs of those activities.

These three merit review principles provide the basis for the merit review criteria, as well as a context within which the users of the criteria can better understand their intent.

### 2. Merit Review Criteria

All NSF proposals are evaluated through use of the two National Science Board approved merit review criteria. In some instances, however, NSF will employ additional criteria as required to highlight the specific objectives of certain programs and activities.

The two merit review criteria are listed below. **Both** criteria are to be given **full consideration** during the review and decision-making processes; each criterion is necessary but neither, by itself, is sufficient. Therefore, proposers must fully address both criteria. ([GPG](#) Chapter II.C.2.d.i. contains additional information for use by proposers in development of the Project Description section of the proposal.) Reviewers are strongly encouraged to review the criteria, including [GPG](#) Chapter II.C.2.d.i., prior to the review of a proposal.

When evaluating NSF proposals, reviewers will be asked to consider what the proposers want to do, why they want to do it, how they plan to do it, how they will know if they succeed, and what benefits could accrue if the project is successful. These issues apply both to the technical aspects of the proposal and the way in which the project may make broader contributions. To that end, reviewers will be asked to evaluate all proposals against two criteria:

- **Intellectual Merit:** The Intellectual Merit criterion encompasses the potential to advance knowledge; and
- **Broader Impacts:** The Broader Impacts criterion encompasses the potential to benefit society and contribute to the achievement of specific, desired societal outcomes.

The following elements should be considered in the review for both criteria:

1. What is the potential for the proposed activity to
  - a. Advance knowledge and understanding within its own field or across different fields (Intellectual Merit); and
  - b. Benefit society or advance desired societal outcomes (Broader Impacts)?

2. To what extent do the proposed activities suggest and explore creative, original, or potentially transformative concepts?
3. Is the plan for carrying out the proposed activities well-reasoned, well-organized, and based on a sound rationale? Does the plan incorporate a mechanism to assess success?
4. How well qualified is the individual, team, or organization to conduct the proposed activities?
5. Are there adequate resources available to the PI (either at the home organization or through collaborations) to carry out the proposed activities?

Broader impacts may be accomplished through the research itself, through the activities that are directly related to specific research projects, or through activities that are supported by, but are complementary to, the project. NSF values the advancement of scientific knowledge and activities that contribute to achievement of societally relevant outcomes. Such outcomes include, but are not limited to: full participation of women, persons with disabilities, and underrepresented minorities in science, technology, engineering, and mathematics (STEM); improved STEM education and educator development at any level; increased public scientific literacy and public engagement with science and technology; improved well-being of individuals in society; development of a diverse, globally competitive STEM workforce; increased partnerships between academia, industry, and others; improved national security; increased economic competitiveness of the United States; and enhanced infrastructure for research and education.

Proposers are reminded that reviewers will also be asked to review the Data Management Plan and the Postdoctoral Researcher Mentoring Plan, as appropriate.

#### **Additional Solicitation Specific Review Criteria**

In addition to the National Science Board merit review criteria, reviewers will be asked to apply the following program-specific criteria when reviewing INFEWS proposals.

- **Systems Approach:** How well does the proposal incorporate and integrate across food, water, and energy systems? Are the proposed study systems appropriately defined?
- **Interdisciplinary Integration:** How well do the proposed research activities integrate across at least three or more intellectually distinct disciplines that, in aggregate, represent scientific areas supported by three or more of the participating NSF Directorates or two Directorates and USDA/NIFA. (USDA/NIFA may be invoked as a "discipline" if the research focus represents a topical area that is uniquely distinct from disciplines typically supported by NSF Directorates. See also FAQ.)
- Does the research team include sufficient expertise to carry out the interdisciplinary research?

## **B. Review and Selection Process**

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Proposals submitted in response to this program solicitation will be reviewed by

Ad hoc Review and/or Panel Review.

Reviewers will be asked to evaluate proposals using two National Science Board approved merit review criteria and, if applicable, additional program specific criteria. A summary rating and accompanying narrative will be completed and submitted by each reviewer. The Program Officer assigned to manage the proposal's review will consider the advice of reviewers and will formulate a recommendation.

The program may implement a two-stage panel review process, depending on the number and breadth of proposals received. During a first review stage, groups of thematically similar proposals would undergo panel review. The program's management team would consider the panels' advice and, if warranted, select proposals to move on to a second stage of review. Proposals not selected for further consideration may be declined at this point.

After scientific, technical and programmatic review and consideration of appropriate factors, the NSF Program Officer recommends to the cognizant Division Director whether the proposal should be declined or recommended for award. NSF strives to be able to tell applicants whether their proposals have been declined or recommended for funding within six months. Large or particularly complex proposals or proposals from new awardees may require additional review and processing time. The time interval begins on the deadline or target date, or receipt date, whichever is later. The interval ends when the Division Director acts upon the Program Officer's recommendation.

After programmatic approval has been obtained, the proposals recommended for funding will be forwarded to the Division of Grants and Agreements for review of business, financial, and policy implications. After an administrative review has occurred, Grants and Agreements Officers perform the processing and issuance of a grant or other agreement. Proposers are cautioned that only a Grants and Agreements Officer may make commitments, obligations or awards on behalf of NSF or authorize the expenditure of funds. No commitment on the part of NSF should be inferred from technical or budgetary discussions with a NSF Program Officer. A Principal Investigator or organization that makes financial or personnel commitments in the absence of a grant or cooperative agreement signed by the NSF Grants and Agreements Officer does so at their own risk.

Once an award or declination decision has been made, Principal Investigators are provided feedback about their proposals. In all cases, reviews are treated as confidential documents. Verbatim copies of reviews, excluding the names of the reviewers or any reviewer-identifying information, are sent to the Principal Investigator/Project Director by the Program Officer. In addition, the proposer will receive an explanation of the decision to award or decline funding.

#### **USDA/NIFA**

Applicants selected for funding by USDA/NIFA will be required to provide additional information in accordance with policies and procedures of the [Agriculture and Food Research Initiative](#) (AFRI) program. Applications selected for funding by NIFA will be forwarded to the USDA/NIFA Awards Management Division for award processing in accordance with the USDA/NIFA procedures.

## **VII. AWARD ADMINISTRATION INFORMATION**

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### **A. Notification of the Award**

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Notification of the award is made to *the submitting organization* by a Grants Officer in the Division of Grants and Agreements. Organizations whose proposals are declined will be advised as promptly as possible by the cognizant NSF Program administering the program. Verbatim copies of reviews, not including the identity of the reviewer, will be provided automatically to the Principal Investigator. (See Section VI.B. for additional information on the review process).

## USDA/NIFA

The award document will provide pertinent instructions and information including, at a minimum, the following:

1. Legal name and address of performing organization or institution to whom the Director has issued an award under the terms of this request for applications;
2. Title of project;
3. Name(s) and institution(s) of PDs chosen to direct and control approved activities;
4. Identifying award number assigned by the Department;
5. Project period, specifying the amount of time the Department intends to support the project without requiring recompetition for funds;
6. Total amount of Departmental financial assistance approved by the Director during the project period;
7. Legal authority (ies) under which the award is issued;
8. Appropriate Catalog of Federal Domestic Assistance (CFDA) number;
9. Applicable award terms and conditions (see <http://www.nifa.usda.gov/business/awards/awardterms.html> to view NIFA award terms and conditions);
10. Approved budget plan for categorizing allocable project funds to accomplish the stated purpose of the award; and
11. Other information or provisions deemed necessary by NIFA to carry out its respective awarding activities or to accomplish the purpose of a particular award.

## B. Award Conditions

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An NSF award consists of: (1) the award notice, which includes any special provisions applicable to the award and any numbered amendments thereto; (2) the budget, which indicates the amounts, by categories of expense, on which NSF has based its support (or otherwise communicates any specific approvals or disapprovals of proposed expenditures); (3) the proposal referenced in the award notice; (4) the applicable award conditions, such as Grant General Conditions (GC-1)\*; or Research Terms and Conditions\* and (5) any announcement or other NSF issuance that may be incorporated by reference in the award notice. Cooperative agreements also are administered in accordance with NSF Cooperative Agreement Financial and Administrative Terms and Conditions (CA-FATC) and the applicable Programmatic Terms and Conditions. NSF awards are electronically signed by an NSF Grants and Agreements Officer and transmitted electronically to the organization via e-mail.

\*These documents may be accessed electronically on NSF's Website at [http://www.nsf.gov/awards/managing/award\\_conditions.jsp?org=NSF](http://www.nsf.gov/awards/managing/award_conditions.jsp?org=NSF). Paper copies may be obtained from the NSF Publications Clearinghouse, telephone (703) 292-7827 or by e-mail from [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov).

More comprehensive information on NSF Award Conditions and other important information on the administration of NSF awards is contained in the *NSF Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

### Special Award Conditions:

#### USDA/NIFA

Awards issued as a result of this RFA will have designated the Automated Standard Applications for Payment System (ASAP), operated by the Department of Treasury's Bureau of the Fiscal Service, as the payment system for funds. For more information see <http://fms.treas.gov/index1.html>.

Several federal statutes and regulations apply to grant applications considered for review and to project grants awarded under this program. These may include, but are not limited to, the ones listed on the NIFA web page - <http://nifa.usda.gov/federal-regulations>.

NIFA Federal Assistance Policy Guide—a compendium of basic NIFA policies and procedures that apply to all NIFA awards, unless there are statutory, regulatory, or award-specific requirements to the contrary is available at <http://nifa.usda.gov/policy-guide>.

### Other Requirements

#### USDA/NIFA:

1. Delegation of Fiscal Responsibility

Unless the terms and conditions of the grant state otherwise, the grantee may not, in whole or in part, delegate or transfer to another person, institution, or organization the responsibility for use or expenditure of grant funds.

2. Changes in Project Plans

- a. The permissible changes by the grantee, PD(s), or other key project personnel in the approved project grant shall be limited to changes in methodology, techniques, or other similar aspects of the project to expedite achievement of the project's approved goals. If the grantee or the PD(s) is uncertain as to whether a change complies with this provision, the question must be referred to the Authorized Departmental Officer (ADO) for a final determination. The ADO is the signatory of the award document, not the program contact.
- b. Changes in approved goals or objectives shall be requested by the grantee and approved in writing by the ADO prior to effecting such changes. In no event shall requests for such changes be approved which are outside the scope of the original approved project.
- c. Changes in approved project leadership or the replacement or reassignment of other key project personnel shall be requested by the grantee and approved in writing by the ADO prior to effecting such changes.
- d. Transfers of actual performance of the substantive programmatic work in whole or in part and provisions for payment of funds, whether or not Federal funds are involved, shall be requested by the grantee and approved in writing by the ADO prior to effecting such transfers, unless prescribed otherwise in the terms and conditions of the grant.
- e. Changes in Project Period: The project period may be extended by USDA/NIFA without additional financial support, for such additional period(s) as the ADO determines may be necessary to complete or fulfill the purposes of an approved project, but in no case shall the total project period exceed ten years. Any extension of time shall

be conditioned upon prior request by the grantee and approval in writing by the ADO, unless prescribed otherwise in the terms and conditions of a grant.

Changes in Approved Budget: Changes in an approved budget must be requested by the grantee and approved in writing by the ADO prior to instituting such changes if the revision will involve transfers or expenditures of amounts requiring prior approval as set forth in the applicable Federal cost principles, Departmental regulations, or grant award.

## C. Reporting Requirements

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For all multi-year grants (including both standard and continuing grants), the Principal Investigator must submit an annual project report to the cognizant Program Officer no later than 90 days prior to the end of the current budget period. (Some programs or awards require submission of more frequent project reports). No later than 120 days following expiration of a grant, the PI also is required to submit a final project report, and a project outcomes report for the general public.

Failure to provide the required annual or final project reports, or the project outcomes report, will delay NSF review and processing of any future funding increments as well as any pending proposals for all identified PIs and co-PIs on a given award. PIs should examine the formats of the required reports in advance to assure availability of required data.

PIs are required to use NSF's electronic project-reporting system, available through Research.gov, for preparation and submission of annual and final project reports. Such reports provide information on accomplishments, project participants (individual and organizational), publications, and other specific products and impacts of the project. Submission of the report via Research.gov constitutes certification by the PI that the contents of the report are accurate and complete. The project outcomes report also must be prepared and submitted using Research.gov. This report serves as a brief summary, prepared specifically for the public, of the nature and outcomes of the project. This report will be posted on the NSF website exactly as it is submitted by the PI.

More comprehensive information on NSF Reporting Requirements and other important information on the administration of NSF awards is contained in the NSF *Award & Administration Guide* (AAG) Chapter II, available electronically on the NSF Website at [http://www.nsf.gov/publications/pub\\_summ.jsp?ods\\_key=aag](http://www.nsf.gov/publications/pub_summ.jsp?ods_key=aag).

### USDA/NIFA:

Grantees are to submit initial project information and annual summary reports to USDA/NIFA's electronic, Web-based inventory system that facilitates both grantee submissions of project outcomes and public access to information on Federally-funded projects. The details of these reporting requirements are included in the award terms and conditions.

**Any additional reporting requirements will be identified in the terms and conditions of the award (see Part VI, B.9. for a link to view the USDA/NIFA award terms and conditions).**

### Additional Reporting Requirements

- For awards funded by NSF, PIs will be required to include descriptions of their project milestones and their data management activities in their annual reports. Data reporting should conform to current NSF data policy guidelines; PIs should consult with the GPG.
- For awards funded by USDA/NIFA, reporting requirements for awards funded will conform to those specified by USDA/NIFA.
- For projects that are funded by NSF and USDA/NIFA, the annual report of the lead project in the collaborative must be resident at NSF and must include a description of the activities and milestones of the parts of the project that are funded by the other agencies.
- When a project is funded by both agencies, the NSF-lead institutions should submit a unified annual report and the USDA/NIFA funded portion of the project should include the NSF-unified annual report as part of its USDA/NIFA annual report (see also FAQ).

## VIII. AGENCY CONTACTS

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*Please note that the program contact information is current at the time of publishing. See program website for any updates to the points of contact.*

General inquiries regarding this program should be made to:

- Thomas Torgersen, Co-Chair, Directorate for Geosciences, telephone: 703-292-4738, email: [ttorgers@nsf.gov](mailto:ttorgers@nsf.gov)
- JoAnn Lighty, Co-Chair, Directorate for Engineering, telephone: 703-292-9763, email: [jlighty@nsf.gov](mailto:jlighty@nsf.gov)
- David Corman, Directorate for Computer & Information Science & Engineering, telephone: 703-292-8754, email: [dcorman@nsf.gov](mailto:dcorman@nsf.gov)
- Alan Tessier, Directorate for Biological Sciences, telephone: 703-292-7198, email: [atessier@nsf.gov](mailto:atessier@nsf.gov)
- Carol Bessel, Directorate for Mathematical & Physical Sciences, telephone: 703-292-4906, email: [cbessel@nsf.gov](mailto:cbessel@nsf.gov)
- Robert O'Connor, Directorate for Social, Behavioral & Economic Sciences, telephone: 703-292-7263, email: [roconnor@nsf.gov](mailto:roconnor@nsf.gov)
- David Campbell, Directorate for Education & Human Resources, telephone: 703-292-5093, email: [dcampbel@nsf.gov](mailto:dcampbel@nsf.gov)
- Lara Campbell, Office of International Science and Engineering, telephone: 703-292-7049, email: [lcampbel@nsf.gov](mailto:lcampbel@nsf.gov)
- Audrey Levine, Office of Integrative Activities, telephone: 703-292-7374, email: [alevine@nsf.gov](mailto:alevine@nsf.gov)
- Rachel Melnick, USDA/NIFA, telephone: 202-401-4980, email: [rmelnick@nifa.usda.gov](mailto:rmelnick@nifa.usda.gov)

- Bruce Hamilton, Directorate for Engineering, telephone: 703-292-7066, email: [bhamilto@nsf.gov](mailto:bhamilto@nsf.gov)
- Patrick Harr, Directorate for Geosciences, telephone: 703-292-8523, email: [pharr@nsf.gov](mailto:pharr@nsf.gov)

For questions related to the use of FastLane, contact:

- FastLane Help Desk, telephone: 1-800-673-6188; e-mail: [fastlane@nsf.gov](mailto:fastlane@nsf.gov).

For questions relating to Grants.gov contact:

- Grants.gov Contact Center: If the Authorized Organizational Representatives (AOR) has not received a confirmation message from Grants.gov within 48 hours of submission of application, please contact via telephone: 1-800-518-4726; e-mail: [support@grants.gov](mailto:support@grants.gov).

*See website for track team members. Those listed above are the members of the INFEWS Working Group responsible for internal oversight of this solicitation. All questions regarding proposal submissions should be directed to [INFEWSquestions@NSF.GOV](mailto:INFEWSquestions@NSF.GOV) or the program officers on the track teams responsible for the different tracks. See program description for descriptions of the different tracks. A complete list of the program officers on these track teams can be found on the program website ([www.nsf.gov/geo/ere/ereweb/infeWS-contacts.jsp](http://www.nsf.gov/geo/ere/ereweb/infeWS-contacts.jsp)).*

## IX. OTHER INFORMATION

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The NSF website provides the most comprehensive source of information on NSF Directorates (including contact information), programs and funding opportunities. Use of this website by potential proposers is strongly encouraged. In addition, "NSF Update" is an information-delivery system designed to keep potential proposers and other interested parties apprised of new NSF funding opportunities and publications, important changes in proposal and award policies and procedures, and upcoming NSF [Grants Conferences](#). Subscribers are informed through e-mail or the user's Web browser each time new publications are issued that match their identified interests. "NSF Update" also is available on [NSF's website](#).

Grants.gov provides an additional electronic capability to search for Federal government-wide grant opportunities. NSF funding opportunities may be accessed via this mechanism. Further information on Grants.gov may be obtained at <http://www.grants.gov>.

## ABOUT THE NATIONAL SCIENCE FOUNDATION

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The National Science Foundation (NSF) is an independent Federal agency created by the National Science Foundation Act of 1950, as amended (42 USC 1861-75). The Act states the purpose of the NSF is "to promote the progress of science; [and] to advance the national health, prosperity, and welfare by supporting research and education in all fields of science and engineering."

NSF funds research and education in most fields of science and engineering. It does this through grants and cooperative agreements to more than 2,000 colleges, universities, K-12 school systems, businesses, informal science organizations and other research organizations throughout the US. The Foundation accounts for about one-fourth of Federal support to academic institutions for basic research.

NSF receives approximately 55,000 proposals each year for research, education and training projects, of which approximately 11,000 are funded. In addition, the Foundation receives several thousand applications for graduate and postdoctoral fellowships. The agency operates no laboratories itself but does support National Research Centers, user facilities, certain oceanographic vessels and Arctic and Antarctic research stations. The Foundation also supports cooperative research between universities and industry, US participation in international scientific and engineering efforts, and educational activities at every academic level.

*Facilitation Awards for Scientists and Engineers with Disabilities* provide funding for special assistance or equipment to enable persons with disabilities to work on NSF-supported projects. See Grant Proposal Guide Chapter II, Section D.2 for instructions regarding preparation of these types of proposals.

The National Science Foundation has Telephonic Device for the Deaf (TDD) and Federal Information Relay Service (FIRS) capabilities that enable individuals with hearing impairments to communicate with the Foundation about NSF programs, employment or general information. TDD may be accessed at (703) 292-5090 and (800) 281-8749, FIRS at (800) 877-8339.

The National Science Foundation Information Center may be reached at (703) 292-5111.

### About the National Institute of Food and Agriculture

The National Institute of Food and Agriculture (NIFA) is an agency within the U.S. Department of Agriculture (USDA), part of the executive branch of the Federal Government. Congress created NIFA through the Food, Conservation, and Energy Act of 2008. NIFA replaced the former Cooperative State Research, Education, and Extension Service (CSREES), which had been in existence since 1994. NIFA's unique mission is to advance knowledge for agriculture, the environment, human health and well-being, and communities by supporting research, education, and extension programs in the Land-Grant University System and other partner organizations. NIFA doesn't perform actual research, education, and extension but rather helps fund it at the state and local level and provides program leadership in these areas. Through grants offered by NIFA, the USDA enables researchers throughout the United States to solve problems critical to our farmers, consumers, and communities. NIFA is the USDA's major extramural research agency, funding individuals, institutions, and public, private, and non-profit organizations. NIFA's education programs supports and promotes teaching excellence, enhances academic quality, and develops tomorrow's scientific and professional workforce. In cooperation with public institutions, private sector partners, and the Land-Grant University System, NIFA provides national leadership to address critical educational issues. NIFA's extension projects deliver science-based knowledge and informal educational programs to people, enabling them to make practical decisions.

NIFA Web site:

<http://www.nifa.usda.gov/>  
Phone: (202) 720-4423

Street Address:

National Institute of Food and Agriculture  
Waterfront Centre  
800 9th St. SW., Washington, DC 20024

Mailing Address:

United States Department of Agriculture  
National Institute of Food and Agriculture  
1400 Independence Avenue SW., Stop 2201  
Washington, DC 20250-2201

The National Science Foundation promotes and advances scientific progress in the United States by competitively awarding grants and cooperative agreements for research and education in the sciences, mathematics, and engineering.

To get the latest information about program deadlines, to download copies of NSF publications, and to access abstracts of awards, visit the NSF Website at <http://www.nsf.gov>

- **Location:** 4201 Wilson Blvd. Arlington, VA 22230
- **For General Information**  
(NSF Information Center): (703) 292-5111
- **TDD (for the hearing-impaired):** (703) 292-5090
- **To Order Publications or Forms:**  
Send an e-mail to: [nsfpubs@nsf.gov](mailto:nsfpubs@nsf.gov)  
or telephone: (703) 292-7827
- **To Locate NSF Employees:** (703) 292-5111

## PRIVACY ACT AND PUBLIC BURDEN STATEMENTS

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The information requested on proposal forms and project reports is solicited under the authority of the National Science Foundation Act of 1950, as amended. The information on proposal forms will be used in connection with the selection of qualified proposals; and project reports submitted by awardees will be used for program evaluation and reporting within the Executive Branch and to Congress. The information requested may be disclosed to qualified reviewers and staff assistants as part of the proposal review process; to proposer institutions/grantees to provide or obtain data regarding the proposal review process, award decisions, or the administration of awards; to government contractors, experts, volunteers and researchers and educators as necessary to complete assigned work; to other government agencies or other entities needing information regarding applicants or nominees as part of a joint application review process, or in order to coordinate programs or policy; and to another Federal agency, court, or party in a court or Federal administrative proceeding if the government is a party. Information about Principal Investigators may be added to the Reviewer file and used to select potential candidates to serve as peer reviewers or advisory committee members. See Systems of Records, [NSF-50](#), "Principal Investigator/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004), and [NSF-51](#), "Reviewer/Proposal File and Associated Records," 69 Federal Register 26410 (May 12, 2004). Submission of the information is voluntary. Failure to provide full and complete information, however, may reduce the possibility of receiving an award.

An agency may not conduct or sponsor, and a person is not required to respond to, an information collection unless it displays a valid Office of Management and Budget (OMB) control number. The OMB control number for this collection is 3145-0058. Public reporting burden for this collection of information is estimated to average 120 hours per response, including the time for reviewing instructions. Send comments regarding the burden estimate and any other aspect of this collection of information, including suggestions for reducing this burden, to:

Suzanne H. Plimpton  
Reports Clearance Officer  
Office of the General Counsel  
National Science Foundation  
Arlington, VA 22230

## X. APPENDIX

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### INFEWS Frequently Asked Questions (FAQs)

#### *About Disciplinary Requirements*

#### 1. What is meant by interdisciplinary INFEWS research?

Proposals are expected to document that the proposed research is truly interdisciplinary and that the respective components are fully integrated and necessary for the successful execution of the proposed project. Plans for integration of the respective research components must be clearly described in the proposal and reinforced within the management plan. All INFEWS proposals must incorporate science from three or more intellectually distinct disciplines that, in aggregate,

represent scientific areas typically supported by three or more of the participating NSF Directorates or two (or more) Directorates and USDA/NIFA. (USDA/NIFA research goals derive from the basic sciences/engineering much akin to NSF. However, some difference may be perceived. USDA/NIFA may be invoked as a "discipline" if the research focus represents a topical area that is uniquely distinct from disciplines typically supported by NSF Directorates. The FEW Context Statement (see below) should carefully elaborate on the specific differences between an NSF and USDA/NIFA "discipline").

- o Directorate for Computer and Information Science and Engineering (CISE)
- o Directorate for Education and Human Resources (EHR)
- o Directorate for Engineering (ENG);
- o Directorate for Geosciences (GEO);

Directorate for Mathematical and Physical Sciences (MPS); and

Directorate for Social, Behavioral, Economic Sciences (SBE);

**2. My proposal encompasses agricultural research that is relevant to USDA/NIFA. Can I use USDA/NIFA supported research to satisfy the interdisciplinary requirement?**

Yes. Research supported by USDA/NIFA can count as one of the three required disciplines. However, it is important that each of the disciplines included in the proposal are distinctly different. For example, if the agricultural research dimensions of your proposal are similar to areas supported by the BIO Directorate, then you will need to incorporate research supported by at least two other participating directorates (i.e. CISE, ENG, GEO, MPS, SBE, and EHR). Similarly, if you are focusing on agricultural engineering research, then you can consider the ENG Directorate as one of the disciplines and then you will need to incorporate research from at least two other directorates (i.e. BIO, CISE, GEO, MPS, SBE, and EHR).

**3. To cover the disciplinary requirements, can I include more than three disciplines in my proposal?**

Yes. You may include as many disciplines as needed to address the key science questions posed by your research. At a minimum, the research needs to reflect scientific areas that are unique to at least three participating NSF Directorates or two Directorates and one USDA/NIFA science. You may also incorporate science from other disciplines not supported by the participating directorates as well, as long as it is the "fourth" discipline.

**4. If the research and methodologies described in my proposal integrate three very different intellectual fields that are classified under one or two NSF Directorates, can this still satisfy the disciplinary requirements?**

No. You need to incorporate three distinct disciplines that fall under the scope of three different Directorates (i.e. BIO, CISE, ENG, GEO, MPS, SBE, EHR) (or two directorates and USDA/NIFA as explained above) to ensure compliance with the solicitation requirements.

For example, if your proposed research includes ethnographic methods (by a cultural anthropologist), game theoretic work (from an economist), algorithms (by a computer scientist), and policy analysis across different third-world countries (by a political scientist), it would be considered under the purview of two NSF Directorates: CISE (computer science) and SBE (economics, cultural anthropology, and political science). To satisfy the disciplinary requirements, a third discipline that falls under the scope of another Directorate (i.e. BIO, ENG, GEO, MPS, and EHR) must be integrated into the proposed research.

**5. My proposal includes a significant educational component. Can I count this as one of the three disciplines needed to satisfy the interdisciplinary requirement?**

The Directorate of Education and Human Resources (EHR) supports education and education research in science, technology, engineering, and mathematical (STEM) fields. In this capacity, the inclusion of STEM education research into a project may be counted among the three disciplines needed to satisfy the solicitation's interdisciplinary requirement. These elements should be fully integrated with the other disciplinary components of the proposal.

Note: Educational activities are strongly encouraged under INFEWS and contribute to the project's broader impacts. However, educational activities cannot be considered as a unique discipline under the solicitation's interdisciplinary requirements.

**6. I see the Office of International Science and Engineering is participating in this solicitation. Can I count the international component of my proposal as one of the three disciplines needed to satisfy the interdisciplinary requirement?**

No. While the Office of International Science and Engineering and the Office of Integrative Activities are participating in this solicitation, these offices are not research directorates. Proposals that address the interests of these offices are welcome, but such components cannot be counted as one of the three scientific disciplines needed to satisfy the interdisciplinary requirement.

**7. What is the preferred contribution level that should be provided by each project participant/discipline?**

There are no specific requirements for the relative distribution of disciplinary expertise yet each component should be included at a level commensurate with the problem scope. The project team should be developed in accordance with the specific project objectives. Strong and well-defined interdisciplinary integration are an important element of the INFEWS program. The appropriateness of the research team's disciplinary composition and expertise will be factors in the merit review of the proposals. See Additional Review Criteria Section for more information.

**About the Scope of Research**

**1. I noticed that throughout the solicitation, FEW systems are described in plural (i.e. systems versus system). Does this mean my project must study more than one system or can I focus on a single system?**

The solicitation is written using "systems" as a plural noun because all proposals submitted to the INFEWS program must outline plans to examine the intersections of food and energy and water systems. It is important to define the specific systems as well as the system of systems that will be addressed by the project.

**2. Can my FEW systems research be place-based, location-specific, or context-dependent or must it have more comprehensive applications?**

The generalizability of models and results is an important consideration of the INFEWS program. While studies of the interactions among food and energy and water systems in a single location are within the scope of the solicitation,

proposals should articulate how the results and outcomes of such a project will be applicable or generalizable in a much broader context.

**3. Should proposals be focused exclusively on FEW systems or can proposals investigate more comprehensive topics, like Sustainable Development, where FEW systems might represent a sub-focus that is critical to the project's success?**

For this solicitation, proposals must focus on food and energy and water systems. Research could qualify if it is multi-disciplinary (i.e. it includes three or more scientific disciplines as stated in the solicitation) and is targeted towards the complex role of FEW systems in a broader context.

**4. I would like to study the health dimensions of FEW systems. Is this feasible under the INFEWS program?**

You will need to make sure that the project meets NSF requirements. For example, the NSF supports research that examines the social, behavioral, and/or physical dimensions of systems that cause adverse health outcomes. However, medical or clinical research cannot be supported by NSF and thus "health" cannot be specifically identified as one of the three requisite "distinct disciplines". INFEWS could support a project that includes a sociologist or an epidemiologist who plans to quantify adverse health outcomes of people within a FEW system or systems. Similarly, INFEWS could support a project that incorporates plans to examine the hydrological, ecological, or behavioral processes that spread pathogens or other contaminants (e.g. chemicals, nanoparticles, microplastics) within FEW systems. However, a project that includes plans to examine specific disease processes or clinical investigations will not be supported. See GPG for further guidance.

**5. I want to use FEW system modeling (Track 1) to explore an innovative system solution (Track 3). How should I decide whether to submit to Track 1 or to Track 3?**

The best approach is to review the solicitation carefully and try to determine which track is the most appropriate fit for your research. It is specifically necessary to identify the track (in the title and justified elsewhere) for which the proposal is most competitive. Please note that proposals cannot be submitted to more than one track.

**6. Is Track 3 limited to research on new and innovative solutions or is it possible to develop advances that build upon existing approaches and technologies?**

Track 3 proposals may lead to advances in existing systems, develop new solutions, or explore alternative or novel applications for the current state-of-the-art. It is important that Track 3 proposals adopt a systems approach that incorporates foundational or transformative research related to at least three disciplines. In preparing your proposal, bear in mind that it will be reviewed using NSF's intellectual merit review criteria. Therefore, proposals must advance knowledge (element 1) and should be creative, original, and/or potentially transformative (element 2). While Track 3 proposals may certainly develop or use approaches that build upon existing methods, strategies, and/or technologies, proposals should clearly demonstrate how the project is novel and will advance knowledge.

**7. I am wondering if a project that explores social, behavioral, or economic solutions and/or linkages among food and energy, and water systems would meet the requirements of this solicitation?**

INFEWS defines FEW systems very broadly, incorporating physical processes (such as built infrastructure and new technologies for more efficient resource utilization), natural processes (such as biogeochemical and hydrologic cycles), biological processes (such as agroecosystem structure and productivity), and social and behavioral processes (such as decision making and governance), and cyber-elements. Therefore, proposals that examine social, behavioral, or economic solutions and/or linkages among FEW systems are strongly encouraged – as long as the projects sufficiently integrate across multiple disciplines (see solicitation for interdisciplinary requirements) and appropriately explore linkages across the various disciplinary dimensions.

**8. I am intrigued about the virtual resource centers that are mentioned under Track 4. Can you help me figure out what types of activities will fall under the scope of the centers? Are the centers intended to have a regional focus or a thematic focus?**

NSF envisions that the centers will serve multiple purposes including providing networking opportunities for students working on different INFEWS projects and serving as a venue for disseminating course materials, webinars, models, tools, publications, and other resources across the INFEWS community. Because these are virtual centers, they can be organized around thematic, or regional research activities, and/or topics that are aligned with Track 1, Track 2, or Track 3 projects. The resource centers should be designed to promote collaboration and real-time exchange of information, progress, opportunities, and challenges. The centers can serve as a venue for troubleshooting problems, exchanging resources, and outreach.

**9. I understand that informal education institutions are targeted in Track 4b. What sort of activities would NSF/NIFA consider appropriate?**

Informal science education activities should extend beyond the traditional university settings. Informal education channels may be used to help enhance the public's ability to deal with complex information related to food, energy and/or water systems science and engineering to make informed decisions. They may include, but are not limited to outreach activities and programs in museums, zoos, aquaria, nature centers, parks, libraries, and other environments; science communication; research-related experiences such as citizen science, social media and YouTube experiences, and research findings that articulate what works, why, and in what contexts.

**10. I am interested in proposing advanced cyberinfrastructure enabling research in Food, Energy, and Water. Can you provide insights into the cyberinfrastructure emphasis in the solicitation?**

The emphasis should be upon extending existing, shared cyberinfrastructure resources (at the campus, regional, or national level) to specifically address the cyberinfrastructure challenges identified by the proposed INFEWS project and the food, energy, water nexus problem. The proposal must emphasize innovative infrastructure, and would utilize expertise in the cyberinfrastructure community (e.g., existing computing centers, Major Research Instrumentation awards, cloud use). The project must also be connected to the community/ideas/needs of the FEW problem, and should enhance integration across FEWs domains. Funding support may include O&M (operations and maintenance) as well as advanced computational equipment, and the equipment may include computing hardware, cloud capabilities, or some combination of hardware and tools.

The resulting infrastructure will not be merely an upgrade or testbed. The project is expected to provide new cyberinfrastructure configurations and new cyberinfrastructure capabilities that address key cyberinfrastructure challenges and enhance integration across the FEW community.

Successful proposals where advanced cyberinfrastructure is the focus must assess the performance and strategic potential of the new cyberinfrastructure, as well as its ability to enable INFEWS research advances.

**1. Is there a limit to how large my team can be? Likewise, is there a minimum size?**

The team size depends on the overall scope of the project, in addition to the project's budgetary and practical constraints. There are no specific limits on the minimum or maximum number of participants.

**2. How many proposal submissions can I be on? For example, is it feasible to serve as the PI on one proposal, a co-PI on a second proposal, and an unpaid consultant on a third proposal?**

For this solicitation, the maximum number of proposals that any individual can serve on is TWO (2). If you are a PI on one proposal and a co-PI on a second proposal, you cannot be included on any other proposals. Please be advised that if an individual's name appears, in any capacity, on more than TWO proposals, all submittals after the first two proposals (based on the time-stamp) will be returned without review. **I am a researcher at a Federally Funded Research and Development Center (FFRDC). May I submit a proposal or serve as a co-PI?**

You are eligible to participate on a proposal only as part of a sub-award.

**3. Are PIs from the National Center for Atmospheric Research (NCAR), an NSF-sponsored FFRDC, permitted to submit proposals to INFEWS?**

NCAR scientists are not permitted to submit proposals to INFEWS. NCAR participation can only be as a subaward and is subject to two conditions: (1) NCAR's participation must be consistent with the NCAR mission, (2) NCAR's participation is expected to be in partnership with non-FFRDC organizations with NCAR participation as a subaward. As an NSF-sponsored FFRDC, the letter of NSF commitment is not required.

**4. Can an INFEWS project involve international research and/or involve international collaborators?**

INFEWS projects can involve international research. The challenges and complexities of FEW systems are global, therefore international collaborations are encouraged where appropriate. International collaborators, however, must seek support from their respective funding organizations, and not NSF. Funding guidelines for involving international collaborators (see Budgetary Information section of the INFEWS solicitation) allow only the following expenses to be included in the NSF budget: 1) Travel expenses for U.S. scientists and students participating in exchange visits integral to the project; 2) Limited project-related expenses for international partners to engage in research activities while in the United States as project participants; and 3) Project-related expenses for U.S. participants to engage in research activities while abroad.

**5. Are there opportunities for private sector participation in this solicitation?**

Private sector businesses or individuals can participate as subawardees or consultants on projects, but cannot serve as the lead organization.

**6. I would like to include undergraduate students in my project. How do I incorporate a Research Experiences for Undergraduates (REU) experience within my proposal?**

Incorporation of an REU experience within a proposal is an effective mechanism to integrate undergraduate educational activities into a research project. The Research Experiences for Undergraduates (REU) solicitation (NSF 13-542) notes that support for undergraduate students involved in carrying out research under NSF awards should be included as part of the research proposal itself instead of as a post-award supplement to the research proposal. Please consult the REU solicitation for further details.

**About the Submission Process**

**1. I see the deadline for submission is March 22, 2016. Does this deadline mean I can submit to any of the four tracks up until 5 pm (local time) on March 22nd?**

You are only able to submit proposals up to the deadline. Please note that proposals cannot be submitted after the deadline and participation of an individual is limited to a maximum of two proposals. Submitting the proposal early is strongly encouraged to ensure that you meet the deadline.

**2. Can I submit the same proposal to INFEWS and other programs or solicitations?**

NSF prohibits PIs from submitting the same proposal to more than one program or solicitation. Please be aware that submission of duplicate or substantially similar proposals concurrently for review by more than one program without prior NSF approval will result in the return of the redundant proposals.

**3. I live in an EPSCoR jurisdiction and I noticed that there was a recent solicitation for the Research Infrastructure Improvement (RII) Track-2 Focused EPSCoR Collaborations (FEC) programs that encourages INFEWS research. Can I submit an identical proposal on this topic to EPSCoR and to INFEWS?**

NSF prohibits PIs from submitting the same proposal to more than one program or solicitation. You will need to decide which solicitation is more aligned with your research interests and collaboration plans. Please check the EPSCoR website to determine RII Track-2 eligibility requirements.

**4. Can I obtain a waiver of the page limitation for the project description if my project is large and complex, or if my project is a large collaboration among multiple institutions?**

No, all proposals must adhere to the page limit given in the solicitation. Note that "Results from Prior Research" has been moved to "Supplementary Documents" for this solicitation.

**5. Do all proposals require a Data Management Plan? Do all proposals require a Management Plan as well?**

Yes, both types of plans are required in the Supplementary Documents section of all INFEWS proposals. The proposal must include a section that describes data and model sharing plans (Data Management Plan). Please note that the supplemental documents should not repeat the information in the body of the proposal, but provide concise information as defined in the NSF Grant Proposal Guide and in the Proposal Preparation Instructions section of the INFEWS solicitation. If you anticipate that your proposed project would not generate data or samples that require management and/or sharing, please state that in your Data Management Plan. Please note that this statement will be subject to peer review. In the Supplementary Documents section, the proposal must also include a Management Plan, which is also described in the

Proposal Preparation Instructions section of the INFEWS solicitation. The Management Plan differs significantly from the Data Management Plan, as discussed in the solicitation. The quality and appropriateness of the Management and Integration Plan is an important review criterion for INFEWS proposals as outlined in the NSF Merit Review Criteria section of the solicitation. The proposal preparation instructions also provide information on the preparation of the "Context Statement" to also be included in "Supplementary Documents" as well as the Conflict of Interest (COI) Matrix and the Project Personnel Table (PIs, Co-PIs, senior personnel, consultants).

**6. The solicitation requires a COI Matrix of collaborators and individuals with conflicts of interest, and a spreadsheet that lists participating project personnel. These seem redundant. Why are they all necessary?**

You are correct in noticing that there is some overlap among these lists; however, they are used for different purposes. These tables should be created as a spreadsheet and submitted as two PDF files within "Supplementary Documents".

**7. How do we fill out the spreadsheet listing project personnel?**

You will notice that the "List of Participating Individuals" is a subset of the COI Matrix Table. Both should be created as a spreadsheet according to the instructions provided in the solicitation and be submitted as separate pdf files within Supplementary Documents.

**8. What other resources can I read for more information regarding NSF and USDA's involvement in this initiative?**

There is a growing body of literature on topics relevant to the INFEWS initiative. During FY15, NSF funded a series of workshops related to food and water and energy systems. Please consult the NSF award database and other bibliographic search engines for current information.

**9. I am intrigued about the outreach components that are mentioned under Track 4b. Can you help me figure out what types of activities will fall under the scope of these projects? NIFA envisions that it will support projects that increase the ability of the target audience to make informed decisions on topics related to the INFEWS nexus. Informal education can include outreach to decision makers such as communities, natural resource managers, agricultural producers, water managers, etc. Informal educational opportunities can support development of educational programming, workshops, meetings, online materials, etc., that will inform stakeholder communities about issues at the FEW nexus and improve their decision making. Disciplinary requirements apply to Track 4a/b. Projects must incorporate science from three or more intellectually distinct disciplines that, in aggregate, represent scientific areas typically supported by three or more of the participating NSF directorates; or two (or more) directorates and USDA/NIFA. (USDA/NIFA research goals derive from the basic sciences/engineering much akin to NSF. However, some differences may be perceived. USDA/NIFA may be invoked as a "discipline" if the research focus represents a topical area that is uniquely distinct from disciplines typically supported by NSF Directorates. The FEW Context Statement should carefully elaborate on the specific differences between an NSF and USDA/NIFA "discipline").**

**10. I submitted my proposal to NSF and part, or all, of my project was chosen for funding by NIFA? What will I need to do to get my award?**

For proposals selected for funding by NIFA, PIs will be asked to withdraw their proposal from NSF and resubmit it to NIFA in accordance with instructions given by the cognizant NIFA Program Officer. You will be personally contacted by this program office and provided with detailed instructions on how to resubmit your proposal to NIFA. Your proposal will not need to compete again, as it has already been reviewed through the joint INFEWS process detailed in this solicitation. NIFA requires that all proposals be submitted through Grants.gov. Project funds will be dispersed to your institution through the Automated Standard Applications for Payment Systems (ASAP), operated by the Department of Treasury's Financial Management Service. For more information see [http://www.nifa.usda.gov/business/method\\_of\\_payment.html](http://www.nifa.usda.gov/business/method_of_payment.html).

Post award management will be done jointly with NSF. All PI meetings will be held jointly by NSF and NIFA. All projects funded by NIFA will need to submit their project reports through the NIFA reporting system. When projects are jointly funded through NSF and NIFA, they should submit a unified annual report that is a summary of the outcomes, impacts, and progress of the entire project. Reports should be drafted by the team, but will need to be submitted to both NSF and NIFA to meet the federal grant reporting standards of each agency. A similar report can be submitted to the reporting systems of both agencies to present a unified annual report.

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