Proposal Summary

Intellectual Merit — The Long Term Ecological Research (LTER) Network Office (LNO) provides critical services in support of the research and education goals of the LTER Network, represents the Network in its interactions with other scientific networks and centers, facilitates the operation of the Network as a cohesive research entity, and fosters new, broadly-based initiatives that extend LTER science, education, and cyberinfrastructure to new communities. Significant changes in the vision for LTER Network science have taken place since the last renewal of the LNO Cooperative Agreement in 2003, and this proposal reflects those changes. The Decadal Plan for LTER, the result of an intensive three-year planning effort by the LTER Network, describes a broad vision for LTER science that encompasses substantial new levels of synthesis and transdisciplinary research. In this plan, the LTER Network envisions collaborations between ecologists and social scientists to create a new body of theory in social ecology that draws on and incorporates information technology and the most advanced educational approaches to amplify the societal impact of this vision.

To address the goals set out in the Decadal Plan, the LNO requests $15,662,179 to carry out 17 activities reflecting four groups of functions: Support for Research Synthesis, Cyberinfrastructure, Core Services, and Development and Outreach. The request includes $10,350,000 to support Continuing Operations of the LNO, which represents a 15% increment over current funding and maintains the historical funding trajectory of the LNO and the LTER Network. Continuing Operations include organization of two All Scientists Meetings in 2009 and 2012; basic cyberinfrastructure support for the LTER Network; stewardship of Network databases; continued development of the Network Information System; information technology, database, and web consulting to LTER sites; facilitation of Network governance meetings; development of a strategic communication plan; communication of information about LTER to a variety of audiences; and creation and maintenance of strategic partnerships.

In consultation with the LTER Executive Board and the LTER Information Management Committee, the LNO identified needs for additional funding beyond this core request to address new Network research, cyberinfrastructure, and governance goals defined in the LTER Decadal Plan ($5,312,179). Activities addressing new science and governance goals include expanded funding for research working groups, support for meetings to capitalize on the intellectual momentum developed in the planning process, and funds to support the activities of the LTER Science Council and Chair. Activities addressing new cyberinfrastructure goals include completion of the Network Information System, management of increased numbers of Network data bases created through the EcoTrends project, the creation of new synthetic databases, and increased training opportunities for LTER information managers and scientists. The proposal outlines new approaches to assessment and evaluation of the outcomes of proposed activities that will inform a flexible and responsive management strategy for the LNO.

Broader Impacts — The impact of the proposed work extends well beyond the bounds of the LTER Network to include the broader social-ecological and informatics communities. The LNO will stimulate the interdisciplinary interactions necessary to begin to address Decadal Plan goals. By supporting research working groups, the LNO will encourage interactions between ecologists and social scientists and will provide opportunities for increasing synthesis and expanding collaborations. These developing collaborations will encourage a broader-scale of transdisciplinary activity as envisioned in the Decadal Plan. Additional impacts will result from development of distributed data services and their use for new synthetic research, co-development of standards of practice for ecological information management, development of new cyberinfrastructure tools, increased access to data for education and underserved groups, and collaboration with other environmental observing networks to plan a robust and efficient national cyberinfrastructure for ecological research.

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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

1.0 Results from Prior Support from Cooperative Agreement
DEB 02-36154 — *A Proposal for the Network Office of the U.S. LTER Program*
March 1, 2003 — February 28, 2009; Principal Investigator: R. B. Waide

In 1983, the National Science Foundation (NSF) created the Long Term Ecological Research Network Office (LNO) to support and coordinate network and site activities of the U.S. Long Term Ecological Research (LTER) Network. In 1997, responsibility for operating and managing the LNO shifted from the University of Washington to the University of New Mexico (UNM) through a Cooperative Agreement (CA) with the NSF. A Scope of Work (SOW) within the CA defined the tasks of the LNO in detail and grouped them into ten categories of activities [1]. Sections 1.1 through 1.10 below report the most important accomplishments in each of these categories from the past six years of successful LNO operation. More detailed descriptions of accomplishments can be found in LNO annual reports [2]. Links to additional information appear as bracketed numbers in the text and refer to items in Section 7.0 of this proposal. Supplemental material submitted with this proposal includes a list of acronyms used in the text.

1.1 Network Office Administration and Service Activities

Interactions with external entities — LNO staff (Waide, Michener, Vande Castle) served as the principal point of contact and coordination between the LTER Network and NSF, other Federal agencies (e.g., U. S. Geological Survey (USGS), Forest Service, Agricultural Research Service, National Aeronautics and Space Administration (NASA)), other national and international networks (e.g., Organization of Biological Field Stations, National Ecological Observatory Network, Water and Environmental Research Systems Network, National Phenology Network (NPN), India Flux Network), non-governmental organizations (e.g., Internet2, American Distance Education Consortium), and individual sites and scientists.

Administration of funds — From 3/1/2003 to 3/1/2008, the LNO administered $10,973,280 in funds from the CA and supplements as well as funds from competitive proposals to address LTER Network objectives. Funds by source were: $8,099,998 in yearly increments for continuing activities, $1,711,236 in supplemental awards, $1,150,711 in cost share, and $11,335 in program income. Administration of funds (McConnell) included fiscal compliance with University, State, and Federal regulations, annual fiscal accounting and reporting, timely budget analysis, accurate projection rates, and managing day-to-day activities of project goals.

Proposal preparation (supplements and competitive proposals) — The LNO prepared ten supplement proposals to support specific activities of the LTER and International Long Term Ecological Network (ILTER) Networks. These included supplements: for the All Scientists Meetings (ASM) in 2003, 2006, and 2009; for maintenance of the ILTER databases and web page; for increases in LNO efforts resulting from LTER Network growth; for planning meetings to implement the Decadal Plan; for preparation of an ILTER Brochure; and for web applications development in support of the EcoTrends project [3]. In addition, the LNO prepared 11 competitive proposals to support and enhance core activities and to strengthen partnerships with the broader ecological and informatics communities and emerging networks such as the National Ecological Observatory Network (NEON) and the Water and Environmental Research Systems (WATERS) Network [4].

Meeting coordination — To increase the pace of synthesis and facilitate new research and governance initiatives, the LNO, in the span of five years, coordinated 219 research and governance meetings with more than 4,200 participants [5]. Meetings and workshops took place at a wide range of LTER sites and other locations around the country. LNO meeting coordination services included negotiating hotel contracts, direct payment of meeting and travel costs, reimbursements to participants, general logistics, invitations to international participants, and computer/software and audiovisual support.

1.2 Computational and Communication Infrastructure

Implementation and maintenance of network cyberinfrastructure — The LNO provided a critical service to the LTER community by maintaining basic computing, communication, and collaboration infrastructure. Specifically, LNO staff maintained the servers required for hosting web sites, managing

data, archiving documents, forwarding email, storing source code, tracking requests, and managing videoconferences. In addition, LNO staff (Brunt, Wyman) retooled the server infrastructure, making it more secure, modular, and redundant, and enabling it to host new applications such as virtualization. The retooled server infrastructure represents a major step towards participating in a service-oriented architecture (SOA).

Collaboration tools — The LNO greatly expanded collaboration capabilities within the LTER Network by implementing a high-quality, low-cost, video-teleconferencing (VTC) system. With funds obtained from UNM, the LNO (Brunt) purchased and installed a Polycom MGC50+ Communications Bridge valued at over $100K. The bridge enables multiple, simultaneous, multi-party conferences using internet protocols over existing connections. The LNO (Brunt) purchased and installed seven high-end VSX 3000 VTC units for Executive Board members and purchased two desktop VTC software licenses for each LTER site. LTER governance and research working groups have used the VTC system extensively (***Figure 1***). LNO staff, both independently and with synthesis working groups, evaluated a wide range of collaboration software products **[6]** to identify potential additional tools for LTER scientists.

Training laboratory — In cooperation with the project *Enabling the Science Environment for Ecological Knowledge* (SEEK; see ***Table 1***), the LNO designed and implemented a state-of-the-art information technology training facility (***Figure 2***) that prepares the LTER Network to meet the workforce training needs outlined in the Decadal Plan. LNO staff (Michener and Brunt) designed the facility's unique configuration to maximize interaction between instructors and participants.

1.3 Information Management and Methods Development

Promotion of metadata standards — The LNO worked with leaders of the informatics community, the Information Management Committee (IMC), the Network Information System Advisory Committee (NISAC), and one-on-one with site information managers to define best practices and implement Ecological Metadata Language (EML) after it was adopted as the Network standard by the LTER Coordinating Committee in 2004. All LTER sites now produce EML documented data sets and participate in the LTER Network data catalog. LNO staff (Brunt, Servilla, Costa, Michener, San Gil) collaborated with the National Center for Ecological Analysis and Synthesis (NCEAS) and LTER information managers to fix errors in and improve and enhance EML. This year, the LNO will contribute to a corrected version of EML, thereby improving the ability of LTER sites to work with and generate compliant metadata. The LNO also fostered a relationship with the genomics standards community and promoted the use of EML for environmental genomics metadata **[7]**.

Curation, maintenance, and expansion of LTER Network databases — LNO staff (Brunt, White) maintained interfaces and access to the LTER personnel, bibliography, and site characteristics databases, and they expanded the bibliography to include unique accession and digital object identifier (DOI) numbers from each site. These improvements facilitated an analysis of changes in social networking within LTER over the last 20 years **[8]**.

Web services interface — LNO staff (Brunt, Servilla, Costa, San Gil) developed a prototype web services interface to LTER Network databases that are routinely updated by sites (personnel, site, and bibliography). This interface provides a mechanism for individual site information systems to have programmed synchronization with the LTER Network databases. Functionality includes secure "query", "insert", "update", and "delete" record commands for all centrally-managed databases. This year, the LNO will release to the community a request for comments on this interface along with example code and information on use case scenarios.

Remote sensing archive — LNO staff (Vande Castle) maintained and curated a historical archive of remote sensing data for the LTER Network. The archive consists of Landsat, SPOT, MODIS and AVIRIS data from LTER Network acquisitions starting in 1990 and from past NASA and USGS research projects **[9]**. The LNO provided links to other collaborators and agencies that acquire data useful to the LTER, including MODIS data from the Oak Ridge National Laboratory Distributed Active Archive Center, International Space Station (ISS) imagery acquired as part of the ISS science plan, and Global Fiducial Library Reconnaissance imagery. Access information for other types of data, such as LIDAR and more recent SPOT imagery, was made available, and a collaboration with the Center for Rapid Environmental Assessment and Terrain Evaluation at UNM provided access to near real-time direct broadcast Terra and Aqua MODIS data through automated acquisition and processing. Standard data products were acquired and archived for 22 of the 26 LTER sites **[10]**.

1.4 Network Development, Community Outreach and Training

Network development and community outreach included an array of activities to benefit LTER scientists and educators as well as the broader community of environmental scientists and teachers. A consortium, the Partnership for Biodiversity Informatics (PBI), consisting of the LNO, NCEAS, the San Diego Supercomputer Center (SDSC), and the University of Kansas Center for Biodiversity Research, provided leadership for several of these activities (***Table 1***). The PBI continued their collaboration in 2008 to produce two additional cyberinfrastructure proposals currently pending at NSF: INTEROP and DataNet (see below).

Network development — The LNO (Michener, Brunt), the Organization of Biological Field Stations (OBFS), NCEAS, and numerous other institutions collaborated to facilitate storage, discovery, and access to the strategic environmental information resources collectively held at North American biological field stations through a Research Coordination Network (RCN). The LNO assisted in revamping the OBFS web site **[11, 12]**, in maintaining mailing lists, and in infusing informatics and geospatial technologies into field stations and marine laboratories.

Community outreach and Network linkages — LNO staff maintained and expanded synergistic communication, collaboration, or coordination with institutions, partnerships, networks and other groups. ***Table 1*** describes some of these collaborations and their outcomes.

LNO staff (Michener, Brunt, Waide) were key participants in SEEK, a six-year, multi-institutional, multi-national initiative designed to create cyberinfrastructure for ecological, environmental, and biodiversity research and to educate the ecological community (especially, under-represented groups) about ecoinformatics. This collaboration helped the LNO develop the training laboratory described in Section 1.2 above.

LNO staff (Michener) developed a strategic partnership with the National Biological Information Infrastructure (NBII) that led to NBII support for hiring a Senior Application Support Analyst (San Gil) at the LNO. This partnership focused on metadata standardization and led to several key LTER and community-wide outcomes (***Table 1***).

During 2003-2007, LNO staff (Michener, Waide) participated in design activities for several emerging U.S. environmental observatories (NEON, CLEANER, WATERS, NPN), environmental monitoring networks in India and Portugal, and related US planning activities and workshops. Michener was on assignment to NEON, Inc. from February 2006 through August 15th, 2007. In this capacity, he and Dr. Bruce Hayden (University of Virginia) completed the NEON Measurement Book for use in detailed network design and cost analysis. NEON stands to both complement and benefit LTER, especially those LTER sites selected as NEON sites.

In addition, Michener collaborated with Dr. Jan Poley of the American Distance Education Consortium and others in a proposed effort to enhance communications and networking for approximately one-third of the LTER sites as well as for several additional field stations and international research sites. Michener led a collaborative effort focused on enhancing the interoperability of data collected and archived by LTER, NBII, NASA, NCEAS, the National Evolutionary Synthesis Center (NESCent), and other research networks and centers. This effort resulted in submission of an NSF proposal entitled *INTEROP: Creation of a Virtual Data Center for the Biodiversity, Ecological and Environmental Sciences*. He also coordinated a collaborative effort to enhance data preservation and use across a broad array of biological and environmental research networks, including LTER, resulting in a proposal to the DataNet program at NSF.

Training — The LNO CA does not have funds specifically targeted for training LTER scientists and students. Nevertheless, funds associated with the SEEK, RCN, Mellon Foundation and NBII projects as well as supplement funds in 2007 supported training for many LTER scientists in ecoinformatics, geospatial analyses, wireless communication and advanced sensing technologies, web site development, metadata management, and cybersecurity.

1.5 Network Publications and Public Outreach

LNO publications – LNO staff (Thomas) facilitated the publication of two documents in the LNO numbered publication series, Integrative Science for Society and Environment **[41]** and The Decadal Plan for LTER **[42]**. The LNO (Bonito) contributed support to several of the site volumes in the LTER Oxford

book series [43]. Individual LNO staff members published journal papers, book chapters, and other articles related to the accomplishments of the LNO and the LTER Network (see attached list of publications).

Paper materials — Informational and promotional materials produced during the current award include: 21 site brochures, one LTER Network brochure, and 12 issues of the Network Newsletter. LNO staff (Thomas, Bonito) created additional brochures and programs for the triennial All Scientists Meeting and produced scientific fact sheets and other information and promotional material to convey LTER results to the general public.

World Wide Web — The LNO website and LTER Network web portal each underwent major re-designs based on usability studies and community input to enhance their effectiveness, and LNO staff scanned, catalogued, and archived hundreds of historical LTER documents on the LTER portal. Based on usability studies and user feedback, LNO staff redesigned the LTER document archive and considerably improved the site's overall organization and search functions to make navigation more intuitive and materials easier to locate.

Traveling exhibit — The LNO significantly upgraded the LTER multimedia traveling exhibit and displayed it at annual meetings of the Ecological Society of America (ESA) and SACNAS (Society for Advancement of Chicanos and Native Americans in Science), and periodically at the American Association for the Advancement of Science (AAAS), the American Society of Limnology and Oceanography, the LTER All Scientists' Meeting, and local science fairs. The LNO Public Information Officer and Senior Web Designer conveyed information about the LTER Network to a wide-ranging audience, including the general public, scientists and educators, and policy-makers.

Video — Using an external consultant, the LNO facilitated production of an informational DVD video that highlights research being conducted by LTER and a similar video focusing on the International LTER. The LTER video was subsequently reformatted for the web [44].

1.6 Synthesis

The LNO encouraged synthesis efforts across the LTER Network: by providing support and coordination for science theme meetings of the LTER Science Council; by organizing two LTER All Scientists Meetings (ASM) and planning a third; by funding 44 research working groups with 315 participants; and by documenting products of these meetings and archiving results [45].

In support of synthesis, the LNO staff organized and implemented the triennial ASM. The 2003 meeting in Seattle, WA (711 participants, 66 working groups, 400 posters) and the 2006 meeting in Estes Park, CO (863 participants, 69 working groups, 439 posters; ***Figure 3***) involved more than a year of effort by LNO staff. These efforts included: securing supplemental and other funding for the ASM and related meetings; contracting meeting providers; organizing lodging, local transportation and meals; providing funding (including pre-payments and reimbursements) for meeting participants; managing registration fees; organizing the program of speakers; and coordinating the extensive working group meetings. Coordination by the LNO (Waide, Vande Castle) included working with the organizers to facilitate working groups, collecting abstracts and meeting notes, and providing support through web pages, email lists and follow-on activities of results and future plans for the working groups. The statement of appreciation passed unanimously by the LTER Science Council [46] documents the success of these meetings.

The research working groups supported by the LNO produced a wide range of products including reports, proposals, data sets, and publications [5]. One example of a synthesis product that was facilitated by a research working group supported by the LNO is the recent paper in *Nature* from the Lotic Intersite Nitrogen Experiment (LINX) **[47]**, which has been cited widely in the scientific and popular press **[48,49,50]**.

1.7 Network Information System Design and Development

Establishing the distributed data network — LNO staff (Brunt, Servilla, Costa, San Gil) made significant progress towards the development of the Network Information System (NIS) including the completion and approval of the NIS Strategic Plan [51] and the development and prototyping of an architectural framework. The modular architectural framework for the NIS, called PASTA (Provenance Aware Synthesis Tracking Architecture) [52], leverages the LTER metadata catalog [53] and site investment in EML (***Figure 4***). PASTA is a conceptual model for dynamically harvesting and archiving

site-based data and metadata used to generate and deliver derived data products. The NISAC, the IMC, and several community partners accepted the PASTA framework, and components of PASTA were prototyped in support of the EcoTrends collaboration (see below).

Community collaboration and standardization efforts — LNO staff (Servilla, Costa) collaborated with NCEAS and SEEK developers on the 'Data Manager' library for EML that provides automatic insertion of well-documented data sets into a standard database management system based solely on the metadata description. LNO staff collaborated with the IMC on: implementing EML and site participation in the LTER Network data catalog (***Figure 5***); developing an advanced search interface to enable discovery of data from the Network; creating metrics and proposed standards for data access and data auditing of online information access using a proxy server called Data Access Server **[54]**; designing an online registry of standard units for EML **[55];** and prototyping the first phase of development of an ecological vocabulary of controlled terms.

Promoting and supporting synthetic research collaboration — The EcoTrends project was the predominant synthesis effort undertaken by the LTER Network **[56]**. LNO staff (Brunt, Servilla, Costa, San Gil) worked directly with the EcoTrends editorial board and technical subcommittee, New Mexico State University staff, and an independent web design firm to implement a time-series data model and data delivery system tailored to the EcoTrends website design to complement the EcoTrends book due out this year (***Figure 6***). LNO staff contributed significantly to this high-profile and community-supported project while simultaneously gaining valuable implementation experience for components of the PASTA architecture model for the NIS.

1.8 International LTER

The LNO SOW emphasized a transition of the ILTER Network from an activity largely supported by the NSF through the LNO to an activity broadly supported through a consortium of ILTER Networks. The U.S. LTER Network created a new standing committee (International Committee) to manage interactions with the ILTER Network, eliminating most of the responsibilities of the LNO in this area. In 2003 and 2006, with supplemental support from NSF, the LNO (Vande Castle) helped coordinate ILTER Coordinating Committee meetings as part of the LTER ASM and assisted the ILTER in becoming more independent of the U.S. LTER Program.

1.9 Education

The SOW limits LNO support of education activities to maintenance of the Schoolyard LTER web page and several short-term activities that concluded in 2003. Since NSF did not conduct a proposed review of the LTER education program, LNO restricted its educational responsibilities to those listed in the SOW.

1.10 Strategic Planning for the LTER Network

The LNO played a key role in facilitating LTER Strategic Planning by providing logistical support for 30 face-to-face meetings (2004-2007) with 584 participants (as well as numerous video and phone conferences), developing email lists, and providing collaboration software support and office space. LNO senior personnel (Brunt, Vande Castle, Servilla, Waide) contributed intellectually to the various planning elements (Research, Education, Governance, and Cyberinfrastructure) and played a major role in drafting, writing, and editing the planning documents. The result of the strategic planning effort was the completion of two documents: *Integrated Science for Society and the Environment* and *The Decadal Plan for LTER* **[41,42]**.

The LNO, with the help of a consultant funded by UNM, developed a strategic plan to align the goals of the LNO more closely with the goals of the LTER Network **[60]**. This plan provides operational goals for the LNO and guides decisions about priorities and resource allocation. The LNO is updating the goals of the Strategic Plan and an accompanying implementation plan to incorporate the objectives of the LTER Decadal Plan.

2.0 Introduction

The Long Term Ecological Research Network Office plays a critical role in the operation of the 26-site LTER Network (***Figure 7***). The LNO supports the research and education goals of the Network; represents the Network in its interactions with other scientific networks and centers; facilitates the operation of the Network as a cohesive research entity; and fosters new, broadly-based initiatives that extend LTER science, education, and cyberinfrastructure to new communities. Recognizing the importance of these functions, the NSF has funded the LNO since 1982, originally through an award to Kansas State University and subsequently to Oregon State University and the University of Washington. As the LTER program grew during this period, LNO responsibilities, staffing, and funding levels increased concomitantly. The present LNO, established at UNM in 1997, operates with a six-year budget of $8.5 million from NSF, additional supplemental funding from NSF ranging from $276-415K a year, and funding from competitive sources for projects (e.g., SEEK) that complement and extend the activities of the LNO.

Since the renewal of the LNO CA in 2003, the vision for LTER Network science has changed significantly. The Decadal Plan for LTER **[42]**, the result of an intensive three-year planning effort, describes a broad vision for LTER science that encompasses substantial new levels of synthesis and transdisciplinary research (***Figure 8***). In this plan, the LTER Network envisions new collaborations between ecologists and social scientists to create a new body of theory in social ecology that draws on and incorporates information technology and the most advanced educational approaches to amplify the societal impact of this vision. The scope and complexity of the ideas envisaged in the Decadal Plan will require greatly increased efforts to organize and coordinate the proposed transdisciplinary synthesis The LNO has demonstrated by its past performance that it is ideally suited to be the catalyst for implementation of the vision of the Decadal Plan. The LNO will play a key role in organizing people, tools, and ideas to promote the synthesis science that will address the increasing need to understand social-ecological systems from local to global scales. The activities described in this proposal were selected by the LTER community because they represent important contributions that the LNO can make to stimulate the evolution of the LTER Network from a group of associated sites to a closely integrated research community with a new focus on synthesis and transdisciplinary research.

The Decadal Plan establishes a revised focus for LNO core services and defines the role of the LNO in achieving new Network objectives in research, cyberinfrastructure, and governance. Bylaws for the LTER Network, adopted in 2003, describe specific responsibilities of the LNO **[59]**. The strategic plan for the LNO, revised in 2008 to incorporate the objectives of the Decadal Plan, provides additional operational guidance for LNO activities **[60]**. Together, these documents created a new context for LNO activities that structured much of the formulation of this proposal.

The external Mid-term Review Panel further encouraged the LNO to explore opportunities for facilitating evolution of the Network.

> *In this time of rapid change, there is need to articulate a shared vision and to work across the Network to implement the vision. The LNO should play a key role in both emergence and implementation of the shared vision. Proactive broad thinking fostered by the LNO can and should have a beneficial effect on the evolution of the LTER Network.*
>
> *As a specific example, there is need for broad thinking about how the synthesis goals can be achieved across a range of funding scenarios. The Network Planning process has created enormous energy and enthusiasm across the Network, leading to a remarkable opportunity to advance Network science. We encourage the LNO to think about how to capitalize intellectually on this opportunity regardless of specific funding scenarios.*
>
> *….the LNO is in a strong position to encourage and support opportunities for groups of sites to self-organize to build Network science.*

Thus, when NSF invited UNM to submit a renewal proposal for the LNO CA to cover the period 2009-2015, the LNO and the LTER Executive Board (EB) (as specified in the LTER Bylaws) had a clear basis

for determining the scope and funding level of this proposal. Subsequently, the EB reviewed each step of the proposal's preparation, recommended changes to more optimally align the proposal with Network objectives including fostering Network synthesis, and approved the proposed activities and budget.

As a result, the LNO requests $15,662,179 to support two major functions that are detailed in Section 3. First, the proposal includes $10,350,000 for continuing operations of the LNO. This amount, a 15% increase over present funding, will partially offset the real increases in cost-of-living and inflation that occurred during the last six years. Second, it includes $5,312,179 in additional funding to address the new research, cyberinfrastructure, and governance goals defined in the LTER Decadal Plan. Science activities will include expanded funding for research working groups, support for meetings to capitalize on the intellectual momentum developed in the planning process, and funding to support the activities of the LTER Science Council and Chair. Cyberinfrastructure activities will include completion of the Network Information System, stewardship of increased numbers of Network databases, creation of new synthetic databases, and increased training opportunities for LTER information managers and scientists. The proposal further outlines: new approaches to assessment and evaluation of the outcomes of proposed activities that will inform a flexible and responsive management strategy for the LNO (Section 4.0); the broader impacts of the proposed activities (Section 5.0); and the management structure and lines of responsibility (Section 6.0). A description of the budget (Section 8.0) provides detailed information about the cost of activities proposed for LNO Continuing Operations, Science and Education in the Decadal Plan, and Cyberinfrastructure in the Decadal Plan, and it provides the justification upon which these costs are based.

3.0 Project Description

The LNO proposes to implement 17 activities in four areas of function:

1. **Support for Research Synthesis;**
2. **Development and Implementation of Cyberinfrastructure;**
3. **Core Services; and**
4. **Development/Outreach.**

A description of each activity and justifications of individual and collective impacts of the activities on the LTER Network appear below. The budget justification (Section 8.0) contains a table linking requested human resources with proposed activities.

The proposal employs a logic model approach **[61]** to document the relationship among impacts, outcomes, outputs, activities, and requested resources for each proposed activity **[62]**. Logic models link cause and effect statements such as "if these resources are available, then these activities can be conducted." This approach facilitates close coordination among model elements and incorporates measurement and evaluation of outputs and outcomes at the appropriate stages in each model. Section 4.0 describes the assessment and evaluation plan for the activities in this proposal.

3.1 Support for Research Synthesis

A primary function of the LNO as articulated by the Mid-term Review Panel (see Section 2.0) is to capitalize on the intellectual investment made in developing the Decadal Plan by mobilizing support to advance its goals. In the long-term, the success of the Decadal Plan will depend on significantly increasing LTER site and LNO funding. In the interim, the LNO requests funding for four activities that will sustain and increase the pace of Network research synthesis. Sections 3.1.1 through 3.1.4 below describe background, specific activities supported, and products and outcomes for each of the four activities.

3.1.1 Science Council. *Support annual meetings of the Science Council as well as related planning meetings.*

Background — One accomplishment of the Decadal Plan is a new governance structure for the LTER Network [63]. As part of this reorganization, the LTER Bylaws have been amended to create a new entity, the Science Council (SC), comprised of two members from each of the 26 LTER sites and the chairs of standing committees. The SC "has the responsibility to provide leadership and planning for cross-site research and education, to develop proposals for the conduct of Network-level science, to interact with existing and emerging networks, to develop products that synthesize Network-level data and information, and to otherwise manage the science affairs of the LTER Network" [59]. The Bylaws require an annual meeting of the SC, and the LNO is responsible for supporting this meeting. The intended long-term impact of SC activities is an increase in operational coordination of science, synthesis, and education across the LTER Network.

Specific activities supported — The LNO funds participant travel and lodging for the annual meeting of the SC as well as any additional required expenses (e. g., meeting rooms, audiovisual). The LNO also supports planning and visioning meetings associated with SC activities. The Executive Director and the Director for Synthesis Support help develop the agenda, supervise meeting preparations and logistics, prepare materials, participate in the meetings, and record the accomplishments of the meetings.

Products and outcomes — Synthesis activities of the SC produce Network-level science publications and synthesis volumes, lay the groundwork for proposals to conduct Network-level science and education, and result in updates to the Network research and education objectives. In addition, the SC performs several administrative functions, including resolution of issues from sites or the Executive Board, approval of Bylaw changes, and election of the Chair. The LNO supports the SC by producing a persistent record of its activities and decisions. Outcomes of the operations of the SC include enhanced Network-level synthesis, increased scientific coordination across and beyond the LTER Network, increased funding for synthesis, evolving strategic plans, and effective governance.

3.1.2 All Scientists Meetings. *Foster integration within and among Network research projects by organizing periodic meetings of the entire LTER research community.*

Background — The LTER Bylaws charge the LNO with organizing the triennial ASM. Key outcomes of past ASM include: formation of new collaborations; sharing of data and ideas; integration of graduate students, educators, and international collaborators into the LTER community; advancement of theory through comparison of conceptual models; identification of transformative research; and coordination of research strategies and standards across the LTER Network. The LTER Network recognizes the value of ASM and enthusiastically endorses continuation of these meetings. The impact of periodic ASM is an increase in the cohesiveness of the LTER scientific enterprise.

Specific activities supported — The Executive Director and the Director for Synthesis Support will supervise the organization of the ASM in 2009 and 2012 and will plan the 2015 meeting. They will coordinate the activities of the LNO staff who provide logistical support throughout the ASM. They will identify possible meeting venues for consideration by the Executive Board, contract the meeting venues and make down payments, work with the program committee to develop meeting agendas, coordinate other activities associated with the meetings, work with a professional meeting organizer (The Schneider Group) to contract service providers (e.g., audiovisual, poster boards, coffee breaks and refreshments), issue invitations, write supplement proposals to fund half of the participants, and preserve meeting documents and materials.

Products and outcomes — LNO efforts will result in well-organized and cost-effective meetings that meet the varied needs of the LTER community, generate new ideas and synthesis products, and build new partnerships and collaborations that enhance the breadth and productivity of LTER research. The LNO will obtain supplemental resources to support at least 400 meeting participants and to create a persistent record of meeting activities and products.

The outcomes from successful ASM include measurable increases in cross-site and Network-level science (***Figure 9***), an increased pace of development of synthesis products, the formation of new

collaborations, the development of new LTER science themes, and better integration of graduate students and new scientists into the LTER community.

3.1.3 Research Working Groups. *Provide support for Network research goals by funding working groups and intensive research visits for project scientists.*

Background — The activities that produced the Decadal Plan also created new collaborations among LTER scientists and with scientists from other disciplines, especially the social sciences. These new collaborations need additional resources to encourage their further self-organization. The LNO currently provides small grants (up to $10,000 per group from a total budget of $50,000/yr) for this purpose. The working groups that received LNO support are highly productive **[5,45]** and support for them is repeatedly identified in the annual surveys of site needs **[64]** as a valuable LNO service.

Specific activities supported — The LNO proposes increasing support for self-organizing groups of sites and scientists to $100,000/yr. The Executive Director and the Director for Synthesis Support (0.10 FTE/yr) will organize and maintain records of annual competitions to disburse these funds, with proposals evaluated by the EB or their delegated representatives. In addition, the LNO proposes new funding to support two LTER scientists per year to focus for one to two months on completing publications or plans emerging from these working groups. Surveys of LTER scientists show that obtaining support for such intensive efforts is a high priority and will significantly enhance the pace of synthesis. To advance the goals of the Decadal Plan, one criterion for awarding funds for research working groups and research visits will be evidence of an interdisciplinary focus linking social sciences and ecology. The LNO will support self-organizing groups of sites and scientists by funding working group meetings to produce specific research products such as publications, experimental designs, new databases, or common standards. The LNO will provide salary support to allow LTER researchers to focus on short-term (one to two months) synthesis projects that support the Decadal Plan research objectives.

Products and outcomes — Research working groups will establish new partnerships and collaborations that advance a new body of theory in social ecology as one element of a developing strategy to meet Decadal Plan objectives over a range of funding scenarios. The working groups will enhance the breadth of LTER research and increase the pace of synthesis by producing multidisciplinary, multi-site publications such as books, monographs, or special issues of journals.

3.1.4 Activities of the Decadal Research Plan. *Provide support for Network research goals by facilitating planning and visioning meetings to address the objectives of the Decadal Plan.*

Background — The Decadal Plan focuses on long-term, social-ecological questions in three thematic areas: 1) land and water use change in urban, exurban, and working systems; 2) climate change, variability, and extreme events; and 3) nutrient mobilization and species introductions. The Decadal Plan presents the broad outlines of a research program in each thematic area, but additional specifics need to be developed. Network science workshops that ask participants to identify individual questions, observations, experiments, and modeling activities within thematic areas, and to identify the corresponding education and cyberinfrastructure needs can help develop the details required to advance the Decadal Plan, and the Executive Board has requested the LNO to support these workshops.

Specific activities supported — The LNO requests new funding to provide support for six to eight additional planning meetings in the first two years of the CA. By the end of Year 2, the NSF and LTER will likely reach an agreement on long-term support for the science agenda in the Decadal Plan.

Products and outcomes — The proposed planning workshops will produce: detailed steps for achieving the science goals of the Decadal Plan; a timeline for the staged implementation of those steps; and interim objectives for LTER sites and scientists. The proposed workshops will lead to a better balance between support for site-based research and Network-level collaborative synthesis. The eventual outcome will be achievement of the goals of the Decadal Plan.

3.2 Development, Implementation, and Maintenance of Cyberinfrastructure

For over two decades LTER science has been interconnected with developments in cyberinfrastructure (CI). The LNO has supported Network CI by offering services that both met the needs of the community and kept pace with evolving technology. As part of the Decadal Plan, the LTER Network developed a CI Strategic Plan that outlines an expanded vision to support the decadal science agenda. Through a broad process of gathering input from community collaborators, investigators, and information managers, the LNO has provided leadership and support in the development of this plan. The proposed LNO CI activities are supportive of and in harmony with the implementation of the CI Strategic Plan, and will provide critical services to the LTER community through four activities:

1. supporting improvement, operation, and maintenance of the LNO computing, communication, and collaboration infrastructure;
2. providing leadership in researching, developing, and implementing Network-wide information management procedures, policies, and practices;
3. completing the development and implementation of the LTER Network Information System (NIS) framework; and
4. offering on-site, group, and individualized consulting services for improving and maturing site information management practices.

3.2.1 Basic CI Support. *Provide basic CI support to the LTER Network to enable collaboration, communication, and security.*

Background — The LNO Chief Information Officer (CIO), System Administrator and Systems Analyst maintain and operate the hardware and software that provides basic computing services for management of Network databases, web sites, access to site databases, administrative functions, software development, archives, and training. In addition, they maintain collaboration and communication technologies. For example, the LNO supports high-quality, low-cost, standards-based VTC for the Network, including regular monthly VTCs for the LTER EB. To date, LNO has supported eleven VTCs for the EB (more than 30 hours of conference time), thereby extending the level of interaction and substantially lowering costs as compared to traditional telephone conferencing. The LNO Systems Analyst verifies the details of each call, programs the request into the teleconferencing software, confirms participation and connection accuracy for each participant, and monitors the call for quality. This experience has increased the quality of the process for handling regular VTC for the Information Management Executive Committee (IMEXEC), the NISAC, and numerous ad-hoc conferences for LTER working groups. New members to specific groups (e.g., EB) are provided new conferencing units or software, along with installation and configuration support. Another area of responsibility is security, which affects all LTER Network activities that rely heavily on public networks and computers. The LNO has significant experience in securing networks, computers, and data against threats and misuse.

Specific activities supported — The LNO will support activities in four areas:

1. Technology improvements — The LNO CIO and System Administrator will operate and maintain computing infrastructure to support Network database management and information services by upgrading server hardware and peripherals twice during the CA period. The LNO Systems Analyst will perform a similar upgrade to the Informatics Training Laboratory (see Section 3.4.4 below). Finally, the Systems Analyst will perform annual updates of desktop computing equipment on a phased schedule that provides complete replacements every three years.
2. Collaboration — The LNO Application Support Analyst will augment the current web and email support for Network committees, working groups, and special interests with basic collaboration tools for hosting web-based conferencing and interactions through shared applications and virtual workspaces. The LNO has performed a thorough analysis of such collaboration tools **[6]** and will match the appropriate application with the level of integration determined necessary by NISAC and scientists' requests. The LNO, working with the NISAC, will promote the evaluation and use of identified collaboration tools for LTER working

groups as recommended in the Decadal Plan. The LNO will continue to monitor the development of new tools and support their implementation when deemed appropriate by NISAC. The LNO Application Support Analyst will deploy web-based collaboration tools to support scientists and synthesis groups during Year 1.

3. Communication — New funding for an LNO Systems Analyst will support the continued operation of VTC services for LTER committees and working groups. In addition, the LNO Systems Analyst will acquire, deploy, and maintain "rich media" recorders to capture and stream presentations via the World Wide Web. Through an investment by UNM in this technology, the LNO will be able to leverage additional recorders for loan to working groups and committees as needed. The annual LTER mini-symposium at NSF and the triennial ASM are examples of events that should be preserved through recordings.

4. Security –The LNO CIO and System Administrator will maintain up-to-date security practices on all LNO CI and will increase communications about security issues to site system administrators through web-seminars and podcasts developed for this purpose. Each year, the LNO will offer four security-oriented technology transfer web-seminars including "how to" and "best practice" guidelines on network and computer security. In addition, the LNO CIO will participate in annual cybersecurity summit meetings sponsored by the NSF.

Products and outcomes — The LNO will provide a secure, modern, and efficient computing and communication environment that will increase the pace and productivity of interactions among LTER scientists and educators. The new capacity to record and stream LTER presentations will improve outreach to the LTER and broader scientific and information management communities. The continued availability of VTC services will result in more frequent and more productive interactions for LTER committees and working groups. In addition, the activities described above will improve access to common collaboration tools for LTER scientists and increase awareness and understanding of security issues for LTER information managers.

3.2.2 Information Management. *Improve information management for the Network by supporting communication and coordination among site information managers, strategic data integration, data stewardship, curated data storage, and other data operations that promote Network synthesis and the creation of data legacies.*

Background — Since 1988, the LNO has actively promoted standards and standard approaches to information management, and it has actively managed LTER Network data sets since acquiring Network-wide satellite data and developing the first personnel database in the early 1990s. LNO support for the annual LTER Information Management Committee (IMC) meetings and workshops keeps LTER sites informed of developing information management practices and technologies. Lack of staff resources has limited the number of databases managed by LNO and the level of management. While the LNO currently manages the personnel directory, all-site bibliography, site directory, data catalog and several synthetic databases (e.g., Net Primary Production), involvement in this valuable Network activity will increase by dedicating new management and curatorial personnel to address the migration of existing site data sets and new synthesis-oriented data sets to the LNO data holdings via the NIS. One new challenge facing the LNO is stewardship of more than 1,200 derived data products from the current and growing EcoTrends (***Figure 6***) project database that is dependent on a largely manual process for updates. The planned NIS framework calls for automated updates in the future.

Specific activities supported — The LNO will support activities in five areas:

1. Information Management Committee meetings — The LNO will coordinate and support IMC meetings and workshops to develop Network standard procedures and protocols, and to exchange techniques and technical information. IMEXEC will meet once a year to plan and address critical issues, with meetings taking place at the LNO to reduce costs and increase interactions with the LNO staff. These meetings will identify and address Network information management challenges through the development of new information management approaches.

2. Working visits to the LNO by information managers — The LNO will increase support to information management (IM) by funding working visits to the LNO by one or two site information managers per year to develop and implement solutions for specific information management challenges affecting multiple sites. In addition, the LNO will fund several product oriented workshops each year to address critical IM issues. For example, site database personnel will meet to determine functional requirements necessary to implement the water chemistry database requested by the SC.

3. Maintain Network databases — LNO staff will continue to manage the personnel database, site characteristics database, and bibliographic databases for the Network through web-based forms and requests to the LNO email-based support system tech_support@LTERnet.edu). The LNO Application Support Analyst supports security for web-based access that allows individual users to change their profile information and site information managers to manage all their project relevant sections of the personnel, bibliography, and site databases.

4. Migrate and create Network databases — The new LNO Information Manager will work with staff from the H.J. Andrews LTER to migrate the climate and hydrologic databases (ClimDB and HydroDB) to the LNO where these databases will be integrated into the Network Information System (NIS) architecture (see Section 3.2.3). As requested by the EB, the LNO Information Manager and Application Support Analyst will also work with scientists and the IMC to develop new synthetic databases resulting from SC and Decadal Plan activities, along with interfaces to such databases, and integrate them into the NIS framework.

5. Manage and extend the EcoTrends database — Funding for the new LNO Information Manager will support the management and curation of existing EcoTrends data, and allow collaboration between NIS developers and site scientists and information managers to implement a dynamic process for the creation of new derived data products. The new LNO Information Manager will: 1) identify new data sets and validate them for quality of metadata and completeness of data using the "EML Data Manager" library; 2) develop program scripts or workflows to transform data from native formats to the EcoTrends time-series format, 3) oversee harvesting and loading data from site repositories into the NIS data "cache", and 4) confirm the transformation and loading of site data into the EcoTrends database.

Products and outcomes — These LNO information management activities will improve information management practices, increase the accessibility of existing Network databases, increase the number of synthetic data sets, and increase the quality and number of Network data sets accepted for management and curation by the LNO. New information management approaches will be embodied in new standard procedures and protocols that will be published as "best practices" documents. By improving information management at a Network level, the LTER Network will become a high quality data provider for scientists and educators and a repository of scientifically rigorous, richly documented data available for synthesis.

3.2.3 Network Information System. *Complete the design, development, and implementation of the LTER Network Information System in collaboration with NISAC, IMC, and strategic community partners.*

Background – In 2003, the LNO acquired its first funds for personnel dedicated to the development of the LTER Network Information System. This initial support led to the production of the LTER data catalog **[53]**, design of the forward-looking PASTA framework for the NIS ***(Figure 4***), and successful demonstration of key PASTA modules in the EcoTrends project (***Figure 6***). These successes laid the groundwork for completing the implementation of the LTER NIS framework in this proposal cycle. Similarly, emphasis on large-scale data integration in the Decadal Plan for LTER and the specific call in the CI Strategic Plan for completion of the NIS in support of such data integration generated timely momentum for these efforts.

Specific activities supported –

1. Complete the LTER NIS — The LNO CIO, NIS Developer, and Analyst/Programmer will complete the design, implementation, and deployment of the PASTA framework (***Figure 4***) in support of the LTER NIS, thereby providing access to all LTER site data sets for the advancement of Network-level science and data synthesis. Accomplishing this objective involves the following major steps.

    - Complete the Data Access Server (DAS, **[54])** to support LTER data access policy compliance for access to LTER site data repositories. The DAS will act as a proxy interface between requests for LTER data and the actual data source, thereby authenticating users who request data and confirming their acceptance of the LTER Data Policy. All requests will be logged for reporting purposes, and the data owner will receive notification of access to their data resource. Use of the DAS would be optional; sites may instead support proxy access for any public interface (e.g., the data URL in the EML) but allow direct access to their data for internal users.

    - Complete a single point-of-access portal for the NIS to support federated authentication (e.g., single sign-on). A NIS portal would provide a single point-of-access to all NIS supported data sets for both LTER scientists and the broader community. Using a federated authentication system will simplify the user experience by allowing reuse of common "log-in" information across LTER sites and other affiliated networks (a similar approach is in use with the EcoTrends web site). The portal will provide a unified data discovery and access process for all NIS data sets, including EcoTrends, ClimDB, and HydroDB, along with comprehensive and complete metadata in the EML.

    - Create an automated extraction and loading process to move site data into a centralized data archive. The PASTA interface to sites will automatically extract site data and then load it into a centralized data cache. The EML "Data Manager" library (see Section 1.0) and the complete documentation of site data in EML make this extraction possible. The cache acts as a replica and permanent archive of the site data, thereby preserving the site and LTER data assets into the future.

    - Develop an interchangeable transformation engine for generating derived data. The PASTA transformation engine provides a seamless mechanism for creating derived data products used in synthesis projects (e.g., EcoTrends). The PASTA framework decouples the transformation engine interfaces (both input and output) from other PASTA components, thus allowing new engines to be deployed without disrupting the entire process.

    - Implement an automated provenance tracking system for all LTER derived datasets. The PASTA framework employs the power of metadata documentation through EML. Currently, EML is fully capable of capturing provenance information that can describe the methods used to create derived data products as well as the originating data documentation. The metadata product emerging as a side-effect of generating derived data will contain this provenance information.

    Because PASTA is only a conceptual framework, the NISAC will review and vet the major implementation and deployment steps described above before any development project begins. NISAC committee members cross both scientific and technical domain boundaries. Their vetting takes different forms depending on the anticipated impact of the project but typically consists of a request-for-comment (RFC) process. The Network Developer will ensure that the NISAC reviews and advises on all PASTA implementation milestones and deployments (see below).

2. Integrate Network databases in the LTER NIS Framework — Integrating existing Network data products is a primary function of the LTER NIS. Specific tasks are listed below.

- The Network Developer will work with database designers, site information managers, and scientists at LTER sites and the broader community to assess and build an integration path for the EcoTrends, ClimDB, and HydroDB databases into the PASTA framework for inclusion in the LTER NIS.
- An RFC process will gather requirements for user query, sub-setting, and descriptive analysis of data residing in the LTER NIS. The Network Developer and Programmer/Analyst will evaluate these requirements, determine a course of action for satisfying such requirements, and integrate desired functionality into the NIS framework. NISAC will review and prioritize all requirements.
- The Network Information Manager and Senior Application Support Analyst will work with LTER site information managers to prepare relevant site data for automated integration into the LTER NIS data modules, including EcoTrends, ClimDB, and HydroDB (See 3.2.2).
- The Network Developer and Programmer/Analyst will make derived data from the ClimDB and HydroDB databases available to the Consortium of Universities for the Advancement of Hydrologic Science (CUAHSI) Hydrologic Information System through the CUAHSI web-service API.

3. NISAC Meetings – All NIS activities will be conducted with the oversight and guidance of the NISAC, which is responsible for planning, prioritizing, and evaluating all NIS activities. NISAC was established to support development of the NIS for facilitating collaborative and synthetic research efforts and improving the quality of LTER synthetic data products and databases. The NISAC consists of site lead PIs, information managers, and LNO personnel. Funding in this CA will provide support for NISAC to meet twice a year in person (once at the LNO) and twice a year by VTC to review and evaluate the outcome of planned projects and to help identify and prioritize critical tasks for NIS development.

Products and outcomes **–** The PASTA framework will support automation of data extraction and loading from LTER sites through structured data integration and publication of such data through web-based applications. More flexible and interoperable access to LTER data provided by the NIS will stimulate and increase LTER science, improve the quality of LTER data and metadata, foster the use of data for synthetic projects, and thereby enhance both national and global research. The NIS, when fully realized, will provide an increasing volume of LTER data to scientists for years to come.

3.2.4 Information Technology, Database, and Web Consulting

. *Provide information technology (IT), database, and web consulting to LTER sites and synthesis working groups.*

Background — The LNO has, with resounding success, gained site participation in Network standards and synthesis activities through the use of individualized consultation and “hands on” technical help for issues ranging from web site design to EML implementation (***Figure 5***). One-on-one support provides an opportunity to accommodate site-specific needs in the development of Network standards. Individualized technical help provided to LTER sites will increase their capability and desire to participate in Network science and education goals defined in the Decadal Plan.

Specific activities supported —

1. Technical support — LNO staff will provide information technology, database, and web application consulting services to sites and working groups.
2. Site visits — With funding for this activity, LNO staff may travel to each site twice during the site performance period to consult and work on site-specific issues related to information management and meeting Network standards for information management. A site preparing for review, working on renewal proposals, or improving its information system to meet increasing site requirements may request assistance for strategy planning and system development, and/or the site can confer with LNO staff to propose reciprocal site visits to update the site’s information management plan. LNO personnel may visit the site to develop an understanding of the site's requirements and help evaluate the level of effort required to

make needed improvements. In addition, the site information managers may be provided the opportunity to spend two weeks at the LNO to work with LNO staff on design or coding issues (see 3.2.2 above) and to prototype needed functionality where feasible. Collaboration software tools can help a site complete its information management plan when direct interaction is not possible.

Products and outcomes — Face-to-face interactions with site personnel are the most productive way to understand site needs and provide optimally crafted technical solutions. The outcome of LNO technical support and site visits will include improvements in information management plans and techniques across the LTER Network.

3.3 Core Services

Many services the LNO provides to LTER scientists, sites, and the Network are of long-standing, some going back to the original call for proposals for a Network office. The SOW in the current LNO CA documents an extensive list of services, many of which have been automated and only require routine maintenance (e.g., the Network bibliography). These continuing activities are not discussed here; however, a complete description of LNO services can be found on the LNO web page **[65]**. The several core services requiring more substantial effort, and therefore requiring more resources, are discussed below. While these services are varied, they have the common goal of enabling the network of sites to function efficiently.

3.3.1 Facilitation of Meetings and other LTER Activities

Provide financial and logistical support for meetings of Network governance and scientific committees.

Background — The LTER Network Bylaws and the Decadal Plan provide for meetings of key Network committees to advance research and education goals and to govern the Network. The LNO supports or facilitates almost all of these meetings, including:

- annual meetings of the SC, the IMC, and the LTER National Advisory Board (NAB);
- semiannual meetings and frequent videoconferences of the EB, the IMEXEC, and the NISAC;
- the annual LTER Network science forum to present research results for agencies at the NSF; and
- meetings and VTCs or teleconferences for up to 20 research working groups active at any time (see Section 3.1.3).

When possible, the LNO facilitates ad hoc meetings of other standing committees (Education, Publications, Graduate Students, Climate, International, Social Science). In addition to research and governance meetings, the LNO supports and organizes triennial ASM involving 800 participants from the 26 LTER sites and other national and international networks and research sites (see Section 3.1.2). Organization of these meetings requires significant LNO staff time during the year preceding the meeting.

Specific activities supported — The LNO facilitates efficient and cost-effective meetings by encouraging pre-planning, including the development of budget goals. The LNO helps meeting organizers identify venues and arranges support services. An agreement with a local travel agency allows the LNO to pay airfares directly, thereby controlling costs and eliminating the need for individual meeting participant payments. Similarly, the LNO negotiates prices with other vendors and sometimes pays meeting costs directly to reduce the burden on participants. The LNO reimburses participants and vendors, provides cost accounting, and maintains a record of meeting participation.

Products and outcomes — During the next six years, the LNO will support an average of 30 meetings a year involving 400 participants. In 2009 and 2012, the LNO will organize ASM. The LNO's central facilitation of meetings reduces the organizational burden on sites and individuals, increases efficiency and productivity, and controls costs by reducing redundancy and by negotiating reduced prices for lodging and related meeting costs. The LNO also provides clear communication of meeting logistics.

3.3.2 Persistent Record of LTER Activities. *Ensure a persistent record of LTER activities, achievements, and decisions by creating, acquiring, and archiving datasets, documents, still and video images, and audio recordings.*

Background — In its 28 years of operation, the LTER Network has produced an extensive record of its activities that includes publications, reports, minutes, notes, datasets, audio recordings, and visual images. The LNO acquires, archives, and manages these records and makes them accessible. The LNO adopts or adapts new technology to improve accessibility and security of the LTER archive, which will provide an historical record of LTER Network activities for future generations, increase understanding and appreciation of accomplishments of LTER Network, and allow more effective governance.

Specific activities supported — The LNO maintains an extensive database of information related to LTER personnel, bibliographies, site capabilities, committee activities, research, scientific initiatives and collaborations. The LNO documents the achievements and decisions of the Network by establishing a record of meetings and their minutes and by acquiring and archiving datasets, documents, audio, and still and video images. Through database activities, web content generation, and data curation, the LNO maintains an active on-line archive of information and activities of the LTER Network **[66]**.

Products and outcomes — The LNO provides easily accessible information from a persistent printed and digital record of key Network products and decisions. Database products resulting from these efforts form the primary content for the various LTER web pages. By creating easily accessible records, the LNO can more effectively disseminate LTER scientific accomplishments, document the relationship between resources and outcomes, provide for well-informed and consistent decision making, and enable smooth transitions in leadership over time.

3.3.3 Acquisition of Data, Hardware, and Software. *Facilitate the acquisition of commercial and public data, hardware, and software products for site-based and Network synthesis activities.*

Background — Communication and data sharing are facilitated by common hardware and software, which can often be acquired at reduced cost through joint purchases. On several occasions in the past, the LNO has served as the Network's agent in acquiring common cyberinfrastructure, and it will act in this capacity more frequently in the future to fulfill the goals of the Decadal Plan. The Network research and education goals developed in the Decadal Plan emphasize synthesis using comparable datasets over broad spatial scales. To address issues of land use, climate change, and invasive species, LTER scientists will require time series of remotely-sensed data. Specific examples of such data sets include: satellite data collected by mission-oriented agencies such as NASA, NOAA, or DOD; field data collected through networks of monitoring stations; and photographic images. The LNO facilitates collection of such data by interacting with LTER sites and the data providers to ensure accurate and complete geographic coverage of LTER sites.

Specific Activities Supported — The LNO works to fulfill needs for cyberinfrastructure and communication tools as identified by sites and the goals of the Decadal Plan. By evaluating the utility and cost-effectiveness of different alternatives, the LNO assists the Network in making decisions about hardware and software acquisitions. Through proposals and partnerships, the LNO obtains resources to acquire common cyberinfrastructure and communication tools. Network-level acquisition and implementation includes communication and coordination with site personal for site-specific needs, negotiation of costs for hardware and software, and distribution of resources across the LTER Network.

The LNO works with private vendors and with partners at UNM centers, NASA, USGS, DOD, and other agencies to identify and acquire data that contribute to LTER research and education goals. The Director for Synthesis Support oversees the collection of information on site needs and the communication of this information to the data provider. The Chief Information Officer is responsible for ensuring delivery of the acquired data to LTER users through a web portal. When required, the LNO provides or requests funding for data acquisition.

Products and outcomes — Central acquisition of cyberinfrastructure and communication tools reduces cost and improves interoperability while reducing redundant effort at each LTER site. The consistent acquisition of standard and new data products across the LTER Network provides opportunities for cross-site synthesis **[67-76]**. Direct collaborations with private companies and

government agencies have reduced redundancy of effort by individual LTER sites and enhanced access to a variety of data including remote sensing data products.

3.3.4 Coordination of Proposal Preparation. *Coordinate the preparation of proposals and supplements to respond to opportunities for Network funding.*

Background — Opportunities to obtain resources to advance Network goals come in many forms, including development of collaborative partnerships, sharing of resources with other networks or centers, and acquiring new funding through proposals. Certain opportunities for funding, such as the periodic supplements provided by NSF for LTER ASM, require a proposal from the LTER Network. Other opportunities may arise suddenly and require an immediate response. In both cases, the LNO takes the lead in preparing proposals. The impact of these activities is an increase in Network resources to achieve the research and education goals of the Decadal Plan.

Specific activities supported — The LNO prepares timely responses to funding opportunities related to Network-level initiatives and manages subsequent funding. The LNO distributes information about funding opportunities and helps to identify appropriate partners within the LTER Network. LNO staff members facilitate meetings and video conferences to develop ideas for proposals that benefit the Network.

Products and outcomes — The LNO will produce on average two successful proposals a year that result in new or increased Network funding for activities such as the acquisition of data, hardware, and software; participation in ASM; or support of research working groups. The outcomes of these proposals include increasing numbers of participants in triennial ASM, increased funding for Network research and synthesis, and increased resources to LTER sites.

3.3.5 Management and Reporting. *Manage and report on the fiscal and administrative activities of the LNO.*

Background — A fundamental responsibility of the LNO is to manage and properly account for the funds received through the CA and associated cost share, supplements to that agreement, and other monies received through competitively-funded projects. In addition, the LNO is responsible for reporting its activities as described in the CA. In order to fulfill these responsibilities, the LNO dedicates a portion of the effort of its supervisory staff to management and reporting tasks.

Specific activities supported —

1. Planning — Senior staff conduct annual reviews of the goals described in the LNO Strategic Plan and the associated Implementation Plan. These reviews lead to revisions in office priorities and re-allocations of resources to meet planning goals. Planning efforts are coordinated with the Chair and the EB.
2. Administration of funds — LNO staff administer funds from the CA, supplements, and other grants by documenting expenditures, reconciling accounts, and providing reports to the NSF.
3. Annual reports — The LNO prepares separate annual technical reports to NSF, the National Advisory Board, the LTER Network, and UNM.
4. Annual reviews — The LNO prepares for and undergoes annual reviews by the LTER EB, the NAB, and College of Arts and Sciences at UNM (resulting from its association with the Center for Research Excellence in Science and Technology). As part of the review by the EB, the LNO administers a survey on office performance with questions developed in coordination with the EB.
5. Personnel reviews — Supervisory staff conduct annual performance reviews of staff and determine salary increases.
6. Mid-term review — The LNO prepares for and undergoes a mid-term review of performance by NSF.

Products and outcomes — The products of LNO management and reporting activities include: 1) an updated LNO Strategic Plan and Implementation Plan to guide office operations; 2) evaluations of LNO performance and measures of site satisfaction; 3) timely and accurate annual and final technical and fiscal reports to EB, NAB, NSF, and UNM; and 4) reviews of staff performance and development of annual goals.

The outcomes of management and reporting activities include close coordination of Network and LNO objectives, adaptive management to address new issues and opportunities, an increased emphasis on broad impacts in LNO reports, a stable and efficient management structure with clearly-defined responsibilities for senior staff, low staff turnover, and a better understanding of LNO activities by NSF and the LTER Network.

3.4 Development and Outreach

The LNO's development, outreach, and training activities raise the profile of LTER; benefit the Network by creating collaborative research, cyberinfrastructure development, and education opportunities; and transfer requisite technological skills and knowledge to LTER scientists and information managers. Outreach supports information flows within LTER and between LTER and the broader community of scientists, educators and the public. Network development has improved communication between LTER and other organizations and led to numerous productive collaborations that have created funding, research, training and other opportunities for the LTER Network. Training workshops have brought critical technologies and skills to LTER sites and groups such as members of the Information Management Committee. Proposed development, outreach, and training activities aim to:

1. Enhance understanding of LTER—its structure (e.g., LNO, EB/SC, sites), capabilities, achievements and contributions to science and society;
2. Promote LTER as a center of excellence offering a network of experts engaged in understanding long-term ecological research and processes;
3. Facilitate and contribute to partnerships between LTER and other networks, mission agencies, and organizations that lead to new mutually beneficial research, cyberinfrastructure, and educational opportunities.
4. Provide LTER scientists, information managers, and students with training in new technologies, standard methods and approaches that facilitate data acquisition, integration and synthesis, as well as communication of knowledge to the broader community of scientists, students, and the public.

Development and outreach during 2009-2015 will focus on activities that most successfully communicate LTER achievements, demonstrate broader scientific impacts, create significant opportunities for collaboration and building partnerships, and provide training that is critical for LTER in meeting its objectives.

3.4.1 Strategic Communication Plan — *Create a strategic communication plan for better enhancing public information and outreach for the Network via a seamless system of information and outreach to the public.*

Background — The principal output of the LTER Network is new knowledge generated both from basic research at LTER sites and from synthesis efforts involving LTER and non-LTER sites. Knowledge dissemination converts LTER data, information, and results of synthesis activities into effective and readily assimilated communications to the various stakeholders and public. Increasingly, LTER science is benefiting society by enhancing our understanding of complex socio-ecological phenomena and providing information that underlies sound decision-making in the public arena. Therefore, demonstrating the capabilities, achievements, and value of the work by Network scientists and educators is a major objective of all LTER communications.

In conjunction with several volunteer communication specialists from LTER sites, the LNO Public Information Officer recently identified the communication and public relations methods used within LTER

to reach its various clients and inventoried communication materials developed by the LTER Network Office. This study revealed that communication and outreach to the public by LTER sites and the Network have been largely ad hoc and reactive rather than proactive in seeking publicity for LTER. Clear opportunities exist for better coordinating public communication and outreach across the Network and for improving the dissemination of information to LTER clients and the public. In particular, a coordinated effort to reach underserved groups would leverage the resources of the Network towards the goal of broadening participation in LTER science.

The LTER Executive Board has asked the LNO to develop a Strategic Communication Plan for the LTER Network. The plan will solicit input from all LTER sites and advice from the broader community of communication experts.

Specific activities supported — To create a strategic communication plan, the LNO will use steps previously used to develop the LTER Network Office Strategic Plan:

1. A *contextual scan* will identify stakeholders, examine external drivers, and summarize site and Network communication activities.
2. *Virtual and face-to-face planning meetings* will allow participants to review the contextual scan; assess LTER strengths, barriers and opportunities; identify and prioritize strategies, tactics, and actions; develop timelines, metrics and milestones; and assign responsibilities.
3. A *Draft Strategic Plan* will enable the Executive Board and Science Council to review the plan, and the LNO to revise it accordingly.
4. The *Strategic Communication Plan* and a summary pamphlet will be published, and stakeholders briefed.
5. *Monitoring and feedback* will occur to gather performance data, provide progress reports to the LTER Executive Committee, monitor external events, and improve the process.

Products and outcomes — The LNO will produce a "living" Strategic Communication Plan for the LTER Network. The plan will address: (1) *who* LTER wishes to communicate with; (2) *why* LTER wants to communicate with them; (3) *what* LTER desires to communicate; (4) *how* the information can be communicated most effectively; and (5) *when and how often* LTER needs to communicate with its stakeholders. The plan will include suggested public communication and outreach tools and products; proposed activities and tasks (e.g., development of an LTER media kit); and timelines, metrics and milestones.

The strategic plan will encourage LTER sites and the Network to become more proactive in seeking publicity for achievements by LTER scientists and educators. Findings attributable to LTER site scientists will be increasingly cited in important media outlets (both professional and public), and LTER scientists will increasingly be invited to participate in public decision-making (e.g., providing expert testimony). LTER will achieve greater name recognition throughout the world for the quality of site and Network science. The strategic plan will specifically address new ways to employ information technology to engage underserved groups in the research and education activities proposed in the Decadal Plan.

3.4.2 Communication and Outreach — *Effectively communicate information about the LTER Network—purpose, activities, and achievements—through an array of proven, high-visibility mechanisms.*

Background — The Public Information Office communicates information about LTER to the public through a web portal (www.LTERnet.edu), video and PowerPoint presentations, a traveling multimedia exhibit that is regularly transported to key national meetings [e.g., annual meetings of the Ecological Society of America, Society for the Advancement of Chicanos and Native Americans (SACNAS)], and a variety of print materials—examples of which are illustrated in ***Figure 10***.

Specific activities supported — The Strategic Communication Plan may lead to the modification of some existing communication and outreach activities as well as to the addition of new activities that are approved by the Executive Board. Nevertheless, core activities that presently form the foundation for the LNO communication and outreach program will continue. These core activities include: (1) publication of LTER Network Newsletters, site and Network brochures, and flyers and occasional publications; (2)

maintenance and continued upgrading of the LTER Network and LNO web sites; (3) revamping of the LTER traveling multimedia exhibit, PowerPoint presentations, and posters; and (4) representation of the LTER Network (including staffing of the multimedia exhibit) at scientific meetings such as the AAAS, ESA, and SACNAS.

One new priority for the Public Information Office is to redesign the traveling multimedia exhibit. The exhibit currently consists of multiple panels that are heavy, difficult and time-consuming to assemble, and prone to damage during assembly. The new multimedia exhibit will consist of a high-definition display, space for books and brochures, and, importantly, a series of modular posters that roll-up from a floor base. The modular poster display, modeled after the exhibit adopted by the Ecological Society of America, can be designed so that each poster is tied to a specific theme—general introduction to LTER, scientific achievements, education, and information management. The individual posters are light-weight and because of their low cost can be revised more frequently. Furthermore, the modular design enables easy and inexpensive transport of only those modules needed at a particular meeting or LTER site.

Products and outcomes — Key products of the Public Information Office include:

- Publication of the Spring and Fall LTER Network Newsletter
- Production of two revised site brochures annually
- One or more revisions of the LTER Network brochure
- Maintenance and regular updating of the LTER and LNO web sites
- Re-design of the traveling multimedia exhibit in Year 1 and the addition of one or two revised poster modules annually
- Production of flyers, posters, and occasional publications as requested by the Executive Board
- Outreach to annual meetings of ESA and SACNAS

Key outcomes include:

- Increased understanding of LTER capabilities, achievements, and contributions to science and society, especially with respect to understanding complex, long term phenomena and to informing decision-making on ecological issues
- Increased understanding within and outside LTER about how its scientific and educational enterprise is organized and managed
- An integrated suite of tools and strategies for disseminating information about LTER scientific achievements
- Identification of LTER as a center of excellence offering a network of experts on long term ecological research, education, and ecological informatics

3.4.3 Development — *Build and maintain strategic partnerships and collaborations that benefit science, cyberinfrastructure development, and education in the LTER Network, as well as the broader community of scientists, students, and educators.*

Background — Following recommendations made in the 10- and 20-year reviews of the LTER Network and responding to directives in the CA with NSF, the LNO has participated in a number of partnerships and collaborations that have benefited LTER and the broader community. Partnering activities have included developing or sharing research resources and cyberinfrastructure, creating informatics research and training opportunities, and designing and coordinating efforts among environmental observatories, organizations and societies to improve efficiency and cost-effectiveness of the LTER scientific enterprise. ***Table 1*** provides examples of past activities, collaborating institutions, and key outcomes that have benefited LTER, partnering institutions, and others.

Specific activities supported — Development encompasses two activities. First, LNO staff will facilitate communication between the LTER Network and other scientific, cyberinfrastructure development, and education enterprises and disseminate information regarding pertinent activities and opportunities to LTER sites and scientists. Second, LNO staff will participate in cross-site, LTER Network, and collaborative research, education, and training proposals that complement the LTER planning effort, provide new research opportunities for LTER scientists, and build or leverage cyberinfrastructure for the Network. LNO personnel will participate in specific collaborative activities that are identified, evaluated, prioritized, and approved according to the procedures documented in the LNO Strategic Plan **[77]**. Coordination and communication with partners and collaborators encompass a range of activities that are necessary to build and maintain a collaboration including: email, phone and videoconferences among the collaborators; reports of activities and results to participants and the broader community; and reports and contracts that meet the requirements of funding agencies and Memoranda of Understanding that may exist among the partnering institutions.

Important ongoing collaborations beneficial to the LTER Network and its partners will continue. These collaborations include: (1) the LTER—NBII Partnership that supports Iñigo San Gil and his efforts to upgrade metadata management systems across the LTER Network (central activities include support and enhancement of the metadata editor/entry tool, outreach efforts to promote adoption of the metadata editor, training sessions, editor usability tests and focus groups to improve the tool, continued help-desk support for assisting LTER sites with data and metadata management, designing protocols for QA/QC and metadata content enrichment, and creating tools that facilitate data integration and synthesis); (2) LTER and NCEAS support of www.ecoinformatics.org—a community web portal that provides access to open source cyberinfrastructure for ecologists and information managers; (3) LTER engagement in the Kepler Core Project—a follow-up effort to the SEEK Project that is providing free and open access to powerful scientific workflow software (i.e., Kepler) for use by LTER scientists; and (4) partnering with the Organization of Biological Field Stations in development of mutually beneficial research, cyberinfrastructure development, and training activities such as those supported in the recently completed Research Coordination Network project (see Results of Prior Support).

The LNO will continue recently initiated partnerships and pursue new collaborative opportunities that benefit the LTER Network, including:

1. Participation in proposals and strategic planning sessions with the Internet2 and National Lambda Rail to enhance high-bandwidth connectivity across the Network and to add new, powerful collaboration technologies to LTER sites.
2. Collaboration with the Oak Ridge National Laboratory Digital Active Archive Center, the two major synthesis centers supported by NSF-BIO (NCEAS, NESCent), the digital library community, NSF-funded supercomputer centers (e.g., SDSC, NCSA, NCAR), NBII, and the Global Biodiversity Information Facility to enhance LTER archive and preservation capacity and to promote interoperability across related research networks and archives.
3. Communication and coordination with research networks (and their supporting agencies) that overlap to some extent in membership and mission with LTER, for example, the USGS National Phenology Network, NEON, WATERS, OOI, the USDA-FS experimental forest network, the Urban Long Term Research Areas (ULTRA; USDA FS), and the Long Term Agricultural Research network (LTAR; USDA Cooperative State Research, Education, and Extension Service).

Products and outcomes — Products include participation in at least two proposals annually. Outcomes of successful proposals are projected to include increased opportunities for training of LTER scientists, CI staff, and students; increased numbers of LTER personnel engaged in collaborative research and CI activities; increased funding for cross-network and cross-agency activities; and increased leveraging of partner contributions (e.g., CI interoperability) to achieve LTER goals.

3.4.4 Training — *Provide or coordinate training for LTER scientists and information specialists in support of Network science and CI development.*

Background — The dissemination of technical information throughout the LTER Network raises understanding to a common level, facilitating productive interactions and promoting the adoption of best practices. The LNO has facilitated various training exercises focusing on LNO partnerships with the Organization for Biological Field Stations and the SEEK project. While LTER scientists and information managers have enrolled in these training opportunities, this will be the first effort to develop a training program focused specifically on LTER. To accomplish this goal, the LNO will seek partnerships with other research networks and scientific enterprises to provide mutually beneficial training opportunities. Network in-reach will be mirrored by similar in-reach programs at the individual LTER sites.

Specific activities supported — Each year, the LNO will organize and host one three-day training workshop that reaches scientists or information managers at the 26 LTER sites. As part of this exercise, the LNO will coordinate workshop planning and training activities, cover participant support costs, capture lectures and live demos on a rich media recorder, and produce formative and summative evaluation tools. Technology training for scientists could alternate with information technology training. At present, LTER information managers have proposed several possible IT training topics, including cybersecurity and advanced GIS analysis. Possible science technology training topics include: creating and running scientific workflows for complex analyses (e.g., Kepler) and establishing sensor networks for in situ measurement programs (e.g., communications, QA/QC, analysis).

Products and outcomes — This activity will result in annual training sessions that will increase the use and proficiency of use of advanced technologies across the LTER Network. This increased proficiency will lead to an increase in cross-disciplinary and cross-site publications based on use of new technologies or scientific approaches.

4.0 Assessment and Evaluation

The LNO's main goals are to facilitate, enhance, or expand the research, education, and synthesis activities of the LTER Network through a set of 17 activities, each with measurable outcomes. Specific areas for evaluation were selected by using logic models to analyze and illustrate the relationship among LNO goals, activities, and outcomes. A logic model graphically depicts how a program will work to achieve identified outcomes **[78]**. ***Figure 11*** shows one of these logic models.

LNO staff, the LTER Executive Board (see Section 6.0), and external evaluators will conduct formative and summative assessment of LNO programs at least annually by employing a mixture of qualitative and quantitative approaches. ***Figure 12*** shows assessment data previously collected by the LNO. The Senior Program Manager and her staff will expand and institutionalize this process during the next six years. The formative component will generate feedback about what works and what does not, thereby enabling the LNO and key stakeholders to modify plans or redesign activities to increase the likelihood of meeting LNO goals **[79]**. The summative component will use qualitative and quantitative measures to produce an objective analysis of LNO outcomes. In some cases, these metrics can be quantitative; in other cases, qualitative descriptions of the impacts of LNO activities on the LTER Network and the broader scientific community will best measure progress. In all cases, assessing the impact of LTER activities will be correlative, since no control data are available **[80]**.

Measures of progress will be similar within categories of proposed activities, but somewhat different among categories. The initial suite of measures is listed below. Annual evaluations of the LNO by the Executive Board may modify this list.

Goal: Facilitate Scientific Synthesis

- Are users of synthetic datasets satisfied with delivery mechanisms, quality, etc.?
- Are collaborations formed among sites that have not collaborated previously? Is the number of sites collaborating on individual projects increasing?
- Does the LNO organize or support at least 12 working groups designed to increase collaboration across sites per year?
- Are the number and quality of products arising from All Scientists Meetings, Science Council Meetings, and research working groups increasing over time?
- Is progress being made towards achievement of Decadal Plan objectives for research?

Goal: Develop, Implement, Operate, and Maintain Cyberinfrastructure to Support LTER Activities

- Are users of communication and collaboration services satisfied with ease of use, reliability, and functionality?
- Are users of the NIS satisfied with ease of use, reliability, and functionality?
- Are the volume of data and the number of data sets in the NIS increasing over time?
- Are the number and quality of products (reports, standards, best practices documents, publications, and presentations) from IM activities increasing over time?
- Is the number of data sets managed by LNO increasing over time?
- Is progress being made towards achievement of Decadal Plan objectives for cyberinfrastructure?

Goal: Provide Core Services

- Are participants in meetings facilitated by LNO satisfied with the timeliness and detail of information transfer, meeting logistics, speed and ease of reimbursement, and availability of results from the meeting?
- Are users of the LTER document archive satisfied with ease of use, reliability, and completeness of the archive?
- Are the volume and diversity of data in the remote sensing archive increasing? Are the number of users and the number products generated from the use of the remote sensing archive increasing?
- Does the LNO prepare at least two successful supplement proposals per year?
- Does the LNO prepare a timely and informative annual report to the Executive Board each year?
- Is the LNO Strategic Plan reviewed annually and revised at least every three years?

Goal: Enhance Development and Outreach

- Did the LNO develop a strategic communication plan for the LTER Network during the first year of the CA?
- Are members of the LTER community satisfied with the breadth, detail, and timeliness of information about LTER activities that they receive through the LNO?
- Are members of the broader scientific community satisfied with the breadth, detail, and timeliness of information about LTER activities that they receive through the LNO?
- Are the number and value of strategic partnerships between LTER and other entities increasing over time? Are the benefits accruing to the LTER Network from these partnerships increasing over time?
- Does the LNO participate in at least two proposals annually that are based on these partnerships?

- Does the LNO conduct an annual training for LTER scientists and information specialists in support of Network science and cyberinfrastructure development? Are participants satisfied with the course structure and content?
- Are LTER scientists participating in an annually increasing number of collaborations (e.g., workshops, standards-setting organizations, training sessions)?

The LNO staff will measure progress directly by collecting data and analyzing regular surveys of LTER investigators. Surveys of participants in ASM and training sessions will provide feedback on the satisfaction and success of those activities.

5.0 Scientific Merit and Broader Impacts

The impact of the proposed work extends well beyond the bounds of the LTER Network to include the broader social-ecological and informatics communities. A major accomplishment of the LTER Network during 2007-2008 was completion of two key planning documents, Integrated Science for Society and the Environment (ISSE) and the Decadal Plan for LTER **[42]**. Together, these documents lay out strategies for an integrated social and ecological science program for the LTER Network and broader scientific community. The scientific merit of this new science program lies in its potential to galvanize a new body of theory spanning the social and ecological sciences. The LNO will facilitate increased synthesis across disciplines, and in so doing simulate the interactions necessary to begin to address Decadal Plan goals. Funds for research working groups requested in this proposal will encourage interactions between ecologists and social scientists and will provide opportunities for increasing synthesis and expanding collaborations through proposals to NSF programs that link human and natural systems. These developing collaborations will encourage a broader-scale of transdisciplinary activity as envisioned in the ISSE and Decadal Plan documents.

Additional scientific and broader impacts will result from development of distributed data services and their use for new synthetic research, co-development of standards of practice for ecological information management, development of new cyberinfrastructure tools, increased access to data for education and underserved groups, and collaboration with other environmental observing networks to plan a robust and efficient national cyberinfrastructure for ecological research.

National High-quality Distributed Data Services — The distributed data repositories of the 26 LTER sites reflect the actual distribution of most ecological data, which are held in separate data management systems developed by field stations, museums, academic institutions, state and local governments, and individual scientists. The structure of these data often differs from repository to repository, making integration of semantically similar data a difficult task. The Network Information System being developed by the LNO and LTER sites using the PASTA architecture model will address the problem of delivering distributed ecological data. For example, the LTER NIS will leverage the value of metadata to facilitate the extraction, transformation, and loading of source data into a database system with a rich, shared lexicon, while supporting experimental data reproducibility and quality assessment through the capture of data provenance and quality metrics. The NIS will provide access to data from the 26 LTER sites through a single point of access and at the same time ensure long-term preservation of site data through centralized stewardship. In addition, the NIS will provide access to derived data products through targeted web-services and by enabling non-LTER sites to participate. The broader impact of completing this project in the next six years will be the dramatic expansion of access to the wealth of LTER data and information in a readily discovered and useful format that promotes learning and scientific discovery by scientists, students, and citizens.

Standards of Practice for Ecological Information Management — LTER Information managers have a history of leadership and partnership in informatics dating back to the inception of LTER. During the next six years, LNO will nurture partnerships with environmental observatories and federal agencies which share the goal of developing community standards and disseminating robust LTER IM practices widely. For example, the partnership between the LNO and the NBII will continue the

LTER Metadata Standardization project to develop metadata standards of practice to optimize cross-site synthesis and the Metadata Crosswalk project that bridges two commonly-used metadata standards for the geospatial, biological and ecological disciplines. These efforts will provide the genesis for standard metadata management practices applicable to both LTER and non-LTER sites (e. g., field stations, international LTER sites) that frequently adopt LTER standards in lieu of developing solutions of their own.

Community Cyberinfrastructure Development — The LNO provides leadership and plays a key role in defining the importance of informatics in ecology and in disseminating knowledge about ecoinformatics throughout the ecological community. Partnerships with NBII, the San Diego Supercomputer Center (SDSC), NCEAS, the National Center for Supercomputer Applications (NCSA), and the University of Kansas are promoting the integration of informatics, computer science, and ecology through large-scale collaborative projects such as SEEK. During the next six years, the LNO plans to expand these partnerships to involve the Oak Ridge National Laboratory, NESCent, the California Digital Library, the Global Biodiversity Information Facility, and many individual scientists at a range of institutions through joint proposals to develop cyberinfrastructure that benefits the LTER Network and the broader scientific community. For example, pending proposals involving many of these partners will develop interoperability standards via participation in the proposed INTEROP and DataNet networks. The broader impacts of the effort include enhanced integration and synthesis of data, improved data sources for geo-statistical and modeling studies, and enhanced access to data for scientists not associated with large projects, large agencies, or major universities.

Increased Accessibility to Data — The LNO engages in a suite of CI activities to improve access to LTER data and information. Although the primary target of these activities is the research community, increased data accessibility also benefits other groups. Achievement of the education objectives of the Decadal Plan will be facilitated by improved data accessibility and enhanced tools to manipulate and share data. Beyond LTER, the availability of LTER data for educational purposes will enhance instruction at all levels. Open access to LTER data and information through public web portals will benefit underserved groups that have limited access to academic data sources. The LTER Strategic Communication Plan to be developed with funding from this proposal has an explicit goal of identifying and implementing information technology to engage underserved groups in LTER science and education.

Coordination of Shared Cyberinfrastructure with Environmental Observing Networks — The LNO is committed to sharing large CI with other environmental observing networks. In the last six years, LNO staff have used their growing expertise and experience to facilitate the design and development of several national and international environmental observatory systems, including NEON, CUAHSI, WATERS, NPN, LTAR, the Collaborative Large-scale Engineering Analysis Network for Environmental Research (CLEANER), and the IndoFlux Network. The LNO will continue to collaborate with these networks as they develop and it will be an integral partner in efforts to leverage shared CI. For example, LNO staff members are part of an observatory working group convened by the NSF to coordinate development and use of CI. One of the group's initial goals is to provide shared access to a national data repository and indexing system. The LNO anticipates strong future interactions with these networks as well as with newly emerging national and international observing networks.

6.0 Management

The LTER Network Office operates through a CA between NSF and UNM. The CA outlines the conditions of the award and contains a scope of work that defines tasks and objectives. Under a CA, changes to the scope of work and funding level can be made during the course of the Agreement with the mutual consent of NSF and UNM. The principal point of contact for UNM in the CA is the Executive Director of the LNO, and the contact person for the NSF is the LTER Program Officer in the Division of Environmental Biology.

The LNO is located administratively at UNM in the Center for Research Excellence in Science and Technology (CREST) in the College of Arts and Sciences. In response to a recommendation in the last LNO renewal, the Dean of Arts and Sciences created CREST in 2004 to manage the CA and related grants and contracts under a separate administrative unit. CREST has two defined positions, a Director who reports to the Associate Dean for Research in Arts and Sciences, and a Senior Program Manager. At present, the Executive Director of LNO is also director of CREST. As stipulated in UNM rules, CREST receives an annual review by the College of Arts and Sciences, and the Associate Dean for Research conducts an annual performance review of the director. The Department of Biology provides support services to CREST for purchasing and personnel matters.

The LNO occupies physical space on UNM Main Campus in the Center for Ecological Research, Informatics, and Art (CERIA) building, along with the Sevilleta LTER program and the Museum of Southwest Biology. This space is within a few minutes walk of the administrative offices of the College of Arts and Sciences and Department of Biology.

Chair of the Science Council and the Executive Board — The LTER Bylaws specify the responsibilities of the Chair as well as compensation for the position. The present CA does not include compensation for the Chair, and therefore we request new funds for this purpose.

> ***Article VI, Section 1. Chair:*** *The Chair shall preside at all meetings of the Science Council and the Executive Board and, along with the Executive Board, generally oversee and supervise the governance of the LTER Network. The Chair shall facilitate communication to Network Sites regarding decisions of the Executive Board; provide a receptive ear for any Network member who wishes to raise an issue of concern; and serve as or appoint liaisons to NSF, other agencies, associations, networks, the public, and to Network committees. The Chair, with assistance from the Executive Director and Office, is responsible for preparing meeting agendas and overseeing the taking of minutes at all Science Council and Executive Board meetings and for ensuring that such minutes are available to Sites within the time frames specified in these Bylaws. The Chair will orient the Chair-Elect to the duties of the office.*
>
> ***Article VI, Section 3. Compensation:*** *The Chair-Elect receives no compensation other than reasonable expenses. The position of Chair requires a substantial level of effort, equal to one-third (1/3) to one-half (1/2) of an FTE. In recognition of the time and effort required of the Chair, the Executive Director of the Office, in consultation with NSF, shall negotiate the mechanism for compensation appropriate to the situation no later than 6 months after the Chair's election*.

Executive Director — The position of Executive Director is defined in the LTER Bylaws:

> ***Article IX, Section 4. Executive Director:*** *The Executive Director of the Office is the Principal Investigator and scientific leader of the Cooperative Agreement. The Executive Director is an employee of the contracting institution, and operational supervision of the Executive Director resides with the contracting institution. The Executive Director is responsible for the day-to-day operation of the Office. The Executive Director will implement programmatic recommendations of the Executive Board, consistent with the Cooperative Agreement with the NSF.*

The current Executive Director holds the position of Research Professor in the Department of Biology. UNM provides salary and fringe benefits for this position as cost-share. The general responsibilities of the Executive Director include cooperation with the EB to set priorities for the LNO, development and implementation of a strategic vision for the LNO, management and evaluation of staff, oversight of LNO efforts as outlined in the CA, and communication with the NSF, LTER, other agencies, and the general public. The Executive Director reports directly to the Chair of the EB (presently Phil Robertson of Michigan State University). Communication between the Chair and the Executive Director occurs through frequent telephone and video conferences. The Executive Director orients incoming chairs and EB members and provides organizational continuity for the LTER Network.

The Executive Director supervises four senior staff members: the Director for Synthesis Support, the Chief Information Officer, the Director for Development and Outreach, and the Senior Program Manager (***Figure 13***). The Executive Director conducts annual reviews of performance for members of the senior staff and meets with them several times each year to update and revise goals.

Senior Staff — The four senior staff members (see Section 8.0), along with the Executive Director, constitute the management team of the Network Office. They advise the Executive Director on matters pertaining to their areas of expertise and work with the Executive Director and other staff to further the goals of the LTER Network. They may assume the duties of the Executive Director in his absence. The Director for Synthesis Support, the Chief Information Officer, and the Director for Development and Outreach have appointments as research faculty in the Department of Biology and serve as co-principal investigators on this proposal. The Senior Program Manager is a regular staff member.

Under the overall supervision of the Executive Director, senior staff members have responsibility for the four categories of activities described in this proposal and supervise the technical staff assigned to these activities (***Figure 13)***.

Goals and Priorities — The SOW that is part of the CA, the strategic plans of the LTER Network **[42]** and the LNO **[77]**, and the EB all define the goals and activities of the LNO. The LNO Strategic Plan contains the operational objectives of the LNO and the means to prioritize these objectives. The Executive Director annually reviews the LNO Strategic Plan, and the management team revises the plan every three years.

Evaluation — The NSF reviews the success of the LNO in meeting its goals through annual reports **[2]**, mid-term site visits **[81-82]**), and renewal proposals every six years. In addition, the Executive Director reports on activities to the LTER Program Officer frequently via videoconference and in person several times during the year. The LTER Bylaws stipulate an annual review of the LNO by the Executive Board:

> ***Article IX, Section 2. Review of Network Office Performance:*** *An annual review of Office performance shall be conducted by the Executive Board at its first meeting of the year. The review will be based on 1) the annual report of the Office, which will be circulated to LTER Sites on January 1 of each year, 2) a survey of Sites administered by the Office in October of each year, and 3) goals set in the LTER Strategic Plan. The Executive Board will recommend modifications to Office tasks. Those recommendations approved by the Executive Board will be submitted by* the Office to the NSF for possible incorporation into the Cooperative Agreement.

Linkages to the LTER Network — The SC and the EB are the governance bodies of the LTER Network (**Figure 14**). Under the ultimate authority of the SC, the EB is empowered to make decisions regarding the management of the LTER Network. The Executive Director is an ex-officio, non-voting member of the SC and the EB, and is thus involved in every LTER governance meeting. Other LNO staff members participate in these governance meetings as required and may also be members of standing committees. The LNO has two operational responsibilities within the LTER Network. Namely, the LNO works on both strategic and tactical planning with the SC and EB, LTER standing committees, the NAB, and the NSF. The LNO also has responsibility for implementing some of these plans by facilitating compliance by individual LTER sites and scientists.

National Advisory Board — The LTER Network has established a NAB **[83]** to provide regular review and advice regarding LTER programs. Members of the NAB are nationally recognized scientists chosen to encompass a wide range of disciplines and backgrounds. The NAB also provides independent review and advice to the LNO. The NAB meets annually and produces a report to NSF and the EB **[84]**.

Table 1. Selected key activities and outcomes supported through strategic partnerships and collaborations.

Strategic Partnership	Activities	Key Outcomes, Products, and Publications[#]
The Knowledge Network for Biocomplexity • LNO staff – Brunt, Waide • Collaborators – NCEAS, SDSC	• specified the Ecological Metadata Language content standard for ecological metadata • developed *Morpho* and *Metacat*—two software tools that support entry and management of ecological metadata records • held multi-institutional graduate training	1) EML adopted as the metadata standard by all sites in the LTER Network; 2) all databases documented using EML-compliant metadata; 3) Metacat is used nationally (LTER, etc.) and internationally for metadata management. http://knb.ecoinformatics.org [13]
Resource Discovery Initiative for Field Stations • LNO staff - Michener and Brunt • Collaborators – OBFS, NCEAS, SDSC, SEV/CAP/VCR LTER sites, California Natural Reserve System (CaNRS)	• created several new databases that are used by both OBFS field stations and LTER sites (e.g., summer courses, site descriptions, personnel, administration, bibliography) • revised the OBFS web site • implemented OBFS Data Registry • held two week-long training activities annually	1) EML-compliant Data Registry adopted by ESA, PISCO, CaNRS, and OBFS; 2) thousands of data sets now easily discoverable by scientists, students and educators; 3) 13 LTER sites are OBFS members and benefited from having new information managers trained in ecoinformatics and ArcGIS. http://www.obfs.org/ [12, 14-16]
Science Environment for Ecological Knowledge. • LNO staff - Michener, Brunt, Waide • Collaborators - NCEAS, SDSC, CAP LTER (ASU), U. North Carolina, U. Kansas, U. Vermont, UC-Davis, Napier University	• created cyberinfrastructure for ecological, environmental, and biodiversity research • provided education and outreach to the ecological community (especially, under-represented groups) about ecoinformatics • state-of-the-art ecoinformatics training lab developed	Created an integrated data grid (EarthGrid) for accessing a wide variety of ecological and biodiversity data and analytical tools (including Kepler—an open-source scientific workflow solution developed as part of SEEK; see http://seek.ecoinformatics.org/ and http://kepler-project.org/). [17-31]
USGS National Biological Information Infrastructure (NBII) • LNO staff - Michener, Brunt • Collaborators - NBII	• provided direct metadata and data management assistance to all 26 LTER sites • achieved interoperability between EML (the LTER metadata standard) and the USGS Biological Data Profile • participated in the new ISO standard working groups for the Biological Data Profile	1) Exposed 6,090 LTER metadata documents through the NBII & ORNL clearinghouses; over half contain information that enable automated data retrieval and integration; 2) co-developed a metadata entry tool that facilitates metadata creation and storage.
Environmental Observatory (EO) Design. • LNO staff – Michener, Waide • Collaborators: NEON, CLEANER, WATERS, NPN, IndoFlux	• served on teams involved in planning environmental observatories • completed planning activities for a continental scale-environmental science research agenda • completed a National Research Council publication focused on linking space-based and ground-based observing networks	1) Completed NEON design documents; 2) designed an environmental monitoring network in India; 3) organized a Special Session at ESA (Annual meeting in San Jose) focused on Decadal Science Planning for the Ecological Sciences. http://neoninc.org [32-40]

		Synthesis				Cyberinfrastructure				Core Services					Development/ Outreach			
	FTE	1.1 Science Council	1.2 All Scientists Meetings	1.3 Research Working Groups	1.4 Activities of the Decadal Plan	2.1 Basic CI Support	2.2 Information Management	2.3 Network Information System	2.4 IT, Database, and Web Consulting	3.1 Facilitation of Meetings	3.2 Persistent Record of LTER Activities	3.3 Acquisition of Data, Hardware, Software	3.4 Proposal Preparation	3.5 Management and Reporting	4.1 Strategic Communication Plan	4.2 Communication and Outreach	4.3 External Relations	4.4 Training
Executive Director (UNM)	1.00																	
Chief Information Officer	1.00					0.25	0.25	0.25	0.10			0.05		0.10				
Director Synthesis Support	0.75	0.15	0.20	0.10	0.10		0.05	0.05				0.05		0.05				
Director Development/Outreach	0.50													0.05	0.05	0.05	0.25	0.10
Senior Program Manager (CREST)	0.50									0.05	0.05	0.05	0.15	0.20				
Office Manager	1.00									0.70	0.10	0.10		0.10				
Accounting Technician	1.00									0.70		0.10	0.10	0.10				
Public Information Officer	1.00														0.10	0.90		
Sr. Application Support Analyst (NBII)	1.00								0.50								0.50	
Application Support Analyst	1.00					0.30	0.30		0.20							0.20		
NIS Developer	0.75							0.75										
NIS Programmer/Analyst	1.00							1.00										
System Administrator	1.00					1.00												
Systems/Analyst	1.00					0.80						0.10						0.10
Information Manager	1.00						1.00											
Total FTEs	13.50	0.15	0.20	0.10	0.10	2.35	1.60	2.05	0.80	1.45	0.15	0.45	0.25	0.60	0.15	1.15	0.75	0.20
Sub-total - FTEs by category of activity		0.55				6.80				2.90					2.25			

Table 2. The LNO proposes to allocate staff effort to 17 activities in four categories. Eight full-time equivalent (FTE) positions funded by the Cooperative Agreement will support Continuing Operations. Another two and one-half positions supported from other sources will contribute to Continuing Operations. Funding for three new positions will support activities related to the objectives of the Cyberinfrastructure Strategic Plan.

Key: Green = supported by funds other than the LNO CA
Yellow = positions dependent on new funding.

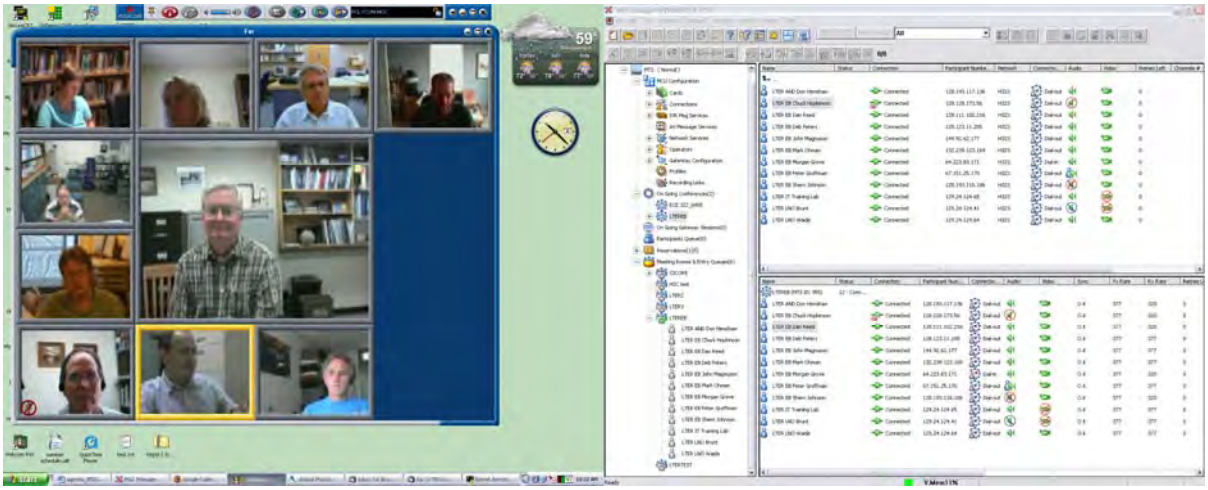


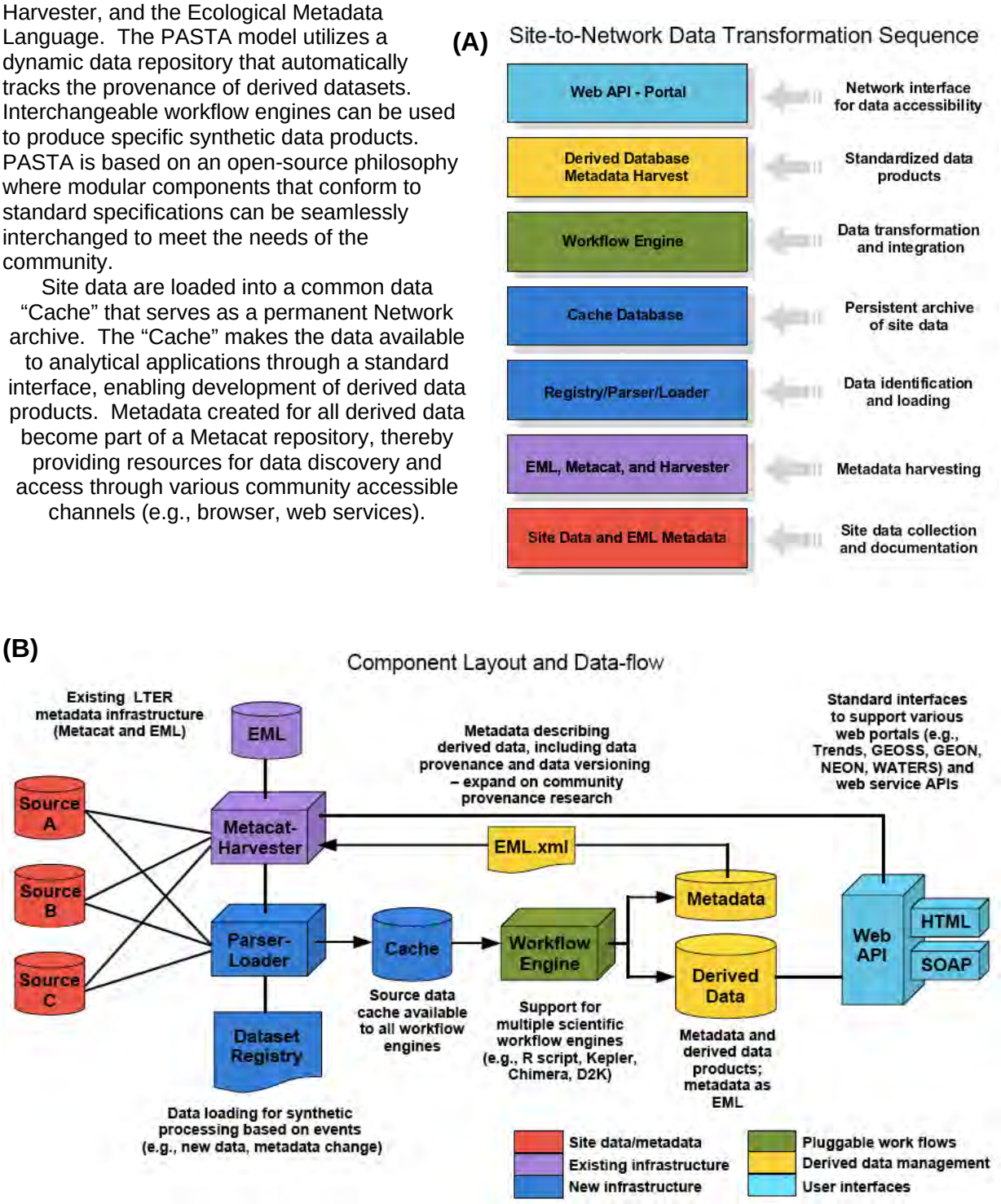
Figure 1. Video teleconferencing (VTC) is improving the way the LTER Network gets business done. The 2006 Executive Board, under the leadership of interim chair John Magnuson, began holding its monthly meetings by VTCs instead of by telephone conferences. The experiment has been a great success. The VTC system establishes connections using a variety of client technologies including desktop software (A), conference room units, and personal standalone VTC units. The Polycom MGC+ MCU bridge at the LNO harmonizes the connection idiosyncrasies and the LNO Systems Analyst monitors VTCs for quality via a full-featured administrative interface (B).

Figure 2. The LTER Informatics Training Laboratory - Here participants receive hands-on instruction in Ecological Metadata Language creation and management. The LNO and the SEEK project co-developed a modern information technology training laboratory that is optimized for student-to-instructor communication, while remaining ergonomically comfortable for long periods of instruction.

Figure 3. The 2006 LTER All Scientists Meeting in Estes Park, CO attracted 863 participants, including members of the LNO team (first row, left to right): Mark Servilla, David Farris, Jeanine McGann, Duane Costa, Steve Carpenter (NTL), Bob Waide, John Vande Castle, Bill Michener, George Garcia, Marshall White, James Brunt, and McOwiti Thomas.

Figure 4. The PASTA (Provenance Aware Synthesis Tracking Architecture) framework is a conceptual model for transforming LTER site-collected data into Network-ready derived products. Diagram (A) shows the sequence of steps used to transform the data and the respective PASTA components that perform the operations; Diagram (B) shows the component layout and data flow. The system uses interoperable components (B) based on existing standards and commonly accepted programming approaches, and it leverages investments in existing community-developed software tools like Metacat, Harvester, and the Ecological Metadata Language. The PASTA model utilizes a dynamic data repository that automatically tracks the provenance of derived datasets. Interchangeable workflow engines can be used to produce specific synthetic data products. PASTA is based on an open-source philosophy where modular components that conform to standard specifications can be seamlessly interchanged to meet the needs of the community.

Site data are loaded into a common data "Cache" that serves as a permanent Network archive. The "Cache" makes the data available to analytical applications through a standard interface, enabling development of derived data products. Metadata created for all derived data become part of a Metacat repository, thereby providing resources for data discovery and access through various community accessible channels (e.g., browser, web services).



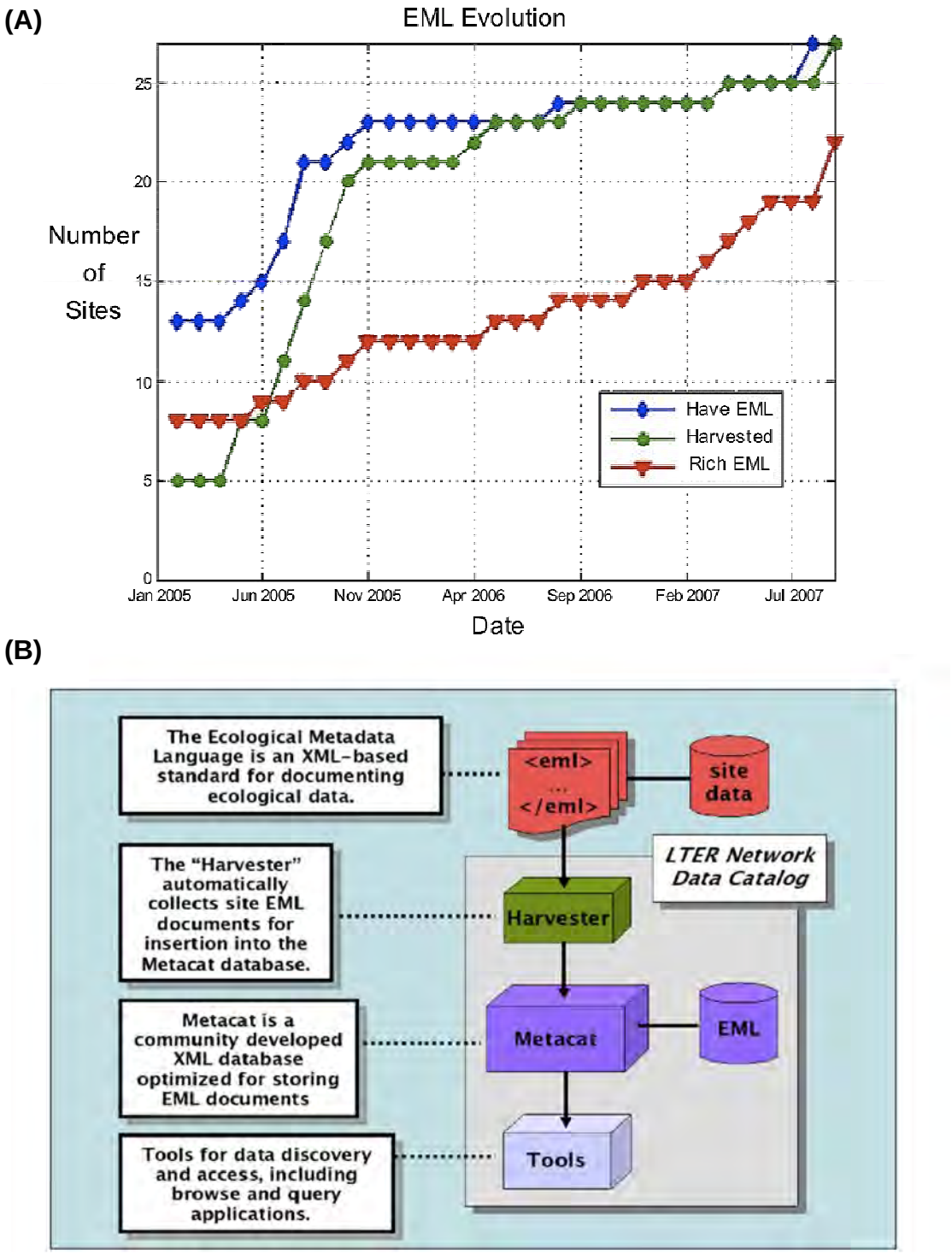


Figure 5. The LNO's aggressive outreach is increasing LTER site use of the Ecological Metadata Language and the LTER Network Data Catalog through automated harvesting of EML documents. Diagram (A) shows progress through July 2007. The quantity and quality of metadata documents available for harvesting from LTER sites continues to increase. Diagram (B) depicts the data harvesting infrastructure, which derives from the Knowledge Network for Biocomplexity project (a previous LNO collaboration), and serves as the metadata update mechanism and repository for the PASTA framework.

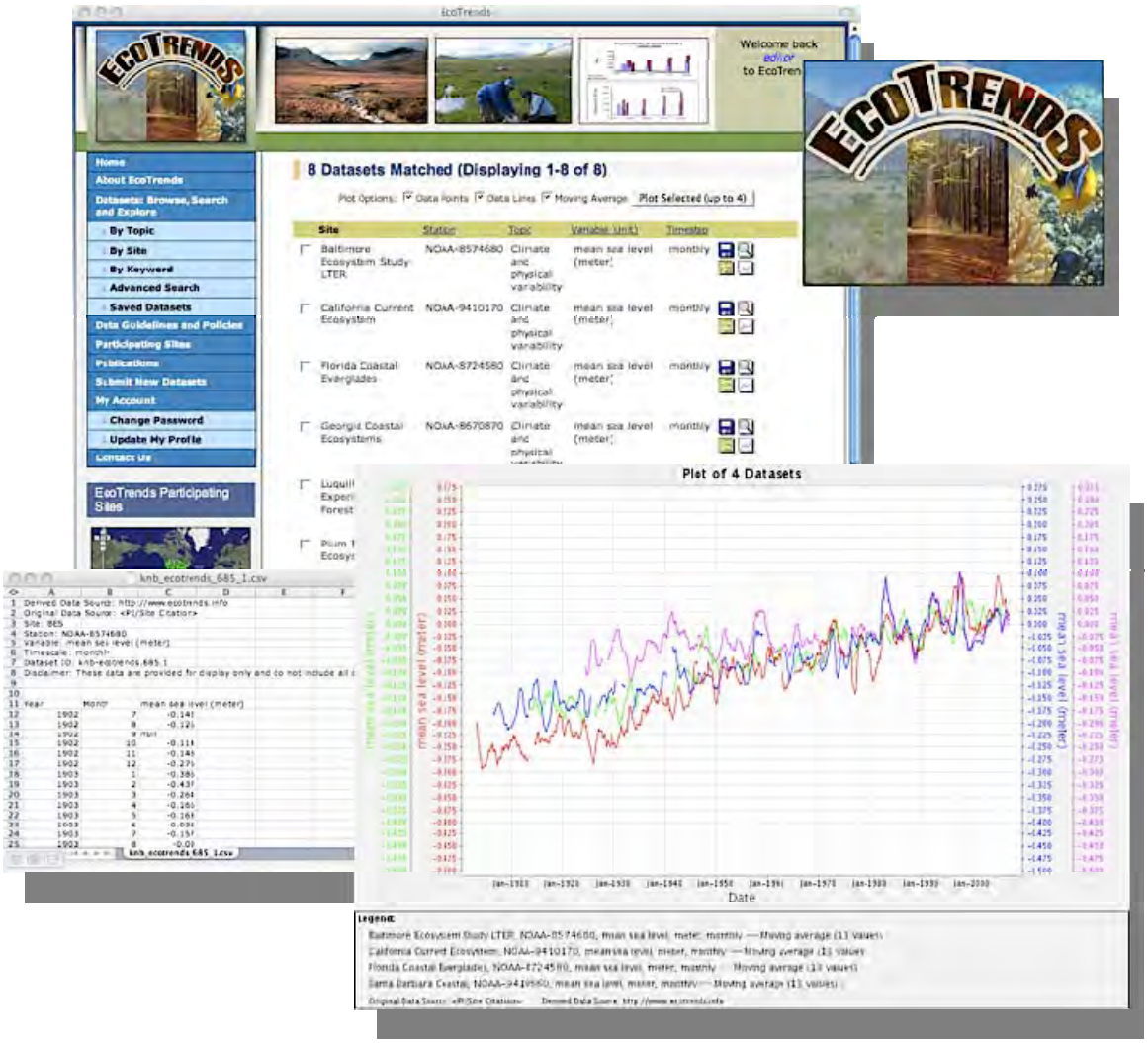


Figure 6. The EcoTrends project began in 2004 as an effort to organize and make available in a simple and common format data sets that exemplify the significant trends demonstrated in the collections of long-term ecological and environmental observations. The original project by Drs. Debra Peters and Ariel Lugo will produce a high-quality print volume of site descriptions and graphs of long-term trends for a variety of variables (due to be released in late 2008). The EcoTrends web site portal (**http://www.EcoTrends.info**) provides a dynamic data discovery and access interface capable of generating multivariate plots, data set persistence, and data use tracking for greater than 1,200 derived time-series data sets from the LTER Network and other research stations. An infrastructure goal of the EcoTrends project is to automatically update datasets as new data become available, thereby providing an ideal test environment for LNO developers to implement components of the PASTA framework model. To date, EcoTrends development by the LNO has focused on the "derived-data" management aspect of PASTA. Future work proposed under the "Cyberinfrastructure for the LTER Decadal Plan" will implement the Ecological Metadata Language "Data Manager" software library to dynamically parse and load source data from sites when updates are available. This process will test a variety of applications, including the Kepler workflow system, by providing data transformation and provenance information as part of its output. EcoTrends will incorporate the functionality and data from existing standalone value-added network data products like the LTER Climate and Hydrologic databases into its common data delivery framework.

AND – **H.J. Andrews Experimental Forest LTER, Oregon**

ARC – **Arctic Tundra LTER, Alaska**

BES – **Baltimore Ecosystem Study LTER, Maryland**

BNZ – **Bonanza Creek Experimental Forest LTER, Alaska**

CAP – **Central Arizona-Phoenix LTER, Arizona**

CCE – **California Current Ecosystem LTER, California**

CDR – **Cedar Creek Natural History Area LTER, Minnesota**

CWT – **Coweeta LTER, North Carolina**

FCE – **Florida Coastal Everglades LTER, Florida**

GCE – **Georgia Coastal Ecosystem LTER, Georgia**

HBR – **Hubbard Brook LTER, New Hampshire**

HFR – **Harvard Forest LTER, Massachusetts**

JRN – **Jornada Basin LTER, New Mexico**

LNO – **LTER Network Office, University of New Mexico, Albuquerque, NM**

KBS – **Kellogg Biological Station LTER, Michigan**

KNZ – **Konza Prairie LTER, Kansas**

LUQ – **Luquillo Experimental Forest LTER, Puerto Rico**

MCM – **McMurdo Dry Valleys LTER, Antarctica**

MCR – **Moorea Coral Reef LTER, French Polynesia**

NWT – **Niwot Ridge LTER, Colorado**

NTL – **North Temperate Lakes LTER, Wisconsin**

PAL – **Palmer Station LTER, Antarctica**

PIE – **Plum Island Ecosystem LTER, Massachusetts**

SBC – **Santa Barbara Coastal Ecosystem LTER, California**

SEV – **Sevilleta LTER, New Mexico**

SGS – **Shortgrass Steppe LTER, Colorado**

VCR – **Virginia Coast Reserve LTER, Virginia**

Figure 7. The LNO provides a central point of contact and collective expertise to support the objectives of the 26 research sites that constitute the LTER Network. These 26 sites include ecosystems spanning broad ranges of environmental conditions and degrees of human domination of the landscape. Geographically, sites range from Alaska to Antarctica and from the Caribbean to French Polynesia. The LTER Network includes agricultural lands, alpine tundra, barrier islands, coastal lagoons, deserts, coral reefs, estuaries, forests, freshwater wetlands, grasslands, kelp forests, lakes, open ocean, savannas, streams, and urban landscapes. Each site develops research programs in five core areas: pattern and control of primary production; spatial and temporal distribution of populations selected to represent trophic structure; pattern and control of organic matter accumulation in surface layers and sediments; patterns of inorganic inputs and movements of nutrients through soils, groundwater and surface waters; and patterns and frequency of site disturbances. Collectively, LTER sites have generated 17,198 publications and 6090 well-documented, publicly accessible data sets. Presently, 1663 scientists and 692 students are actively conducting research at LTER sites. Two of NSF's 50 most important research discoveries are based on research at LTER sites **[57]**. Thirty-eight countries around the world have created national research networks based on the LTER model [58]. Data sources: LTER personnel directory, bibliography, and data catalog.

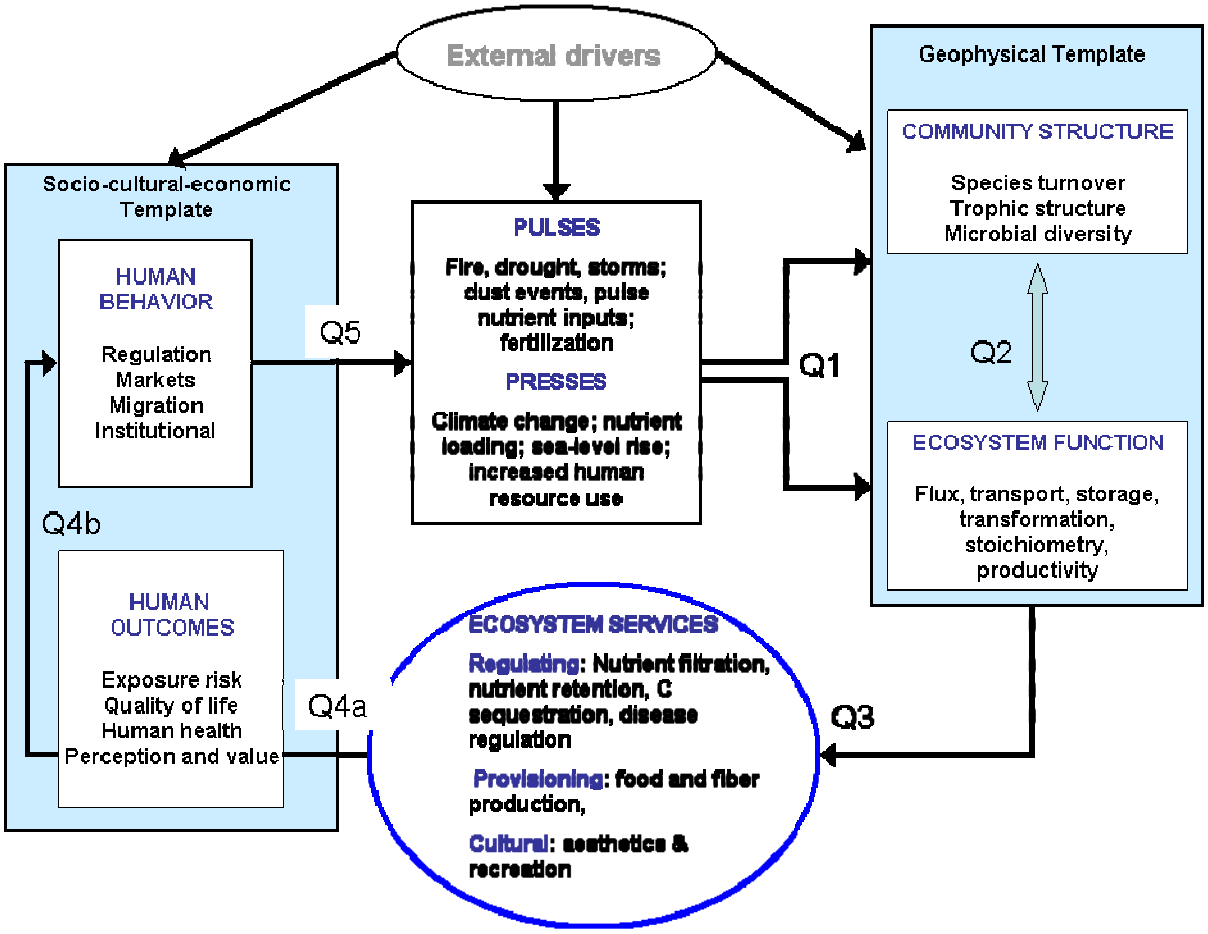


Figure 8. The Decadal Plan proposes a research framework that integrates the traditional domains of ecology and social science. The right side of the diagram represents traditional ecological research. The human dimensions of environmental change occupy the boxes on the left and are linked to ecological research through ecosystem services and press and pulse disturbances. Five questions (see below) provide a common focus for synthesis across sites and across domains.

Q1: How do long-term press disturbances and short-term pulse disturbances ***interact*** to alter ecosystem structure and function?

Q2: How can biotic structure be both a ***cause and consequence*** of ecological fluxes of energy & matter?

Q3: How do altered ecosystem dynamics affect ecosystem services?

Q4: How do changes in vital ecosystem services ***feed back*** to alter human behavior?

Q5: Which human actions influence the frequency, magnitude, or form of press and pulse disturbance regimes across ecosystems, and what determines these human actions?

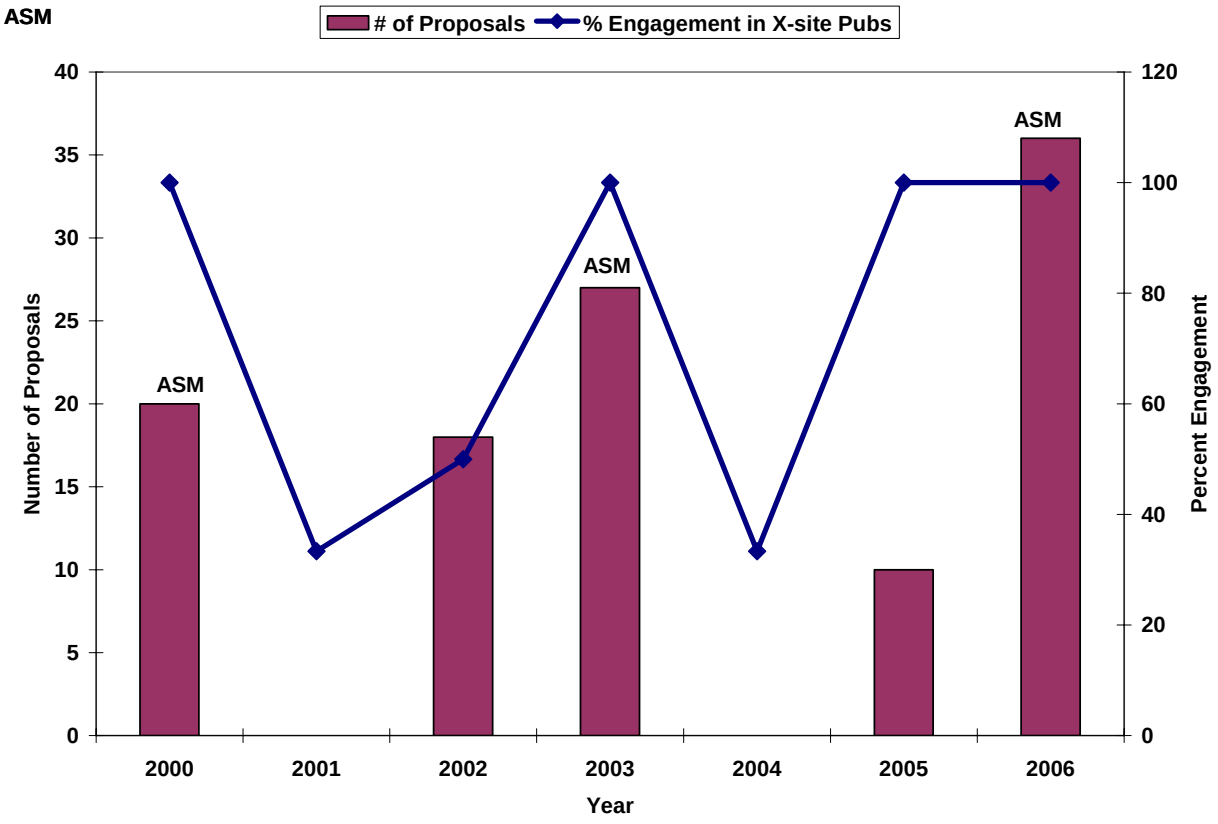


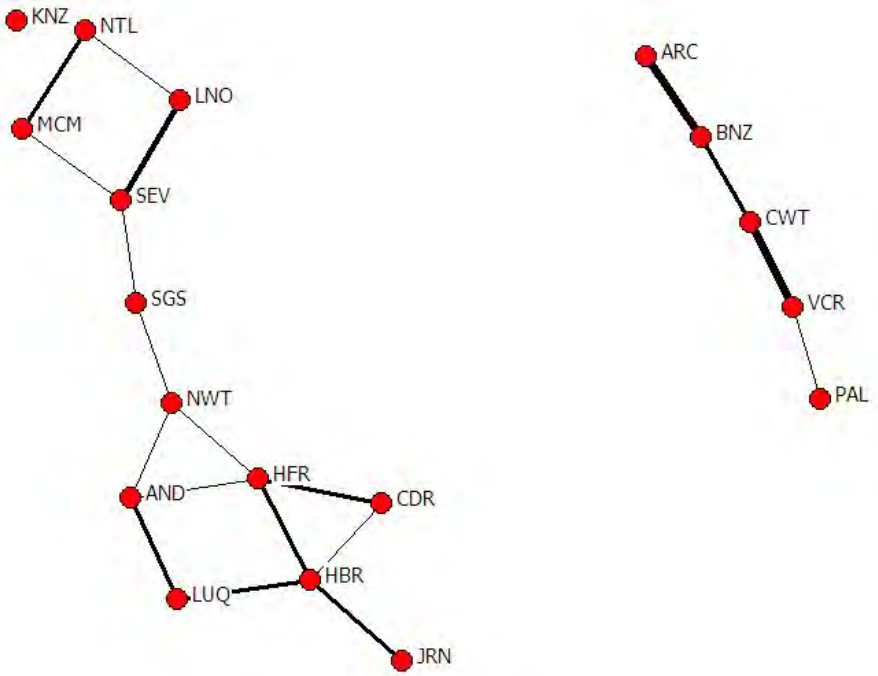
Figure 9. After a hiatus of seven years, the LNO provided leadership that led to the revival of the LTER All-Scientists Meeting in 2000. The LNO supplied funds to stimulate cross-site research on five occasions between 2000-2006. The number of proposals submitted for these research working groups is greater in years with ASMs, and there is a visually significant increase over time in the number of proposals submitted after an ASM. These patterns suggest that ASMs act to stimulate cross-site synthesis, and the effect may be cumulative. This speculation is supported by a network analysis of LTER cross-site publications by Christian et al. **[8]**. This analysis suggests a 2-3 year cycle in the degree of networking among LTER sites based on publications involving three or more sites. In 2000, 2003, 2005, and 2006, the LTER Network has been completely engaged; all sites are connected in a single network cluster (see Figure 12). Analytical tools such as network analysis combined with data from publications and proposal submission records can help the LNO evaluate the effectiveness of ASMs and cross-site working groups.

Figure 10. One of the LNO's major roles is to promote the LTER Network's activities through publications and other promotional material. LNO produced, helped produce, or facilitated the production of several print and web publications, including (clockwise from upper left): *Network News*, the LTER Network newsletter; a sample of informational site brochures; the Bonanza Creek volume in the LTER/OUP synthesis series; the LTER Network Brochure; the Network News portal; the Coweeta LTER site brochure; an NSF brochure highlighting the broader impacts of the LTER program, produced with LNO assistance; and the LNO web site.

RESOURCES	ACTIVITIES	OUTPUTS	SHORT- AND LONG-TERM OUTCOMES	IMPACT
In order to accomplish our set of activities we will need the following infrastructure:	*In order to address our problem or asset we will accomplish the following activities:*	*We expect that once accomplished these activities will produce the following evidence of service delivery:*	*We expect that if accomplished these activities will lead to the following changes in 1-3 and then 4-6 years:*	*We expect that if accomplished these activities will lead to the following changes in 7-10 years:*
• Supplemental funding for costs of All Scientist Meeting •Program committees from LTER community •Down payment to meeting venue •Travel funds for annual Science Council, Executive Board, and IM meetings •Travel funds for LNO/UNM staff •Organizational oversight by Executive Director and Associate Director (0.20 FTE)	•Identify meeting venue •Work with program committee to develop a meeting program that will foster integration among LTER sites and scientists and provide opportunities for synthesis •Provide sites with support for participants •Supervise all aspects of the ASM organization •Preserve meeting documents and materials	•Well organized triennial meetings of the LTER community •Increasing number of participants (800+) •Persistent record of meeting activities and products	•Increase in social networking •Increase in scientific interactions •Increased pace of development of synthesis products •New collaborations •New LTER science themes •Better integration of graduate students into LTER community	•Increase in the cohesiveness of the LTER scientific enterprise

Figure 11. Logic Model 1.2 — Problem: Organize Triennial All Scientists Meeting. An example of a logic model used to link a desired impact with the outcomes that will achieve that impact, the outputs leading to the required outcomes, and the activities and resources required for each output [61].

A)



B)

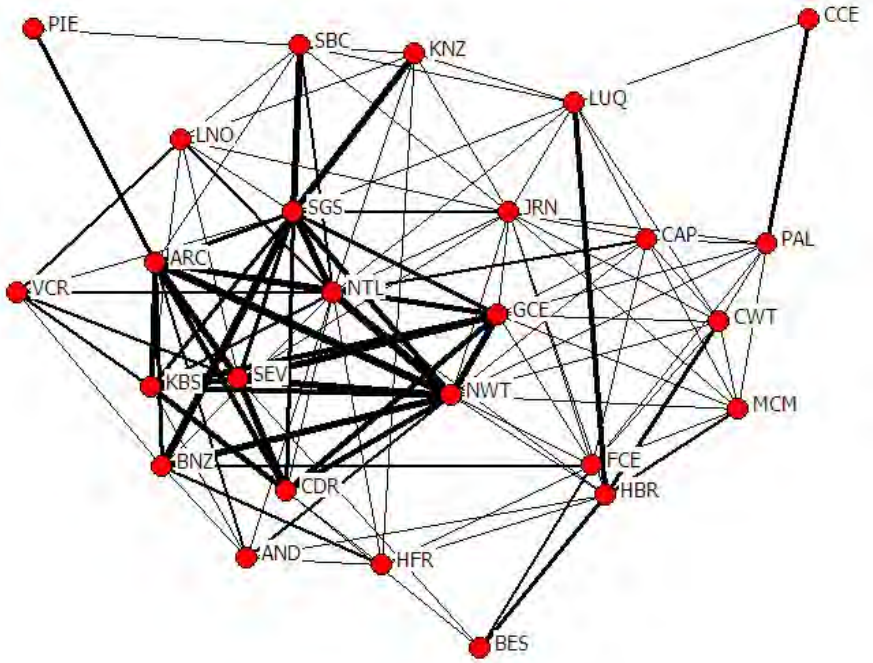


Figure 12. Christian et al. **[8]** used network analysis and data from the LTER bibliography to examine changes in co-authored publications among LTER sites over time. They determined the degree of Network engagement based on publications involving three or more sites. A) In 1995, the Network is only 50% engaged since two distinct interaction clusters occur. B) In 2005, the Network is completely engaged. Analysis of publication records from 1981-2006 demonstrates a trend towards increasing engagement, especially since 1998.

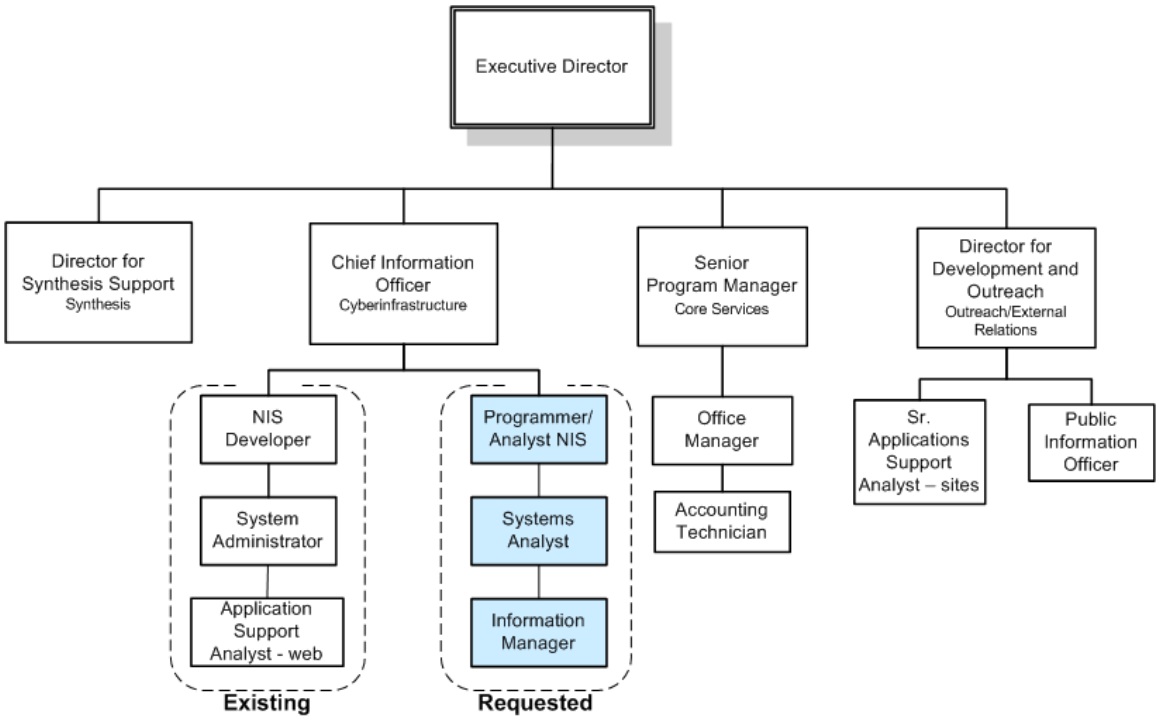


Figure 13. The LNO operates with a lean staff and simple organizational structure. Four senior staff members report to the Executive Director and supervise technical staff in the areas of Synthesis, Cyberinfrastructure, Core Services, and Development/Outreach. Note that the vertical organization of technical staff does not reflect reporting structure; all technical staff report directly to the indicated senior staff member. During the next Cooperative Agreement period, the synthesis science goals of the Decadal Plan will require a more robust cyberinfrastructure and additional technical competencies. To meet these requirements, the LNO is requesting funds to support three positions: a Programmer/Analyst, Systems Analyst, and Information Manager. Requested new positions are shaded in blue.

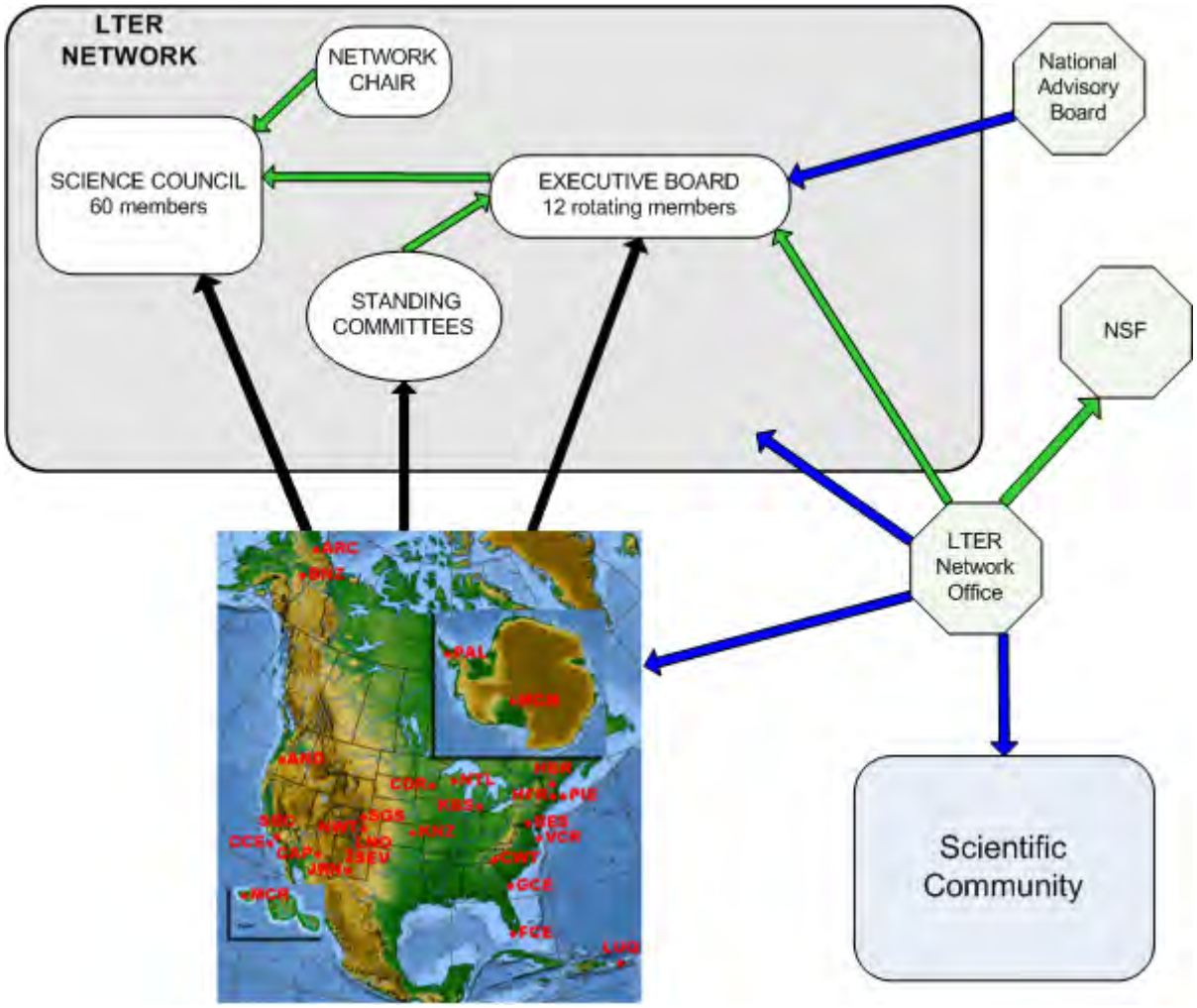


Figure 14. The Decadal Plan for LTER created a new governance and reporting structure for the LTER Network. Members of the Science Council, the Executive Board, and standing committees are drawn from the sites (black lines). The standing committees respond to the Executive Board and the Executive Board and Chair respond to the Science Council (green lines). The LNO responds to the Executive Board and NSF, and provides service and leadership to the Network, LTER sites, and the scientific community (blue lines). The LNO is a leader in the evaluation and implementation of Network-scale cyberinfrastructure and in the development of collaborations with other networks and centers. The dual roles of service and leadership can create conflicting expectations of the LNO.

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52. Provenance Aware Synthesis Tracking Architecture PASTA) Project Web Page. <http://lno.lternet.edu/projects/pasta>

53. LTER Metadata Catalog Search Interface. <http://metacat.lternet.edu>

54. Data Access Server Project Web Page. <http://lno.lternet.edu/projects/das>

55. Custom EML Unit Registry Interface. <http://fire.lternet.edu/customUnit>

56. EcoTrends Web Site. <http://www.EcoTrends.info>

57. *National Science Foundation: Resource Guide 2000*. NSF Celebrating 50 Years. NSF. p. 112, (2002).

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73. Thomlinson,J.R., P.V. Bolstad, and W.B. Cohen.*Coordinating methodologies for scaling land-cover classifications from site-specific to global: steps toward validating global map products.* Remote Sensing of Environment, vol. 70, p. 16-28, (1999).

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75. Vande Castle, J. R., and E.F. Vermote. O*perational Remote Sensing Data for Comparative Ecological Research: Applications of Atmospheric Correction Using Automated Sunphotometers.* Proceedings of Eco-Informa. Global Networks for Environmental Information, p. 791-796, (1996).

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77. LNO Strategic Plan, revised (2008). <http://lno.lternet.edu/renewal/strategicplan/>

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80. Hackett, E. Personal Communication.

81. LNO Mid-term Review Letter from NSF, (2002). <http://intranet.lternet.edu/modules.php?name=UpDownload&req=getit&lid=425>

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83. LTER Network National Advisory Board Web Page. <http://intranet.lternet.edu/NAB/>

84. LTER Network National Advisory Board Reports. <http://intranet.lternet.edu/modules.php?name=UpDownload&req=viewsdownload&sid=13>

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Professional Preparation:

University of Illinois	Biology	B.S.	1969
University of Wisconsin	Zoology	M.S.	1973
University of Wisconsin	Zoology	Ph.D.	1978
Carnegie Museum	Ornithology	Post-Doc.	1978 – 1980

Appointments:

1997 – Present Executive Director, Long-Term Ecological Research Network Office
Professor, Department of Biology, University of New Mexico
1995 – 1999 Professor, Department of Biology, University of Puerto Rico
1995 – 1997 Director, Puerto Rico Minority Research Center of Excellence
1982 – 1997 Director, Terrestrial Ecology Division/Institute for Tropical Ecosystem Studies (University of Puerto Rico-Rio Piedras)
1982 – 1995 Senior Scientist I, Center for Energy and Environment Research, University of Puerto Rico.

Publications:

(i) Publications Most Relevant to Proposal

Michener, W.K. and R.B. Waide. 2008. The Evolution of Collaboration in Ecology: Lessons from the United States Long Term Ecological Research Program. In Scientific Collaboration on the Internet. G.M. Olson, A. Zimmerman, and N. Bos (eds). (in press). MIT Press, Cambridge, MA.

Gosz, J.R. R. B. Waide, and J. J. Magnuson. (in press). Twenty-eight years of the US-LTER Program: Experience, results, and research questions. In Long-term ecological research – between theory and application. (F. Mueller, ed.). Springer.

Robertson, G. P., V. G. Allen, G. Boody, E. R. Boose, N. G. Creamer, L. E. Drinkwater, J. R. Gosz, L. Lynch, J. L. Havlin, L. E. Jackson, S. T. A. Pickett, L. Pitelka, A. Randall, A. S. Reed, T. R. Seastedt, R. B. Waide, and D. H. Wall. 2008. Long-Term Agricultural Research (LTAR): A Research, Education, and Extension Imperative. BioScience (in press).

Vaughan, H.H., R.B Waide, J.M. Maass, and E. Ezcurra. 2007. Developing and delivering scientific information in response to emerging needs. Frontiers in Ecology and the Environment 2007; 5(4): W8–W11. http://www.frontiersinecology.org/specialissue/articles/vaughan.pdf

Andelman, S.J., C.M. Bowles, M.R. Willig, and R.B. Waide. 2004. Disentangling biocomplexity through a Distributed Knowledge Network. BioScience 54:240-246.

(ii) Five Other Significant Publications

White, E. P., P. B. Adler, W. K. Lauenroth, R. A. Gill, D. Greenberg, D. M. Kaufman, A. Rassweiler, J. A. Rusak, M. D..Smith, J. R. Steinbeck, R. B. Waide, and J. Yao. 2006. A comparison of the species-time relationship across ecosystems and taxonomic groups. Oikos 112:185-195.

González, J.E., J.C. Luvall, D. Rickman, D. Comarazamy, A.J. Picón, E.H. Harmsen, H. Parsiani, N. Ramírez, R.E. Vásquez, R. Williams, R.B. Waide, and C.A. Tepley. 2005. Urban heat islands developing in coastal tropical cities. EOS 86:397-412.

Waide, R. B. M.R. Willig, C. F. Steiner, G. Mittelbach, L. Gough, S. I. Dodson, G.P. Juday, and R. Parmenter. 1999. The relationship between primary productivity and species richness. Annual Review of Ecology and Systematics 30:257-300.

Waide, R.B., J.K. Zimmerman, and F.N. Scatena. 1998. Controls of primary productivity in a montane tropical forest: Lessons from the Luquillo Mountains in Puerto Rico. Ecology 79:31-37.

D. P. Reagan and R. B. Waide, eds. 1996. The Food Web of a Tropical Rain Forest, University of Chicago Press.

Synergistic Activities:

- Program co-chair LTER All Scientists Meeting 2000, 2003, 2006
- Member, development committees for NEON, CLEANER, National Phenological Network
- Member, Science Task Force for the LTER Planning Project

Collaborators & Other Affiliations:

Collaborators and Co-editors

Allen, V. G. (Texas Tech U.)
Andelman, S.J. (Conservation International)
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Silver, W.L. (University of California)
Tepley, C.A. (U. of Puerto Rico)
Thompson, J. (U. of Puerto Rico)
Vásquez, R. (U. of Puerto Rico)
Vaughan, H.H. (Environment Canada)
Vogt, D. (U. of Washington)
Vogt, K. (U. of Washington)
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Willig, M. (U. of Connecticut)
Zimmerman, J. (U. of Puerto Rico)

Graduate Advisors and Postdoctoral Sponsors

Beals, Edward, retired, Major Professor
Parkes, Kenneth, Carnegie Museum of Natural History, Pittsburgh, post-doctoral advisor

Thesis Advisor

Li, Y. (Unknown)
Thompson, J. (U. of Georgia)
Tossas, A. (U. of Puerto Rico)

Post-graduate Sponsor

Eastman, J. (U. of Maryland)
Lu, L. (Unknown)
Williams, J. (U. of Minnesota)

James W. Brunt

LTER Network Office, Department of Biology MSC03 2020, 1 University of New Mexico, Albuquerque, New Mexico 87131-1091

Professional Preparation:

New Mexico State University	Biology	B.A.	1986
New Mexico State University	Botany/Chemistry	B.S.	1986
New Mexico State University	Computational Ecology/Experimental Statistics	M.S.	1988

Academic And Professional Appointments:

July 2007 – Present	Research Associate Professor, Associate Director for Information Management, University of New Mexico.
Nov. 1997 – Jun. 2007:	Research Assistant Professor, Associate Director for Information Management, University of New Mexico.
Feb. 1997 – Oct. 1997:	Staff Scientist, Senior Systems Engineer, Photon Research Associates, Inc.
Jan. 1989 – Feb. 1997:	Analyst/Programmer II, Director of Sevilleta Information Management System, University of New Mexico.
1986 - 1988:	GRA, Science Workbench Project, New Mexico State University - Computing Research Lab.

Publications:

(i) Publications Most Relevant to Proposal

Brunt, James W. and William K Michener (In Press, 2008). The Resource Discovery Initiative for Field Stations: Enhancing Data Management at North American Biological Field Stations. BioScience.

Brunt, James W. and Mark S. Servilla. (submitted). Defining and Assessing Data Quality in Online Ecological Information Systems. Ecological Informatics.

Brunt, James W., Peter McCartney, Karen Baker, and Susan G. Stafford. 2002. The Future Of Ecoinformatics In Long Term Ecological Research. In Proceedings of 2002 Systemics, Cybernetics, and Informatics Symposium. July 14-18, 2002 Orlando, Florida.

Michener, William K. and James W. Brunt. 2000. Ecological Data: Design, Management, and Processing. Blackwell Scientific, Ltd., London. 180 pages

Michener, William K., James W. Brunt, John Helly, Thomas B. Kirchner, and Susan G. Stafford. 1997. Non-GeoSpatial Metadata for the Ecological Sciences. Ecological Applications. 7(1):330-342.

(ii) Five Other Significant Publications

Cushing, Judith, Vanderbilt, Kristin, Brunt, James, Jones, Matt, Gupta, Amarnath, McCartney, Peter. 2005. NSF Long Term Ecological Research Sites: Praxis et Theoria – LTER Information Management and CS Research. In, Proceedings of the 17th International Conference on Scientific and Statistical Database Management, pp 303-307, Jim Frew (Editor). 17th International Conference on Scientific and Statistical Database Management. University of California, Santa Barbara, June 2005.

Baker, Karen S., James W Brunt, and David Blankman. 2002. Organizational Informatics: Site Description for a Research Network. In Proceedings of 2002 Systemics, Cybernetics, and Informatics Symposium. July 14-18, 2002 Orlando, Florida

Brunt, J. W., and R. Nottrott. 1996. The LTER Network Information System for the 21st Century. Eco-Informa '96, Lake Buena Vista, Florida, 4-7 November 1996. 10:104.

Michener, W. K., J. W. Brunt, and S. G. Stafford (Eds.). 1994. Environmental Information Management and Analysis: Ecosystem to Global Scales. Taylor & Francis, London. 555 pages.

Brunt, James W. 1994. Research Data Management in Ecology: A Practical Approach for Long-term Projects. Pages 272-275 in Proceedings of the Seventh International Working Conference on Scientific and Statistical Databases. IEEE Computer Society Press.

Synergistic Activities:

- Facilitates and advances ecological science through the use of information technology. Activities range from sponsoring workshops, software development projects, and standards development projects, to the production of training materials, and the establishment of a community-of-practice in ecological informatics.
- Actively works to broaden the inclusion of underrepresented groups in ecological science. As a PI on an NSF funded UMEB – Undergraduate Minorities in Environmental Biology – project, introduced students to the exciting field of informatics and gave them experience that they could

use in furthering their scientific careers. Actively recruits staff from underrepresented groups to the LTER Network Office.

- Champion of quality in all aspects of work, particularly in data quality and the maintenance of scientific integrity. Works within the community to develop solutions to data quality and scientific integrity issues particularly in the areas of quality assessment, metadata, and data provenance for new data-intensive technologies.

Collaborators & Other Affiliations:

Collaborators

J. Beach (U of Kansas)
C. Berkley (NCEAS at UCSB)
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Professional Preparation:

Clemson University	Zoology	B.S.	1977
Clemson University	Entomology, Fisheries, and Wildlife	M.S.	1980
University of South Carolina	Biological Oceanography	Ph.D.	1990

Appointments:

2007-present	Director, New Mexico EPSCoR State Program, University of New Mexico
2000-present	Associate Director (LTER Network Office) and Research Professor (Department of Biology), University of New Mexico
1999-2000	Program Director (Ecology and Biocomplexity), National Science Foundation
1993-1999	Associate Scientist, J.W. Jones Ecological Research Center
1993-2002	Baruch Associate, Baruch Institute, University of South Carolina
1996-2001	Adjunct Faculty, Department of Zoology, Auburn University
1995-2006	Graduate Faculty, Institute of Ecology, University of Georgia
1993-1995	Adjunct Faculty, Institute of Ecology, University of Georgia
1984-1993	Director, Coastal Geographic Information Systems & Research Database Facility, Baruch Institute, University of South Carolina
1982-1984	Statistician, Baruch Institute, University of South Carolina
1980-1982	Research Associate, Baruch Institute, University of South Carolina

Publications:

(i) Publications Most Relevant to Proposed Project

National Research Council. In press. *Integrated Observations for Hydrologic and Related Sciences: Pursuing New, Complementaqry Spaceborne, Sub-orbital, and Ground-based Observations for Advancing Hydrologic and Related Sciences*. National Academy Press, Washington, DC.

Peters, D., P. Groffman, K. Nadelhoffer, N.B. Grimm, S. Collins, W. Michener, M. Huston. In press. Living in an increasingly connected world: a framework for continental-scale environmental science. *Frontiers in Ecology and the Environment.*

Sundareshwar, P.V., …, W. K. Michener, et al. 2007. Environmental monitoring network for India. *Science* 316:204-205.

Michener, W.K., J.H. Beach, M.B. Jones, B. Ludaescher, D.D. Pennington, R.S. Pereira, A. Rajasekar and M. Schildhauer. 2007. A knowledge environment for the biodiversity and ecological sciences. *Journal of Intelligent Information Systems* 29:111-126.

Porter, J., P. Arzberger, H. Braun, P. Bryant, S. Gage, T. Hansen, P. Hanson, F. Lin, C. Lin, T. Kratz, W. Michener, S. Shapiro, and T. Williams. 2005. Wireless sensor networks for ecology. *BioScience* 55:561-572.

(ii) Five Other Significant Publications

Michener, W.K., T.J. Baerwald, P. Firth, M.A. Palmer, J.L. Rosenberger, E.A. Sandlin, and H. Zimmerman. 2001. Defining and unraveling biocomplexity. *BioScience* 51:1018-1023.

Michener, W.K. and J.W. Brunt. 2000. *Ecological Data: Design, Management and Processing.* Blackwell Science, Oxford, UK. 180 pp.

Houhoulis, P.F. and W.K. Michener. 2000. Detecting wetland change: a rule-based approach using NWI and SPOT-XS data. *Photogrammetric Engineering & Remote Sensing* 66:205-211.

Michener, W.K., E.R. Blood, K.R. Bildstein, M.M. Brinson, and L.R. Gardner. 1997. Climate change, hurricanes and tropical storms, and rising sea level in coastal wetlands. *Ecological Applications* 7:770-801.

Michener, W.K., J.W. Brunt, J. Helly, T.B. Kirchner, and S.G. Stafford. 1997. Non-geospatial metadata for the ecological sciences. *Ecological Applications* 7:330-342.

Synergistic Activities:

- Recent large grants administration and project management—Associate Director of the NSF-supported Long Term Ecological Research Network Office (2000-present) at the University of New

Mexico; Director of the Ecology and Biocomplexity Programs at the National Science Foundation (1999-2000); Project Science Management Training (2002-2006)

- Teaching and broadening participation—organized week-long ecoinformatics training workshops for new faculty (2003-2007) and field station personnel (2002-2006), focusing on under-represented groups
- Databases—coordinated development of multiple research, education and administrative databases for the Organization of Biological Field Stations as part of an NSF-funded RCN project
- Software—managed an NSF large-ITR project that created a variety of open source software tools including the Kepler Scientific Workflow System and EarthGrid
- Editorial service—Editor of Ecological Society of America's data journal *Ecological Archives* (2001 to present); Associate Editor for *Journal Ecological Informatics* (2005 to present)

Collaborators and Other Affiliations:

Collaborators

D. Agarwal (LBNL)
I. Altintas (SDSC)
D. Baldocchi (Berkeley)
C. Baru (SDSC)
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J. Beach (U. Kansas)
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E. Blood (NSF--COI)
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D. Vieglais (U. Kansas)
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T. Vision (NESCent)
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Graduate and Postdoctoral Advisors

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Professional Preparation:

University of Wisconsin	Biological Aspects of Conservation	BS.	1976
University of Wisconsin	Zoology	MS.	1979
University of Wisconsin	Aquatic Biology, Computer Science	Ph.D.	1985
University of Wisconsin	Aquatic Applications of GIS & Remote Sensing	Post-Doc.	1985-1986
University of Wisconsin	GIS, and Remote Sensing	Post-Doc.	1986-1989

Appointments:

1997 – Present Research Associate Professor, Department of Biology, University of New Mexico, Associate Director, Center for Rapid Environmental Assessment and Terrain Evaluation, and Associate Director, Long-Term Ecological Research Network-Network Office

1997 – 2002 Affiliate Research Associate Professor, College of Forest Resources, University of Washington

1990 – 1997 Research Assistant Professor, College of Forest Resources, University of Washington and Network Manager, Long-Term Ecological Research Network

1986 – 1989 Assistant Scientist, Research Associate, and Lecturer, Environmental Remote Sensing Center, University WI-Madison

1986 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

1982 – 1985 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

1980 – 1982 Research Associate, National Water Research Institute, West Vancouver, BC.

1976 – 1979 Professional Staff, Project Associate and Research Associate and Research Scientist, Great Lakes Water Institute, University WI-Milwaukee

Publications:

(i) Publications Most Relevant to Proposal

Pregenzer, A, R. Parmenter, H. Passell, J. Vande Castle, K. Budge, G. Bonito 2005. Sustainability in Arid Grasslands: New Technology Applications for Management In: Biodiversity in Drylands: Toward a Unified Framework. Shachak, M., J. Gosz, S Picket and A. Perovolotsky eds. Oxford University Press

Vande Castle, J.R. 2003. Vegetation Change Observations of Long-Term Ecological Research Sites Using Remote Sensing Data. Proceedings - 30th Symposium of the International Society on Remote Sensing of the Environment: TS-42.4

Yates T.L., J.N. Mills, C.A. Parmenter, T.G. Ksiazek, R.R. Parmenter, J. Vande Castle, C.H.Calisher, S.T.Nichol, K.D. Abbott, J.C. Young, M.L.Morrison, B.J.Beaty, J.L.Dunnum, R.J.Baker, J. Salazar-Bravo and C.J. Peters. 2002 – Ecology and Evolutionary History of and Emergent Disease: Hantavirus Pulmonary Syndrome. Bioscience 52:11;989,998

Pennington, D., Fountain, T., Wang, G. and Vande Castle, J., 2002, Spatio-temporal Data Mining of Remotely Sensed Imagery for Ecology, Proceedings of GIScience 2002, Second International Conference on Geographic Information Science, September 25-28, 2002, Boulder, Colorado.

Riera, J, J. Magnuson, J.Vande Castle and M.MacKenzie 1998. Analysis of Large-Scale Spatial Heterogeneity in Vegetation Indices among North American Landscapes. Ecosystems 1:268-282

(ii) Five Other Significant Publications

Vande Castle, Pennington, Fountain and Pancake. 2002. A Spatial Data Workbench for Data Mining, Analyses, and Synthesis, Proceedings, SCI2002 ISBN:980-07-8150-1(420-424)

Vande Castle, J.R 1999 Remote sensing applications in ecosystem analysis. In: Scale Issues in Ecology. 13:271-288. D. Peterson and V.T. Parker Eds. Columbia University Press.

Chopping, M., T. Schmugge, A. Rango, J. Ritchie, B. Kustas, and J. Vande Castle 2001. The impact of the structure and composition of shrub-coppice dune landscapes on MASTER reflectance anisotropy IAHS Proceedings on Remote Sensing and Hydrology 2000, Owe, M, K. Brubaker, J. Ritchie & Albert Rango, Editors. IAHS Publication #267, ISBN 1-901502-46-5

Holben B.N., D.Tanre, A.Smirnov, T.Eck, I.Slutsker, A.Setzer, B.Markham, J.Vande Castle, D.Ward,

Y.Kaufman, T.Nakajima, and N.T.O'Neill, 2001. Aerosol climatology measured from the globally distributed ground-based AERONET system, Proceedings: Fifth Scientific Conference of the International Global Atmospheric Chemistry, Seattle, Washington, USA, August 19-25, 1998.

Vande Castle, J. R. and E.F. Vermote, 1996. Operational Remote Sensing Data for Comparative Ecological Research: Applications of Atmospheric Correction Using Automated Sunphotometers. Proceedings of Eco-Informa '96: Global Networks for Environmental Information pp. 791-796

Synergistic Activities:

- Part of “Core” LTER Cyberinfrastructure Planning team and coordinator for the LTER Cyberinfrastructure supplemental planning grant
- Member, LTER Network Information System Advisory Committee
- Development of the Long Term Ecological Research Network "Technology" Web pages to disseminate information and data access related to historical, current and planned LTER activities related to technological issues, data access and information management (http://www.lternet.edu/technology)
- With collaborators at UNM, OSU, and UC-San Diego/SDSC, co-developed the "LTER Spatial Data Workbench", for access, analysis and synthesis of geospatial datasets, including hyperspectral remote sensing data
- Lecturer for GIS, remote sensing and wireless networking for NSF funded SEEK and OBSF/RDI training courses

Current Collaborators and Other Affiliations (COI):

Collaborators and Co-Editors
Robert Waide (U. of New Mexico)
William Michener (U. of New Mexico)
James Gosz (U. of New Mexico)
James Brunt (U. of New Mexico)
Louis Scuderi (U. of New Mexico)
Robert Parmenter (U. of New Mexico)
Deanna Pennington (U. of New Mexico)
Timothy Thomas (U. of New Mexico)
Mark Chopping (Montclair State U.)
Tony Fountain (U. of California)
Brent Holben (NASA-Goddard)
Eric Vermote (NASA-Goddard)
Jerry Franklin (U. of Washington)
David Peterson (U. of Washington)
Thomas Parker (U. of Washington)
John Porter (U. of Virginia)
Joan Riera (U. of Wisconsin)
Mark MacKenzie (Aurburn U.)
Graduate Advisors and Postdoctoral Sponsors
Arthur Brooks (U. of Wisconsin)
Tony Remson (U. of Wisconsin)
Thomas Lillesand (U. of Wisconsin)
John Magnuson (U. of Wisconsin)
Thesis Advisor and Postgraduate-Scholar Sponsor
Richard Lathrop (Rutgers U.)
Randolph Wynne (Virginia Tech)
Paul Bolstad (U. of Minnesota)
Mathew Clark (U. of California)
Howard Passel (U. of New Mexico)
Martha Innis (U. of New Mexico)

G. Philip Robertson
Professor, Dept. of Crop & Soil Sciences, Michigan State University

Education:

Hampshire College, Amherst MA	Biology	B.A. 1976
Indiana University, Bloomington	Ecology & Evolutionary Biology	Ph.D. 1980

Professional Experience

1985-Present	Assistant, Associate, and Full Professor, Dept. of Crop and Soil Sciences and W.K. Kellogg Biological Station, Michigan State University
1981-1984	Postdoctoral Research Associate, Michigan State University
1980-1981	SCOPE-Mellon Postdoctoral Fellow, Royal Swedish Academy of Sciences, Stockholm
1993-1994	Visiting Fellow, CRC-CSIRO, Adelaide, Australia (sabbatical)
2001-2002	Visiting Fellow, CRC in Greenhouse Accounting, Univ Queensland, Australia (sabbatical)

Professional Activities (selected recent)

Chair	U.S. Long-term Ecological Research (LTER) Network Science Council and Executive Board (2007- present)
Member	Science Committee, Ecological Society of America (2000 - present)
Member	SCOPE North American Nitrogen Center Board of Directors (2004 - present)
Editor	*Biogeochemistry* (2004 - present)
Member	U.S. Carbon Cycle Science Scientific Steering Committee (2004 - 2007)
Reviewer	IPCC Working Group III, Third and Fourth Assessment Reports (2000-2007)
Co-chair	Consortium of Regional Ecological Observatories (COREO) (2005 - 2007)
Member	National Ecolological Observatory Network (NEON) Design Committee (2005)
Member	NSF Panels on Ecosystem Studies (2000-2004); Biocomplexity (2002)
Member	EPA Special Committee on Non-CO_2 Greenhouse Gas Mitigation (2002)
Member	CAST Taskforce on Agriculture's Response to Global Climate Change (2002-2004)
Chair	NRC Committee on Research Opportunities in Agriculture - Environment Subcom (2000-2002)

Publications:

(i) Publications Most Relevant to Proposed Project

Robertson, G.P., V.G. Allen, G. Boody, E.R. Boose, et al. 2008. Long-term Agricultural Research: A research, education, and extension imperative. BioScience, in press.

Swinton, S. M., F. Lupi, G. P. Robertson, and S. K. Hamilton. 2007. Ecosystem services and agriculture: cultivating agriculture ecosystems for diverse benefits. Ecological Economics: 64:245-252.

Robertson, G. P., J. C. Broome, E. A. Chornesky, J. R. Frankenberger, et al. 2004. Rethinking the vision for environmental research in U.S. agriculture. *BioScience* 54:61-65.

Robertson, G. P., and S. M. Swinton. 2005. Reconciling agricultural productivity and environmental integrity: A grand challenge for agriculture. *Frontiers in Ecology and the Environment* 3: 38-46.

Robertson, G. P., C. S. Bledsoe, D. C. Coleman, and P. Sollins, eds. 1999. *Standard Soil Methods for Long-Term Ecological Research*. Oxford University Press, NY.

(ii) Five Other Significant Publications

Robertson, G. P. 2004. Abatement of nitrous oxide, methane, and the other non-CO_2 greenhouse gases. Pages 493-506 in C. B. Field and M. R. Raupach, editors. *The Global Carbon Cycle*. Island Press, Washington, DC.

McSwiney, C. P., and G. P. Robertson. 2005. Non-linear response of N_2O flux to incremental fertilizer addition in a continuous maize (*Zea mays* sp.) cropping system. *Global Change Biology* 11: 1712-1719.

Robertson, G. P., E. A. Paul, and R. R. Harwood. 2000. Greenhouse gases in intensive agriculture: Contributions of individual gases to the radiative forcing of the atmosphere. *Science* 289:1922-1925.

Robertson, G.P. and P. Groffman. 2006. Nitrogen transformations. In E.A. Paul and F.E. Clark, ed. *Soil Microbiology, Biochemistry, and Ecology*. Springer, N.Y.

Grandy, A. S., and G. P. Robertson. 2007. Land use intensity effects on soil C accumulation rates and mechanisms. *Ecosystems* 10: 59-74.

Synergistic Activities (5 recent examples):

- Director, KBS K-12 Partnership for Scienctific Literacy, includes 14 rural school districts in SW Michigan, 80 science teachers, KBS scientists, and College of Education faculty; currently funded by an NSF GK-12 award "Ecological Literacy in Rural School Districts of Southwest Michigan." The partnership is promoting better science teaching via inquiry learning activities and environmental literacy. Teachers attend 4 schoolyear workshops and a summer science institute, and graduate fellows spend 2 days per week during the school year in mentor teacher classrooms.

- Invited Plenary Speaker at various professional and policy forums, including in past 3 years ESA Symposium on NSF Funding for Education (2007); ESA Symposium on Ecological Challenges of Organic Agriculture (2006); National Conference on the Ecological Dimensions of Biofuels Sustainability (2008); Midwest Governors CO_2 Cap and Trade Conference (2008), ASA Symposium on Soil Biophysical and Environmental Controls on Greenhouse Gas Emissions (2006); USDA Symposium on Greenhouse Gases and Carbon Sequestration (2005); DOE Conference on Carbon Capture and Sequestration, (2005); International Plant Nutrition Colloquium, Beijing (2005); SWCS Workshop on Managing Agricultural Landscapes for Environmental Quality (2006).

- Presentations to Congressional Committees, including a 2005 Briefing for the U.S House Science Committee on Broader Impacts of Long-term Ecological Research; a 2003 briefing for a) the U.S Senate Agriculture, Nutrition and Forestry Committee and b) the U.S. House Agriculture Committee on Findings of the NRC Committee to Evaluate USDA Research, Extension, and Education Activities; a 2002 Briefing for the U.S. House Agriculture Committee on Greenhouse Gas Mitigation Potentials for US Agriculture; in 2001 Testimony before the U.S. Senate Agriculture, Nutrition, and Forestry Committee on Research, Extension and Education in the Farm Bill; and a 2000 Briefing for the U.S. Senate Agriculture, Nutrition, and Forestry Committee on Carbon Sequestration Potentials in the US.

- Principal investigator on a project to develop a web-based greenhouse gas calculator for better explaining the impact of farming on atmospheric greenhouse gas concentrations; three versions are being developed - for 1) farmers and policy-makers, 2) the general public, and 3) K-12 middle school students. The general public calculator is being developed in collaboration with the Smithsonian Museum of Natural History, and will be included in a major Soils exhibit opening on the mall in 2008 for 2 years and then touring for 5 years, expecting to reach some 14 million visitors. The K-12 version will be developed in concert with the public version, together with curriculum developers.

- Lead developer of a protocol for N_2O offset credits to the Chicago Climate Exchange. N_2O is a major greenhouse gas produced in agricultural soils; the protocol represents a practical means for mitigating growing atmospheric concentrations of this gas by allowing farmers to be paid carbon-equivalent credits to avoid emissions (by adopting practices that increase nitrogen fertilizer use efficiency). The protocol is now under development with Electric Power Research Institute (EPRI) and Chicago Climate Exchange (CCX) funding.

Mark S. Servilla
LTER Network Office, Department of Biology, University of New Mexico, Albuquerque, NM 87131
505-277-2619; 505-277-2541 (Fax); servilla@LTERnet.edu

Professional Preparation:

University of New Mexico	Geology	B.S.	1985
University of New Mexico	Computer Science	M.S.	1991
University of New Mexico	Earth and Planetary Sciences	Ph.D.	1996
University of Alaska	Volcanology	Postdoc	1996-1997

Appointments:

2004 – Present University of New Mexico; Research Assistant Professor; Lead Scientist, LTER Network Information System.

2002 – 2004 Photon Research Associates, Inc; Senior Scientist; Manager of Geospatial Software Development.

1999 – 2002 EarthScan Network Inc.; Chief Technology Officer; Director of Technology.

1997 – 1999 Photon Research Associates, Inc.; Lead Scientist; Program Manager, Commercial Remote Sensing.

1996 – 1997 University of Alaska, Fairbanks/Alaska Volcano Observatory; Research Associate.

1991 – 1996 University of New Mexico/Earth and Planetary Sciences; Research Fellow.

Publications:

(i) Publications Most Relevant to Proposed Project

Butler, R., Servilla, M., Gage, S., Basney, J., Welch, V., Baker, B., Fleury, T., Duda, P., Gehrig, D., Bletzinger, M., Tao, J., Freemon, D.M. 2006. CyberInfrastructure for the Analysis of Ecological Acoustic Sensor Data: A Use Case Study in Grid Deployment, International Symposium on High Performance Distributed Computing 2006, Paris, France.

(ii) Other Significant Publications

Servilla, M. and Rasure. J. 1999. EarthScan: A Real-time Internet Based Remote Sensing Management and Analysis Tool for Agriculture, Agrotec99 (Brazilian conference on Agriculture).

Servilla, M. and Towner, M. 1999. A comparative study of 1998 corn yield-monitor data to a temporal sequence of high-spatial resolution multispectral images in South-central Nebraska, 1999 Second International Conference on Geospatial Information in Agriculture and Forestry.

Dean, K., Servilla, M., Roach, A., Foster, B., and Engle, K. 1998. Satellite Monitoring of Remote Volcanoes Improves Study Efforts in Alaska, EOS, 1998, Vol. 79, No. 35, pp. 413, 422-423.

Synergistic Activities:

- Software Architecture – (1) Lead scientist and system architect for the LTER Network Information System. Technology includes Java, Java Servlet, and Java Server Pages; the Metacat metadata catalog; "R" statistical language; and PostgreSQL database design and management. (2) Investigation of grid-based computing technologies in support of the LTER Network Information System. (3) Lead software architect from August 2002 to May 2004 for the development of web-based geospatial tools, including data warehousing, discovery, management, and exploitation.
- Advisory Committees – Member of the LTER Network Information System Advisory Committee (NISAC); member of the Ecological Metadata Language Developer's Group.
- Training/Education – Metadata trainer for ecoinformatics workshops, including those sponsored as part of the Science Environment for Ecological Knowledge, Resource Coordination Networking, and the Organization of Biological Field Stations.

Collaborators and Other Affiliations:

Collaborators and Co-Editors

K. Baker (U. of California)
J. Brunt (U. of New Mexico)
R. Butler (National Center for Supercomputer Applications)

J. Cushing (Evergreen State College)
M. Freemon (National Center for Supercomputer Applications)
M. Jones (U. of California)
W. Michener (U. of New Mexico)
M. O'Brien (U. of California)
D. Pennington (U. of New Mexico)
J. Porter (U. of Virginia)
J. Rasure (The MIND Institute)
M. Schildhauer (U. of California)
W. Sheldon (U. of Georgia)
B. Shetler (Photon Research Associates, Inc.)
J. Vande Castle (U. of New Mexico)
R. Waide (U. of New Mexico)

Graduate Advisors

A. Maccabe (U. of New Mexico)
J. Papike (U.of New Mexico)

Postdoctoral Advisor

K. Dean (University of Alaska)

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**114,864**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**71,349**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**65,832**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**101,424**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**83,706**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**437,175**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**8**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	78.00	0.00	0.00	**353,784**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**2**) UNDERGRADUATE STUDENTS				**24,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**25,716**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**840,675**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**288,560**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,129,235**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **CI equipment** $ **60,000**					
TOTAL EQUIPMENT				**60,000**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **463,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**422**) TOTAL PARTICIPANT COSTS				**463,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**173,200**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**18,900**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**222,100**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,941,035**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (TDC less equip, part costs) (Rate: 50.0000, Base: 1417335)**					
TOTAL INDIRECT COSTS (F&A)				**708,668**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,649,703**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,649,703**	$

M. COST SHARING PROPOSED LEVEL $ **218,384** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

ORG. REP. NAME*: **Roland Wildman**

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 1

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	83706

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**118,310**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**73,489**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**67,807**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**104,467**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**86,217**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**450,290**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**8**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	78.00	0.00	0.00	**364,397**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**2**) UNDERGRADUATE STUDENTS				**24,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**26,487**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**865,174**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**319,806**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,184,980**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) **CORE equipment** $ **42,500**					
TOTAL EQUIPMENT				**42,500**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **452,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**411**) TOTAL PARTICIPANT COSTS				**452,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**144,700**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**16,400**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**191,100**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,937,280**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (TDC less equip, part costs) (Rate: 50.0000, Base: 1442080)**					
TOTAL INDIRECT COSTS (F&A)				**721,040**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,658,320**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,658,320**	$

M. COST SHARING PROPOSED LEVEL $ **229,934** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

ORG. REP. NAME*: **Roland Wildman**

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 2

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	86217

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**121,859**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**75,694**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**69,841**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**107,602**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**88,804**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**463,800**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	72.00	0.00	0.00	**343,104**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**2**) UNDERGRADUATE STUDENTS				**24,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**27,282**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**858,186**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**315,861**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,174,047**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **372,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**339**) TOTAL PARTICIPANT COSTS				**372,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**144,700**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**11,900**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**186,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,799,347**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (TDC less part costs) (Rate: 50.0000, Base: 1426647)**					
TOTAL INDIRECT COSTS (F&A)				**713,324**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,512,671**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,512,671**	$

M. COST SHARING PROPOSED LEVEL $ **236,832** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Roland Wildman

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	88804

SUMMARY PROPOSAL BUDGET

YEAR 4

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**125,515**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**77,965**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**71,936**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**110,830**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**91,468**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**477,714**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	72.00	0.00	0.00	**353,398**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**1**) UNDERGRADUATE STUDENTS				**12,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**28,100**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**871,212**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**325,210**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,196,422**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **352,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**321**) TOTAL PARTICIPANT COSTS				**352,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**169,700**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**16,900**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**216,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,831,722**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (TDC less part costs) (Rate: 50.0000, Base: 1479022)**					
TOTAL INDIRECT COSTS (F&A)				**739,511**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,571,233**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,571,233**	$

M. COST SHARING PROPOSED LEVEL $ **246,014** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

ORG. REP. NAME*: **Roland Wildman**

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Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 4

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	91468

SUMMARY PROPOSAL BUDGET

YEAR 5

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PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION
University of New Mexico

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR
Robert B Waide

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**129,280**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**80,304**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**74,094**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**114,155**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**94,212**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**492,045**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	72.00	0.00	0.00	**364,001**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**1**) UNDERGRADUATE STUDENTS				**12,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**28,943**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**896,989**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**329,219**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,226,208**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
CORE Equipment $ **43,124**					
TOTAL EQUIPMENT				**43,124**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **352,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**321**) TOTAL PARTICIPANT COSTS				**352,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**144,700**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**16,400**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**191,100**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,879,132**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
50% MTDC (TDC less equip, part costs) (Rate: 50.0000, Base: 1483308)					
TOTAL INDIRECT COSTS (F&A)				**741,654**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,620,786**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,620,786**	$

M. COST SHARING PROPOSED LEVEL $ **255,855** AGREED LEVEL IF DIFFERENT $

PI/PD NAME
Robert B Waide

ORG. REP. NAME*
Roland Wildman

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 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 5

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	94212

SUMMARY PROPOSAL BUDGET

YEAR 6

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PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	12.00	0.00	0.00	**133,158**	
3. **William K Michener - Co-PI**	6.00	0.00	0.00	**82,713**	
4. **Phil Robertson - Senior Personnel**	4.00	0.00	0.00	**76,317**	
5. **Mark Servilla - Senior Personnel**	12.00	0.00	0.00	**117,579**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	9.00	0.00	**97,038**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	34.00	9.00	0.00	**506,805**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**7**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	72.00	0.00	0.00	**374,922**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**1**) UNDERGRADUATE STUDENTS				**12,000**	
5. (**1**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**29,811**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**923,538**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**342,206**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**1,265,744**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				**0**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**66,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **372,700**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS (**339**) TOTAL PARTICIPANT COSTS				**372,700**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**144,200**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**11,900**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**30,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**186,100**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**1,890,544**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) **50% MTDC (TDC less part costs) (Rate: 50.0000, Base: 1517844)**					
TOTAL INDIRECT COSTS (F&A)				**758,922**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**2,649,466**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **2,649,466**	$

M. COST SHARING PROPOSED LEVEL $ **266,089** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

ORG. REP. NAME*: **Roland Wildman**

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Date Checked	Date Of Rate Sheet	Initials - ORG

 ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

SUMMARY PROPOSAL BUDGET COMMENTS - Year 6

Other Senior Personnel Name - Title	Cal	Acad	Sumr	Funds Requested
Vande Castle, John R - Co-PI	0.00	9.00	0.00	97038

SUMMARY PROPOSAL BUDGET

Cumulative

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months) Proposed	Granted
AWARD NO.		

ORGANIZATION: **University of New Mexico**

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: **Robert B Waide**

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. **Robert B Waide - PI**	0.00	0.00	0.00	$ **0**	$
2. **James W Brunt - Co-PI**	72.00	0.00	0.00	**742,986**	
3. **William K Michener - Co-PI**	36.00	0.00	0.00	**461,514**	
4. **Phil Robertson - Senior Personnel**	24.00	0.00	0.00	**425,827**	
5. **Mark Servilla - Senior Personnel**	72.00	0.00	0.00	**656,057**	
6. (**1**) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.00	54.00	0.00	**541,445**	
7. (**6**) TOTAL SENIOR PERSONNEL (1 - 6)	204.00	54.00	0.00	**2,827,829**	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (**0**) POST DOCTORAL SCHOLARS	0.00	0.00	0.00	**0**	
2. (**44**) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	444.00	0.00	0.00	**2,153,606**	
3. (**0**) GRADUATE STUDENTS				**0**	
4. (**9**) UNDERGRADUATE STUDENTS				**108,000**	
5. (**6**) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				**166,339**	
6. (**0**) OTHER				**0**	
TOTAL SALARIES AND WAGES (A + B)				**5,255,774**	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				**1,920,862**	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				**7,176,636**	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) $ **145,624**					
TOTAL EQUIPMENT				**145,624**	
E. TRAVEL 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)				**396,000**	
2. FOREIGN				**0**	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ **0**					
2. TRAVEL **2,367,200**					
3. SUBSISTENCE **0**					
4. OTHER **0**					
TOTAL NUMBER OF PARTICIPANTS **2,153**) TOTAL PARTICIPANT COSTS				**2,367,200**	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				**921,200**	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				**92,400**	
3. CONSULTANT SERVICES				**0**	
4. COMPUTER SERVICES				**180,000**	
5. SUBAWARDS				**0**	
6. OTHER				**0**	
TOTAL OTHER DIRECT COSTS				**1,193,600**	
H. TOTAL DIRECT COSTS (A THROUGH G)				**11,279,060**	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				**4,383,119**	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				**15,662,179**	
K. RESIDUAL FUNDS				**0**	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				$ **15,662,179**	$

M. COST SHARING PROPOSED LEVEL $ **1,453,108** AGREED LEVEL IF DIFFERENT $

PI/PD NAME: **Robert B Waide**

ORG. REP. NAME*: **Roland Wildman**

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

C ***ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**

8.0 Budget Description and Justification

The LNO requests funds to manage and operate the LTER Network according to the Network Bylaws and to conduct activities that advance the research and education goals of the Network as stated in The Decadal Plan for LTER. The proposed six-year budget of $15,662,179 includes funds necessary for the Continuing Operations of the LTER Network Office ($10,350,000), and it includes new or increased funding to support science and governance goals of the Decadal Plan ($2,106,540) and to implement preliminary objectives of the LTER Cyberinfrastructure Strategic Plan ($3,205,639). ***Figure 15*** shows each of these elements as a share of the total budget. An analysis and justification for each of the three elements of this request follows.

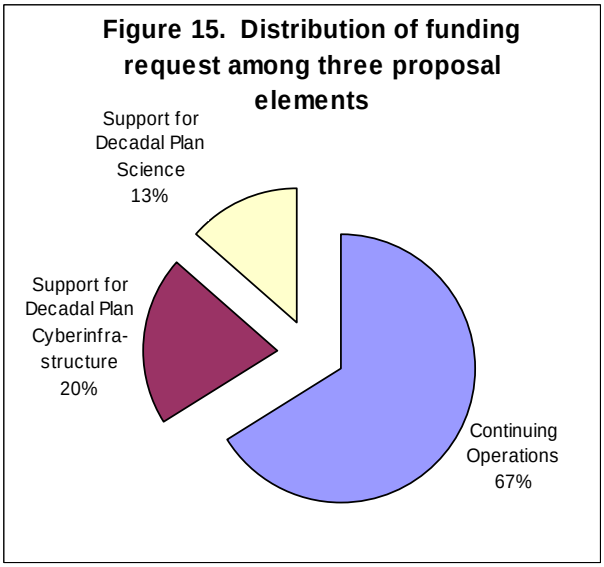


Figure 15. Distribution of funding request among three proposal elements

The LNO, in consultation with the EB and other LTER committees, identified 17 distinct activities for implementation during the new Cooperative Agreement (CA). The body of this proposal links each activity with anticipated outcomes and needed resources using a logic model approach. The budget explanation specifies resources needed for each activity, thus providing a clear link between requested funds, resulting activities, and eventual outcomes.

LNO staff salaries, fringe benefits, and associated indirect costs constitute the majority of the requested budget. ***Table 2*** shows how salaried staff effort will be allocated to each proposed activity. Several points need clarification at the outset. Three staff members (the Executive Director, Senior Application Support Analyst, and Senior Program Manager) receive all or part of their salaries from UNM, USGS, and CREST, respectively. Funding for three new positions (Programmer/Analyst NIS, Systems Analyst, Information Manager) is part of the request for support of the LTER Cyberinfrastructure plan. The Director for Synthesis Support (0.75 FTE), the Director for Development and Outreach (0.50 FTE), and the NIS Developer (0.75 FTE) have appointments as research faculty and obtain additional salary support from other sources.

As ***Table 2*** shows, two groups of activities consume the majority of LNO staff time: Cyberinfrastructure (6.80 FTE) and Core Services (2.90 FTE). Staff time dedicated directly to Network Synthesis (0.55 FTE) is low because LTER scientists and students carry out most of these activities. The Core Services budget contains funding for effort to organize synthesis meetings such as the Science Council (SC) and All Scientists Meetings (ASM).

8.1 Continuing Operations

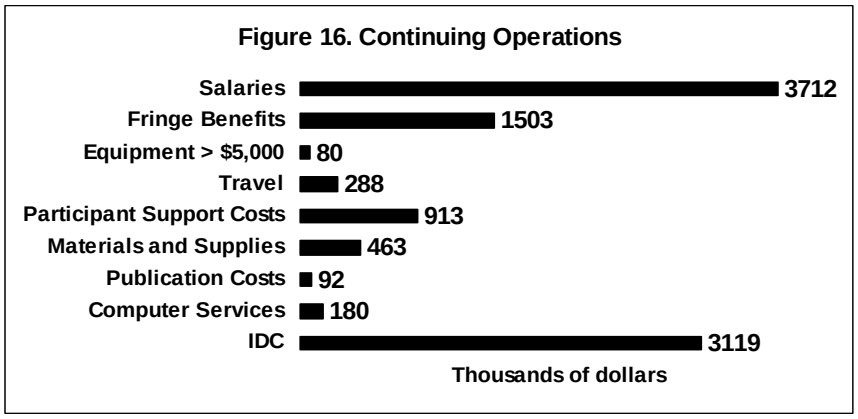
Salaries and fringe benefits for nine employees (8 FTEs; see ***Figure 16***) comprise the largest portion of the proposed budget for Continuing Operations, accounting for 50.4% of the budget. Indirect costs are the next largest budget category, although UNM returns approximately 50% of these costs to the LNO as cost share (see below). Participant support costs, mostly for scientific, planning, and governance meetings, constitute 8.8% of the budget; and materials and supplies, travel, equipment, publication costs, and computer services contribute decreasing proportions of the budget in that order.

8.1.1 Budget Description for Continuing Operations. The CO budget includes salaries and fringe benefits, equipment, travel, participant costs, materials and supplies, publications costs, computer services and indirect costs as depicted in ***Figure 16*** and described below.

Salaries and Fringes —

The Executive Director oversees the activities of the LNO, recruits and supervises the Director for Synthesis Support, the Director for Development and Outreach, the Chief Information Officer, and the Senior Program Manager, and is responsible for fulfilling the obligations of the CA. He serves as an ex officio member of the SC and the Executive Board (EB), in which capacity he contributes to and supports the activities of these groups. The Executive Director also serves on other Network standing and ad hoc committees as required. He is the principal point of contact between the LNO and the NSF, and is often called upon to represent the Network in interactions with Federal agencies, other research centers and networks, and the media. He reports on the accomplishments of the LNO to the NSF, the Executive Board, LTER sites and committees, the LTER National Advisory Board, and UNM. The Executive Director prepares proposals for funding the activities of the LNO and oversees management of funds from these proposals according to NSF guidelines and University regulations. He is responsible for strategic planning for the LNO. UNM funds the salary and fringe benefits for the Executive Director.

Figure 16. Continuing Operations



The Director for Synthesis Support (DSS) works with the SC, the EB, and LTER sites and scientists to facilitate synthesis activities such as annual meetings of the SC, triennial ASM, research working groups sponsored by the LNO, and LTER planning meetings. The DSS helps to determine the goals and products of each meeting and to identify the support necessary to achieve stated goals. Working with the LNO Office Manager, the DSS establishes benchmarks and timelines for organizing each meeting. The DSS works with the EB to determine priorities for disbursement of LNO support for research working groups, coordinate requests for proposals for these working groups, summarize evaluations of these proposals, and accumulate reports and other products from each working group. He works with the SC to plan and document science theme meetings and meetings to implement the Decadal Plan. When required, the DSS prepares supplement proposals for funding to support ASM, planning meetings, and research working groups. The DSS, in conjunction with collaborating partners such as NASA and the USGS, organizes and carries out Network-level acquisition and management of remotely-sensed data and provides access to these data via the Internet. He provides expertise to document and guide acquisition of new technology and cyberinfrastructure for the LNO and LTER sites, participates in preparing reports on LNO activities, and serves on the NISAC. This proposal includes 0.75 FTE in salary and fringe benefits for the DSS.

The Chief Information Officer (CIO) leads and supervises the technical staff responsible for operations and maintenance of LTER Network cyberinfrastructure, development and implementation of the Network Information System, and management of Network databases and web sites. He is responsible for planning and implementing cyberinfrastructure and information management standards to support the mission and goals of the LTER Network in coordination with the IM Committee and the NISAC. The CIO is an expert member of the team responsible for implementing the LTER Network CI Strategic Plan and is the technical representative of the LTER Network to national and international efforts to coordinate shared cyberinfrastructure and standards for interoperability. The CIO assumes the duties of the Executive Director in his absence, participates in the preparation of reports on LNO activities, and interacts with NSF on Network CI issues. The proposal includes full salary support (1.0 FTE) for the CIO.

The CIO has the following direct reports:

- A Network Developer (0.75 FTE) who develops and implements the LTER Network Information System; coordinates software development efforts with site, partner, and community development efforts; gathers requirements, develops prototypes, and garners feedback from the community on approaches; and provides regular reports of progress to IM and NISAC committees.
- A System Administrator (1.0 FTE) who maintains, upgrades, and provides security for computer, communication, and information management infrastructure that supports the LTER Network; is responsible for backup, recovery, and critical system redundancy; and provides technical support to LNO staff and to LTER sites.
- An Application Support Analyst (1.0 FTE) who provides expertise in and support for web-based applications and designs, develops, and maintains LTER Network web sites including the public site (http://www.lternet.edu), the Intranet (http://intranet.lternet.edu), and the LNO site (http://lno.lternet.edu), and who assists and consults with sites as needed.

In addition to the above, the CIO will supervise the Programmer/Analyst, Systems Analyst, and Information Manager requested under the Cyberinfrastructure in the Decadal Plan section (see below).

The Director for Development and Outreach (DDO) coordinates and implements activities to develop mutually beneficial relationships between LTER and Federal agencies, international research programs and other networks. He facilitates the joint development and dissemination of CI (including training) for LTER through long-term partnerships with leading institutions (e.g., NCEAS, PBI, NBII, OBFS, DOE, NESCent) in relevant disciplines. The DDO develops and manages competitive, multi-institutional grant proposals (e.g., SEEK, RCN, Kepler-Core) that provide opportunities for the LTER Network to benefit from leading edge technology (data networks, interoperability tools, scientific work flows). He manages the contract with the NBII that funds a Senior Application Support Analyst in the LNO. The DDO oversees outreach activities to LTER sites, the broader scientific community, agencies, policy makers, and the public through supervision of the Public Information Officer. The DDO leads development of the LTER communication plan and manages the ecoinformatics training program. The DDO helps to prepare reports on LNO activities. The proposal requests 0.50 FTE in salary and fringe benefits for the DDO.

The DDO has the following direct reports:

- A Public Information Officer (1.0 FTE) who plans and implements strategies for disseminating information about the LTER Network through public information products and tools. The Public Information Officer is responsible for public and media relations, produces LTER brochures and newsletters, and provides content for the LTER web sites.
- A Senior Application Support Analyst (1.0 FTE) who provides outreach to site information managers and assists sites in developing and maintaining their links to Network databases and their participation in Network and National standards. A partnership with the NBII funds this position, saving the LNO and NSF $135,000 annually.

A Senior Program Manager (0.5 FTE contributed by CREST in Years 1 and 2; 1.0 FTE contributed in Years 3-6) manages Core Services, coordinates management of major LNO projects, oversees accounting of LNO grants and contracts, coordinates report and proposal preparation, and supervises administrative staff. The Senior Program Manager has the following direct reports:

- An Office Manager (1.0 FTE) who facilitates governance and science meetings and provides general administrative support.
- An Accounting Technician (1.0 FTE) who tracks and reconciles expenditures, aids in projecting and balancing working group budgets and supplements to the LNO, and maintains the LNO accounting system for cross-referencing expenditures.
- Undergraduate students who copy and file documents, prepare travel reimbursements, and perform general clerical tasks.

Fringe benefits on salaries for the positions described above are UNM estimates of future costs. Fringe benefits on undergraduate stipends are 1%. Salaries after Year 1 show a projected 3% annual increase.

Equipment — Information management, electronic communication, and Network Information System responsibilities of the Network Office require the support of a sophisticated, reliable computer network that is accessible from any point in the world. Necessary capabilities include mass storage of data, high-speed information exchange, large format printing, videoconferencing, wireless networking, and manipulation of digital video. Regular upgrades to equipment are necessary to maintain the high level of service and reliability for the LTER Network. This proposal includes funds to replace half of the servers (Activity 2.1) in Year 2 ($42,500) and half again in Year 5 ($43,124). Experience during past CAs demonstrates that this frequency of equipment replacement is necessary for the efficient operation of information management and communications. The Materials and Supplies section discusses replacement of peripherals and other technical items.

Travel — The LNO requests travel support for UNM employees to attend the following annual activities:

- SC meetings (Executive Director, DSS, CIO, DDO, two Sevilleta representatives) — 6 trips @ $1100 = $6600;
- One meeting of the Information Management Committee (CIO, DDO, DSS, Network Developer, Programmer/Analyst, Application Support Analyst, Senior Application Support Analyst, Information Manager, Sevilleta Information Manager) — 9 trips @ $1100 = $9900;
- Two professional meetings (ESA, American Association for the Advancement of Science) for community outreach (Executive Director, Public Information Officer, Application Support Analyst) and one meeting for dissemination of scientific results (Executive Director, CIO, DDO, DSS, Senior Program Manager) — 11 trips @ $1100 = $12,100;
- Visits to four LTER sites to assess needs, discuss site priorities, and arrange technical assistance (Executive Director) — 4 trips @ $1100 = $4400;
- Three professional development seminars for LNO administrative staff ($3300);
- Two trips to NSF to consult with LTER program officer (Executive Director) — 2 trips @ $1100 = $2200;
- Meetings with collaborators, including the PBI, NBII, OBFS, and others as necessary (DDO, Executive Director) — 8 trips @ $1100 = $8800.

Total travel costs range from $38,500 to $53,900 per year.

Participant support costs — The LNO is responsible for organizing and supporting meetings of LTER committees and working groups. Therefore, the LNO requests support for the following annual meetings:

- One SC meeting (two representatives each from 25 sites (with the Sevilleta site covered under the travel budget); eight chairs of standing committees) – 58 trips @ $1100 = $63,800 plus $4000 meeting expenses (room rental, audiovisual, coffee breaks). Of this amount, $44,700 appears under Continuing Operations and the remainder appears as a new expense under support for the Decadal Plan.
- Two EB meetings per year — 22 trips @$1100 = $24,200;
- One meeting of the NAB (15 members) — 15 trips @ $1100 = $16,500;
- One meeting of the IMC (one representative each from 25 sites, five outside experts) — 30 trips @$1100 = $33,000;
- One meeting of the IMEXEC — 8 trips @ $1100 = $8,800;
- One meeting of NISAC — 9 trips @ $1100 = $9900; a second meeting is listed under support for CI.

- LTER mini-symposium speakers — 6 trips @ $1100 = $6600.

To reduce LNO travel costs, the IMEXEC and the NISAC will meet in Albuquerque.

In FY 2009-10 only, the budget contains ten trips to bring together outside experts to assist in developing a Network Communication Plan (Activity 4.1).

In 2011 and 2014, the LNO will pay a deposit (estimated at $20,000) on the venue for the ASM in 2012 and 2015. The budget includes this amount under participant support because it will apply to lodging or other meeting costs (Activity 1.2).

Materials and Supplies — Funds for office operations are estimates based on costs for the first 11 years of the program (annual total = $55,000). Office operations include phone/fax, computer and paper supplies, copying, equipment insurance, postage/freight/express services (both national and international), graphic services, and small office hardware/supplies. Because apportioning these costs among activities is difficult, Activity 3.1 (Meetings) includes the costs for all office operations, including costs for computer replacement. Note: the Federal definition of equipment (items > $5000 each) places most computer purchases in the Materials and Supplies budget where they will incur Indirect Costs.

- Desktop Computing and Video Teleconferencing —The LNO will replace five desktop computers per year to distribute costs and deployment efforts ($15,000). In addition, the LNO will purchase two new video teleconferencing units each year for LTER scientists to participate in synthesis and committee meetings ($5,000).
- Updates to LTER display —The LNO will add multimedia capability to the LTER display (deployed at national scientific meetings) in Year 1 ($5200) and update the content of the display yearly ($1700 to print new display panels).

Publication costs — Publication costs are projections based on LNO staff experience. Costs vary from year-to-year depending on the production schedule for each publication. Costs below include annual and total costs for the six year period (Activity 4.2):

- Publish LTER Newsletters (2 per year @ $2500 x 6 = $30,000);
- Reprint site brochures (2 per year @ $1200 x 6 = $14,400);
- Update LTER Network brochure twice (2 @ $3000 = $6,000);
- Traveling exhibit re-design (once) and maintenance ($5000);
- ASM materials (2 @ $5000 = $10,000);
- Miscellaneous posters, promotional materials, exhibits, LNO publications, Network documents, page charges ($4,000 per year x 6 = $24,000);
- Video copying and distribution (2 @ $1500 = $3000).

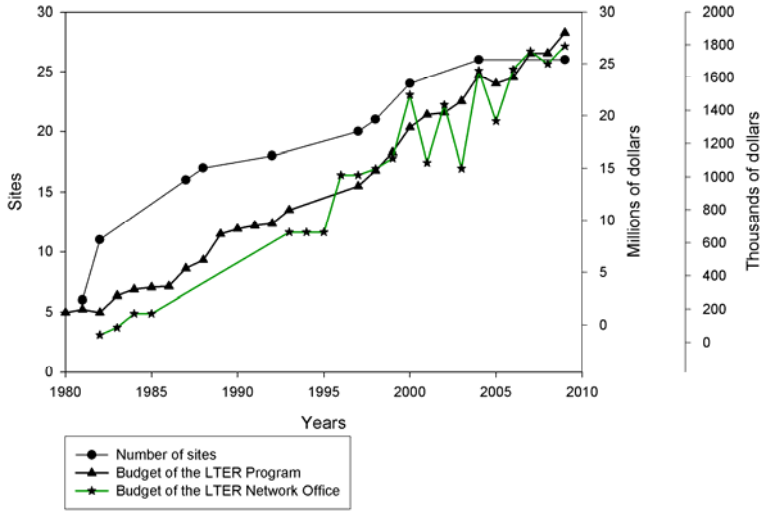
Computer services — Computer services ($30,000/year) cover recurring costs necessary to maintain Network and Office computing infrastructure (Activity 2.1). Costs are projections based on average annual expenditures during the previous five years of the CA and include:

- Computer maintenance contracts, labor, and replacement parts — $16,400/year;
- Software maintenance for remote sensing software (ARC/INFO, ERDAS IMAGINE, ENVI), database management system software, data modeling software (ER Studio) and data manipulation software (Data Junction) — $5,600/year;
- New software and software upgrades including VTC — $8,000/year.

8.1.2 Budget Justification for Continuing Operations. In its 28 years of operation, the LTER Network has become one of NSF's most prestigious programs, with six directorates and programs (***Figure 17***) contributing to its $26 million annual budget. In 1982, the first funds directed towards Network coordination represented 3.75% of the total LTER budget. By 1985, LNO responsibilities increased, and the LNO budget rose to 4.86% of the program budget. As the Network grew and became more diverse,

the LNO budget grew proportionately. In the proposed LNO budget for FY 2009, the first year of the new CA, the cost of Continuing Operations (governing, managing, and operating the LTER Network) is 6.40% of the total budget of the program.

Figure 17. Growth of the LTER Network



LNO budget growth closely parallels growth in the LTER Network (***Figure 17***), with fluctuations deriving from varying amounts of supplemental funding. The present request includes an increase in funding for Continuing Operations (15%) in the first year of the new CA. This increase is similar to increments awarded to LTER sites at renewal and covers the costs of inflation in several key LNO budget categories.

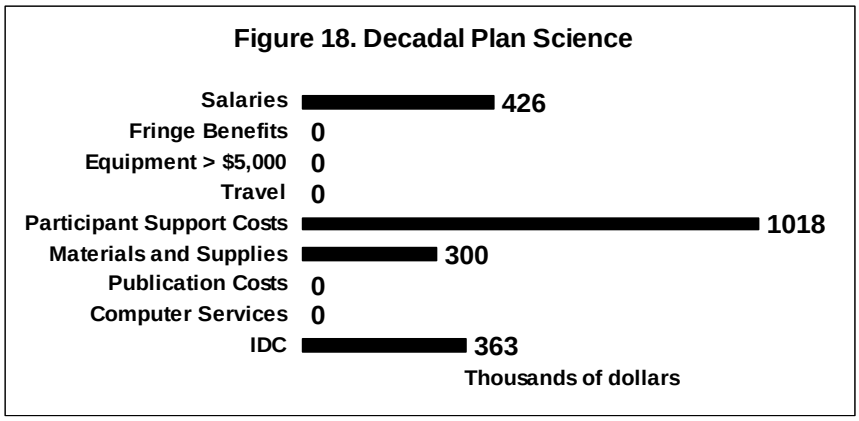
Salaries and fringe benefits in the proposed budget show the greatest increases compared to the current CA. The increase in salaries results in part from greater than expected annual increases for UNM staff. The current CA includes 3% annual increments for staff, a rate slightly less than the increase in the Consumer Price Index for the period 2002-2007. However, average annual salary increases for staff at UNM averaged around 4% for the past several years. To maintain salaries at a par with UNM peers, the LNO awarded similar increases to its staff. Although the current proposal includes 3% annual cost-of-living increases for staff, the LNO will, when appropriate, award merit increases using funds generated from indirect cost return to the LNO, new income from competitive grants, and savings created by staff turnover. By combining these sources of funds, the LNO expects to increase salaries at the same average rate as UNM while rewarding excellent performance with merit raises.

UNM fringe benefits increased substantially over the past six years, and projections indicate future increases on a par with similar institutions. Estimated rates for the next six years are 18-51% greater than corresponding rates in the present CA, depending on the salary for the position.

Projected costs for materials and supplies, services and participant support show significant increases over the period of the next CA. Since the LNO supports substantial amounts of Network travel, increases in airfares, per diem, and lodging significantly affect the budget. The present CA budgeted $800 per-trip; by the end of current funding, per trip costs will be substantially higher. Projected real cost increases for LTER travel to governance and research meetings over the next six years result in an average, inflation-adjusted trip cost of $1100, which is the amount used in the proposed budget. The budget also uses projected real cost increases for equipment, materials and supplies, and services.

8.2 Science and Education in the Decadal Plan

As a result of concerted effort over the last three years, the LTER Network now has a strategic science, education, and cyberinfrastructure plan (The Decadal Plan for LTER). The plan is under consideration by the NSF Directorate for Biological Sciences. In addition to establishing a series of science, education, and cyberinfrastructure goals, the Decadal Plan provides a blueprint for funding to achieve these goals. Even under the most optimistic scenario, regular funding to address science goals would not be available until FY 2011.



In the interim, the LNO must facilitate realization of the new research, education, and cyberinfrastructure goals outlined in the Decadal Plan. Addressing these new goals will require new resources beyond those needed to maintain Continuing Operations. New funds requested to address new scientific and education goals directly respond to recommendations made in the report from the mid-term review of the LNO.

The Decadal Plan proposes important changes in the governance and operation of the LTER Network. In the short term, the LNO, as requested by the LTER EB, will facilitate implementation of the new LTER governance structure and seek funds for continued planning and implementation of science and education goals. The proposed budget incorporates funds for these activities (totaling $2,106,542; ***Figure 18***).

8.2.1 Changes in LTER governance. The LTER SC has, as part of the Decadal Plan, instituted several changes in LTER governance that will increase costs to the LNO. The most significant decision establishes a fixed term for the Chair of the LTER Network and compensates the Chair at the rate of 0.33-0.50 FTE. The present Chair of the LTER SC and EB (Phil Robertson) receives four months of salary and fringe benefits for his service. The LNO absorbed the Chair's salary in the last two years of the present CA through supplements from NSF and by allocating LNO staff time to other projects. The current proposal includes estimated annual compensation for the Chair that ranges between $100,000 and $114,000 per year (including indirect costs). The actual amount will depend on the salary and time dedicated to LTER by future chairs.

Revisions in the size and frequency of meetings of LTER governance and standing committees will increase travel costs despite success in substituting video- or teleconferences for many meetings. The proposed budget includes 33 more trips per year than the current CA, including funding for ten discretionary trips for the Chair. This increase results from increased committee size or meeting frequency for the EB, NISAC, and NAB as established in the LTER Bylaws. The number of trips by LNO staff to governance meetings increases only slightly from the current CA (23 vs. 21 trips).

8.2.2 New Science and Education Goals. Specifying experiments and measurements that can achieve the new science and education goals (Activity 1.4) will require additional planning meetings. The LTER EB estimates an annual cost of $100,000 to conduct three meetings of all 26 sites plus outside collaborators. The proposed budget includes this amount in Years 1 and 2. By Year 2 of the new CA, NSF's response to the plan will determine subsequent steps.

The LNO requests increased funding for meetings of scientific working groups to pursue research questions stemming from the Decadal Plan and research themes arising from interactions among LTER scientists (Activity 1.3). The current CA provides $50,000 per year for these working groups. The LNO uses most of these funds to encourage collaborations emerging from triennial ASM. However, LNO surveys of LTER sites identified a need for additional funds for research working groups; therefore, the LNO proposes to increase the amount available annually to $100,000, which will support 12-15 working groups per year. These working groups will plan and coordinate cross-site and network-wide synthesis efforts, standards development, development of value-added data sets, and interactions with other agency efforts. The LTER EB will allocate funds to working groups based on proposals submitted through the LNO.

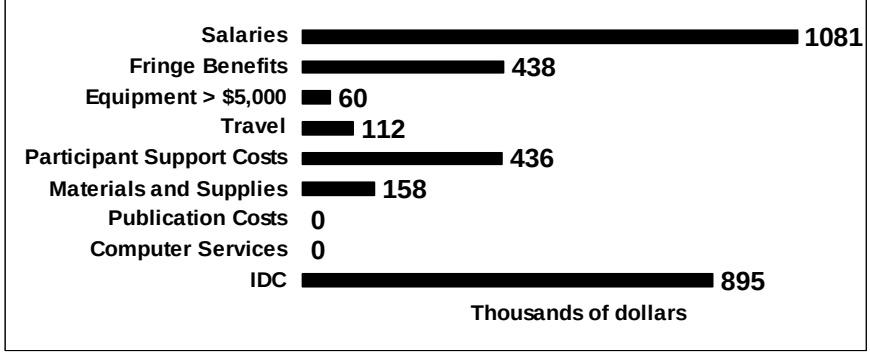
Surveys also identified the importance of support for short-term, focused efforts by LTER scientists to complete synthesis studies arising from cross-site collaboration. Discussions with LTER scientists indicate that one or two months of salary would significantly enhance the pace of LTER synthesis. The

LNO requests $50,000 to support two such research efforts per year. Because each transaction will be small, the request appears under Materials and Supplies rather than as Sub-awards, in accordance with NSF Grants and Contracts guidelines.

8.3 Cyberinfrastructure in the Decadal Plan

The Decadal Plan includes a Strategic Plan for Cyberinfrastructure for the LTER Network, which defines cyberinfrastructure needs for sites and the Network to carry out the new science and education agenda. In preparing this proposal, the LNO asked the LTER EB and IMC to identify specific cyberinfrastructure needs for inclusion. The following budget recommendations emerged from these discussions (***Figure 19***).

Figure 19. Decadal Plan Cyberinfrastructure



8.3.1 Salaries and Fringe Benefits. New cyberinfrastructure goals described in the Strategic Plan require additional technical support staff at sites and at the LNO. Support staff at the LNO will provide expertise and effort needed to complete the NIS, manage increasing numbers of Network databases, and expand training for LTER scientists and data managers. Progress in these key areas will strengthen the ability of the LTER Network to advance ongoing discussions on common cyberinfrastructure needs in ecological observing networks. The LNO proactively created two positions in anticipation of activities required to fulfill the Strategic Plan for Cyberinfrastructure. For the short term, these positions are being paid by a combination of funds from the CA, from supplements to the LNO in support of EcoTrends and other projects, and by sharing staff time with other projects such as SEEK. Long-term, this funding strategy is not tenable; therefore, the LNO requests new funding to maintain staff support for the objectives of the Strategic Plan for Cyberinfrastructure. The proposed budget for Cyberinfrastructure includes funds for these positions, which are:

- A Programmer/Analyst (1.0 FTE), recruited to support the development of the Network Information System, is already making progress on developing the NIS (Activity 2.3), and further development depends on the availability of this programming expertise. The specific functions of this position are to develop software solutions to link site databases and applications to the NIS, develop tools to allow sites to implement Ecological Metadata Language, and administer the LNO Metacat metadata repository. The present CA funded only two years of salary for this position with the expectation that additional funding would be forthcoming from NSF. When this additional funding did not materialize, the LNO maintained the position through various economies and by leveraging other projects. Retaining this position is a high priority for completing the NIS. Moreover, the IM Committee recognizes the need for additional programming support to advance and complete the NIS. Therefore, to address this need, the LNO requests three months of summer salary (0.25 FTE) for the existing position of Network Developer to devote time to software programming in addition to his present duties.
- A new Systems Analyst (1.0 FTE), added in 2006, is supporting VTC and desktop computing and managing the LNO training laboratory (Activities 2.1, 3.3, and 4.4). UNM provided space for this state-of-the-art laboratory, and the SEEK project and LNO staff equipped the laboratory. The lab houses the site-based and distance training activities for LTER, and is an important resource for future LTER activities arising from the Decadal Plan. NSF support for this position will ensure the

continued operation of the training lab and the training activities described in this proposal. Without NSF support, the LNO will have to decommission the training lab.

The EB strongly recommended adding capability in information management (Activity 2.2) to improve the utility of Network databases for future synthesis. In making this recommendation, the EB expected that managing, updating, and disseminating the >1200 LTER EcoTrends data sets would be managed as part of the Network Information System responsibilities. The NSF provided supplemental funds to recruit for this position in the last year of the present CA. The proposed budget requests a new position of Information Manager (1.0 FTE) to address management of existing Network databases and the creation and management of new data modules for the Network Information System.

8.3.2 Equipment. The LNO requests funds for the initial purchase of fixed and traveling rich media recorders and a server to capture, archive, and stream scientific and educational presentations over the web ($60,000; Activity 2.1).

8.3.3 Travel. To address the goals of the CI Strategic Plan, LNO staff need travel funds to attend meetings and to assist site information management.

- Attend one meeting of NISAC per year (Activity 2.3; CIO, DDO, DSS, Executive Director, Network Developer) — 5 trips @$1100 = $5500;
- Visit four LTER sites per year to assess needs, discuss site priorities, and provide technical assistance (Activity 4.2; CIO, Senior Application Support Analyst) — 8 trips @ $1100 = $8800;
- Two LNO staff members attend IM production meetings each year (Activity 2.2; 4 trips @ $1100 = $4400).

8.3.4 Participant Support. Site information managers require travel support for production and training meetings.

- The IMC requests funds for two production meetings each year to address specific technical aspects of LTER information management. The expectation for each meeting will be the resolution of a pressing IM issue (Activity 2.2; 16 trips @$1100 = $17,600).
- Training (Activity 4.4) is an important activity requiring increased LNO support. The LNO expects that as a result of the goals of the Decadal Plan, information managers and scientists will need training in the latest scientific and cyberinfrastructure technologies. Therefore, the LNO requests funds for two training activities per year ($43,000 including travel for 30 people and stipends for the trainers).
- The LNO requests funds for two trips per year for short working visits by site information managers to the LNO or other sites (Activity 2.2; $2200).
- The LNO requests funds for one meeting of the NISAC per year (Activity 2.3) – 9 trips @ $1100 = $9900.

8.3.5 Materials and Supplies. The LNO requests compensation to sites for time spent by information managers on Network activities and periodic replacement of computers in the LNO training lab.

- The IMC requests support for short (one month) working visits by information managers to other sites or to the LNO. Two visits per year will target information technology solutions to specific data management problems related to participation in Network synthesis activities. The proposed budget requests travel funds and compensation for time that information managers spend on these projects. Compensation is particularly important to make participation in Network projects more feasible by providing sites the means to replace the information managers' time dedicated to these projects (Activity 2.2; $15,000).
- The LNO will refresh 24 training lab computers in Year 1 and Year 4. Note: the LNO is replacing only CPU's, not monitors. (Activity 2.1; $25,000)
- Annual training exercise will require copies of instructional materials (Activity 4.4; $3,000).

8.4 Cost Share

Without charge, UNM provides space for the LNO in the newly-constructed CERIA building. The space consists of offices for LNO employees and associated projects (eight single or double offices, a reception area with three desks, a large space with 11 cubicles, climate-controlled server room, and the state-of-the-art LTER Training Laboratory). Located on the main campus of UNM, the LNO is near the Department of Biology, the Student Union, the campus bookstore, and UNM administration.

UNM also provides the salary of the Executive Director, who is a tenured professor in the Department of Biology. The value of this contribution will be $1,453,105 over the course of the new CA.

The NBII program of the USGS supports Senior Application Support Analyst San Gil, thereby saving the LNO $135,000 per year. Although this relationship has been strong and stable for several years, future collaborations will depend both on mutual interests and Federal funding for USGS.

8.5 Facilities and Administrative Costs

Facilities and Administrative Costs are calculated at 50% Modified Total Direct Costs as specified in the UNM agreement with Health and Human Services dated April 14, 2005.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Robert Waide	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the US Long Term Ecological Research Network

Source of Support: NSF Cooperative Agreement DEB-0236154
Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/10/03 - 02/28/09
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 10.50 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long-Term Ecological Research in the Luquillo Experimental Forest IV

Source of Support: National Science Foundation
Total Award Amount: $ 4,920,000 Total Award Period Covered: 12/01/06 - 11/30/12
Location of Project: University of Puerto Rico
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: ITR Collaboration Resarch: Enabling the Science Environment for Ecological Knowledge (SEEK)

Source of Support: National Science Foundation
Total Award Amount: $ 4,439,765 Total Award Period Covered: 10/01/02 - 09/30/08
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office FY 09-15 (This proposal)

Source of Support: National Science Foundation
Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 10.50 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☒ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: River in a Dry Land

Source of Support: National Science Foundation
Total Award Amount: $ 75,000 Total Award Period Covered: 07/01/08 - 06/30/13
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.50 Acad: 0.00 Summ: 0.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Robert Waide

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Targeted Partnership: Culturally Relevant Ecology, Learning Progressions and Environmental Literacy

Source of Support: National Science Foundation

Total Award Amount: $ 249,985 Total Award Period Covered: 10/01/08 - 09/30/13

Location of Project: Colorado State University

Person-Months Per Year Committed to the Project. Cal:0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: James Brunt	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the US Long Term Ecological Research Network

Source of Support: National Science Foundation

Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/01/03 - 02/28/19

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 12.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office 09-15 (This proposal)

Source of Support: National Science Foundation

Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 12.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: William Michener	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: ITR Collaborative: Enabling the Science Environment for Ecological Knowledge (SEEK)

Source of Support: National Science Foundation
Total Award Amount: $ 4,439,765 Total Award Period Covered: 10/01/02 - 09/30/08
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: New Mexico EPSCoR RII (NM NEW)

Source of Support: National Science Foundation
Total Award Amount: $ 6,750,000 Total Award Period Covered: 04/15/05 - 03/31/08
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 6.00 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: National Biological Information Infrastructure (NBII) and University of New Mexico Metadata Standardization Project

Source of Support: US Geological Survey
Total Award Amount: $ 283,000 Total Award Period Covered: 12/01/05 - 11/30/08
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: INTEROP: Creation of a Virtual Data Center for the Biodiversity, Ecological and Environmental Sciences

Source of Support: National Science Foundation
Total Award Amount: $ 749,408 Total Award Period Covered: 01/01/08 - 12/31/10
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.50 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: New Mexico EPSCoR RII (Climate Change Impacts on New Mexico's Sources of Water)

Source of Support: National Science Foundation
Total Award Amount: $ 15,000,000 Total Award Period Covered: 07/01/08 - 06/30/13
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: 0.00 Summ: 0.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: William Michener	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: DataNetONE: Observation Network for Earth

Source of Support: National Science Foundation

Total Award Amount: $ 19,999,741 Total Award Period Covered: 10/01/08 - 09/30/13

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office 09-15 (This proposal)

Source of Support: National Science Foundation

Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 6.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: John Vande Castle	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the US Long Term Ecological Research Network

Source of Support: National Science Foundation

Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/01/03 - 02/28/09

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 9.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: Long Term Ecological Research Network Office 09-15 (This proposal)

Source of Support: National Science Foundation

Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15

Location of Project: University of New Mexico

Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 9.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Phil Robertson	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: LTER in Acricultural Ecology

Source of Support: National Science Foundation
Total Award Amount: $ 49,000,000 Total Award Period Covered: 12/01/04 - 11/30/10
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.20 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Evaluation of N2O as a Greenhouse Gas Offset Mechanism

Source of Support: Electric Power Research Institute
Total Award Amount: $ 680,000 Total Award Period Covered: 09/01/06 - 08/31/09
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.10 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: GK-12: Ecological Literacy in Rural Michigan Classrooms

Source of Support: National Science Foundation
Total Award Amount: $ 15,000,000 Total Award Period Covered: 02/01/06 - 01/31/09
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.10 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: A Field-based Education and Resarch Facility at KBS

Source of Support: National Science Foundation
Total Award Amount: $ 249,500 Total Award Period Covered: 10/01/06 - 09/30/09
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.05 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Ecosystem Services from Low-input Cropping Systems

Source of Support: National Science Foundation
Total Award Amount: $ 400,000 Total Award Period Covered: 10/01/05 - 09/30/08
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.10 Acad: 0.00 Summ: 0.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Phil Robertson	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Ecosystem Services: Biogeochemical Contributions to Cropping Systems

Source of Support: U.S. Department of Agriculture CSREES
Total Award Amount: $ 49,500 Total Award Period Covered: 08/01/06 - 07/31/08
Location of Project: Michigan State University
Person-Months Per Year Committed to the Project. Cal: 0.10 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Great Lakes Bioenergy Research Center

Source of Support: U.S. Department of Energy
Total Award Amount: $ 135,000,000 Total Award Period Covered: 10/01/07 - 09/30/12
Location of Project: Michigan State University (T. Donohoe PI)
Person-Months Per Year Committed to the Project. Cal: 0.20 Acad: 0.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: LTER Leadership Award

Source of Support: National Science Foundation
Total Award Amount: $ 68,270 Total Award Period Covered: 06/01/07 - 05/31/09
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.20 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Long Term Ecological Research Network Office FY 09-15 (This proposal)

Source of Support: National Science Foundation
Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.20 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Mark Servilla	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: A Proposal for the Network Office of the Long Term Ecological Research Network

Source of Support: National Science Foundation
Total Award Amount: $ 8,100,000 Total Award Period Covered: 03/01/03 - 02/28/09
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 9.00 Sumr: 0.00

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: CI Team Demonstration Project: Advancing Cyberinfrastructure-based Science through Education, Training, and Mentoring of Science Communities

Source of Support: National Science Foundation
Total Award Amount: $ 249,000 Total Award Period Covered: 10/01/06 - 09/30/08
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 1.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: INTEROP: Creation of an International Virtual Data Center for the Biodiversity, Ecological, and Environmental Sciences

Source of Support: National Science Foundation
Total Award Amount: $ 745,959 Total Award Period Covered: 01/01/08 - 12/31/10
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: CI TEAM: Advancing Cyberinfrastructure-based Science through Education, Training, and Mentoring of Science Communities

Source of Support: National Science Foundation
Total Award Amount: $ 559,209 Total Award Period Covered: 01/01/08 - 12/31/09
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title: DataNetONE: Observation Network for Earth

Source of Support: National Science Foundation
Total Award Amount: $ 19,999,741 Total Award Period Covered: 10/01/08 - 09/30/13
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: 0.00 Summ: 0.00

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

Current and Pending Support

(See GPG Section II.C.2.h for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Mark Servilla

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☒ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title: Long Term Ecological Research Network Office 09-15 (This proposal)

Source of Support: National Science Foundation
Total Award Amount: $ 15,662,179 Total Award Period Covered: 03/01/09 - 02/28/15
Location of Project: University of New Mexico
Person-Months Per Year Committed to the Project. Cal:12.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
Total Award Amount: $ Total Award Period Covered:
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Summ:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

LTER Network Office - University of New Mexico

Facilities to Support Staff Conferencing and Workgroups

The Long Term Ecological Research Network Office (LNO) occupies a 2,700 square-foot suite comprising seven offices, an 8 person technical workspace, and two 40-person conference rooms in the CERIA building on the main campus of University of New Mexico. This space is ideally positioned to support the activities and research proposed. For collaborative technology, the LNO supports a Polycom MGC50+ IP video conferencing bridge that can support video conferences up to 48 persons. In addition, there are polycom units that can be easily relocated in any of the working group conference facilities described above.
The LNO and the SEEK ITR project have co-dedicated a modern information technology training laboratory that compliments the above facilities. This training laboratory is optimized for student-to-instructor communication, while remaining ergonomically comfortable for long periods of instruction. The center piece of this laboratory is a fire-wall protected, 24-student pod facility with the latest Dell duo-core Pentium desktop computers for each student, including dual 20 inch flat-screen monitors that can be shared through the instructor's computer and multimedia/video system. This training facility would enhance all workshop related tasks of the OCI-INTEROP call.

Computing Facilities to Support Research

The LTER Network Office hosts computer facilities for the LTER Network Information System Infrastructure; the backbone of which is the Network Office Data Center. This climate-controlled center has scalable servers and enhanced network bandwidth to better serve the LTER Network and its partners in the ecological community. 8 Dell Quad-Core Poweredge servers with over 12 Terabytes of disk storage, redundant power supplies and UPS) serve as the core communication, collaboration, and data processing, storage, and delivery components of the LTERnet.edu domain. In addition, there are modern multi-processor development and test machines. The combination of Linux and Windows operating systems on the Intel platform allows for maximum flexibility in incorporating new developments and technology. The Center standardizes on both PostgresSQL and MySQL relational database management systems, although Microsoft SQL Server is available for special purposes. In addition, the Center has a number of large format color output devices and a variety of scanning data input devices.

The UNM campus is wired with a 10 Gigabit redundant fiber backbone for optimal intra-campus networking needs. The CERIA building, which houses the LNO, have both fiber and copper Gigabit ethernet networking capability. Research activities at UNM enjoy OC-3 fiber connection to the Internet II via Denver that is connected directly to national Gigabit backbone infrastructures. In addition, the UNM is a full member of the National LambdaRail consortium. National LambdaRail (NLR) is a major initiative of U.S. research universities and private sector technology companies to provide a national scale infrastructure for research and experimentation in networking technologies and applications.

List of acronyms used in this proposal

AAAS – American Association for the Advancement of Science
ASM - All Scientists Meetings
AVIRIS - Airborne Visible/Infrared Imaging Spectrometer
CI – Cyberinfrastructure
ClimDB - network climate database
CUAHSI - Consortium of Universities for the Advancement of Hydrologic Science
DAS – Distributed Access Server
DOD – Department of Defense
EB – LTER Executive Board
EML – Ecological Metadata Language
ESA - Ecological Society of America
FS – Forest Service
FTE – full-time equivalent
GBIF - Global Biodiversity Information Facility
HydroDB - network hydrological database
ILTER – International Long Term Ecological Research
IM – information management
IMC - Information Management Committee
IMEXEC - Information Management Executive Committee
IndoFLUX – India Flux Network
ISO – International Standards Organization
IT - information technology
LIDAR - Light Detection and Ranging
LNO – LTER Network Office
LTER – Long Term Ecological Research
MODIS - Moderate Resolution Imaging Spectroradiometer
NAB - National Advisory Board
NASA – National Aeronautics and Space Administration
NBII - National Biological Information Infrastructure
NCAR – National Center for Atmospheric Research
NCEAS – National Center for Ecological Analysis and Synthesis
NCSA – National Center for Supercomputing Applications
NEON – National Ecological Observatory Network
NESCent - National Evolutionary Synthesis Center
NIS – Network Information System
NISAC – LTER Network Information System Advisory Committee
NOAA – National Oceanographic and Atmospheric Administration
NSF – National Science Foundation
OBFS – Organization of Biological Field Stations
OOI – Ocean Observatories Initiative
ORNL – Oak Ridge National Lab
PASTA – Provenance Aware Synthesis Tracking Architecture
PBI - Partnership for Biodiversity Informatics
RCN – Research Coordination Network
RFC - request-for-comment
SACNAS - Society for Advancement of Chicanos and Native Americans in Science
SC – LTER Science Council
SDSC – San Diego Supercomputer Center
SEEK - Science Environment for Ecological Knowledge
SOA - Service Oriented Architecture
UNM - University of New Mexico
USDA – U.S. Department of Agriculture
USGS – U.S. Geological Survey
WATERS - Water and Environmental Research Systems Network

LTER Network Executive Board

March 25, 2008

Dr. Henry L. Gholz
Program Director, LTER
Division of Environmental Biology
National Science Foundation
4201 Wilson Blvd.
Arlington, VA 22230

Dear Dr. Gholz,

As you're aware, the current LTER Network governance structure, adopted in 2006, provides that proposals to renew the Cooperative Agreement for the Network Office be developed by the Executive Director of the Office (as Principal Investigator) working with the Network's Executive Board. I'm writing to provide assurances that this did indeed happen, and that the Executive Board fully endorses the activities and scope of the present proposal.

Over the past year the Board and Executive Director have jointly refined the activities and tasks to be undertaken by the Office in the coming grant period, and jointly defined Network Office priorities as reflected in the budget. At its February 27, 2008, meeting, the Board formally and unanimously approved the approach, list of tasks, and general budget for the proposal.

The Executive Board is especially pleased to endorse new activities related to the Network's Decadal Plan. As noted in the proposal, funds are requested for preparing the network to address new ISSE-related research, including initiation of the Plan's cyberinfrastructure component. These funds represent an important resource for the continued elaboration of the Decadal Plan, for initial synthesis efforts, and for the development of site and network cyberinfrastructure that is necessary to achieve the long-term goals articulated in the plan.

I'm pleased to transmit this endorsement, and welcome questions that you or reviewers might have regarding the importance of the Office for undertaking activities critical to the success of the Network.

On behalf of the LTER Community,

G. Philip Robertson
Chair, LTER Network Science
Council and Executive Board

March 20, 2008

To whom it may concern:

We are writing to express the Information Management Committee's (IMC) support for continued and new activities related to cyberinfrastructure (CI) as described in the LNO renewal proposal. We have reviewed and discussed the sections of the renewal request that relate to the implementation of the CI strategic plan. We find that the operations as defined in the proposal provide an important base for all elements of CI development. The resources requested to provide training and assistance in technical implementation, develop tools and practices, and strengthen collaborations will enhance CI capabilities for the broader community. In addition, these requests correspond closely to the needs established by the LTER information management community to attend production meetings, participate in training and professional development, and work directly with other information managers and programmers. The proposed activities are necessary for the LNO and sites to advance CI development as a network, continue the success of the Network Information System (NIS) and manage existing and projected Network data sets (e.g., EcoTrends). Moreover, the resources requested in the renewal proposal are critical to permit progress towards achieving the CI goals established in the strategic plan. For the past twenty-five years, the IMC has worked closely with the LNO on managing extensive and complex datasets and advanced technologies, which serve as an important foundation for investigating current and future scientific questions, including but not limited to cross site synthesis analyses. The LTER Executive Board has recognized the important role of information managers and CI to support their science endeavors:

In the most recent evaluation John J Magnuson on behalf of the LTER Executive Board:

> *The Information Management Committee has been perhaps the most useful standing committee of the LTER network of sites. Your committee is also one that is greatly appreciated not only by the information managers, but by the investigators across the network. Its role will continue and be even more important as we move forward in the LTER science endeavor. Thank you for leading and making us a better program for long-term inter-site research.*

Overall, as we strive to meet the goals of the decadal CI plan, the IMC and its steering committee, the Information Management Executive Committee, strongly support the CI related sections of the LNO request. Therefore, we encourage you to approve the requests for CI and IM support made in the LNO renewal proposal.

Thank you for your time.

Respectfully,

Nicole Kaplan, IMC Co-Chairperson
Corinna Gries, IMC Co-Chairperson

March 20, 2008

Dr. Robert B. Waide
Executive Director
LTER Network Office
UNM Biology Department
MSC03 2020
1 University of New Mexico
Albuquerque, NM 87131-0001

Dear Dr. Waide,

As you know, a critical component of the Decadal Plan for LTER released in 2007 is the Strategic Plan for Cyberinfrastructure. The LTER Network Information System advisory committee (NISAC) has recently reviewed and discussed the sections of the LNO renewal request that relate to implementation of the CI strategic plan, and we find that the continuing operations defined in the proposal provide an important base for all elements of CI development in the LTER Network. Specifically, we believe that the resources requested for the LNO in the renewal section on "CI in the Decadal Plan" are critical for the continued development of the LTER Network Information System and for management of existing and projected Network data sets (e.g., ClimDB/HydroDB and EcoTrends). We also believe that the funds requested to support two key staff positions, a programmer/analyst and systems analyst, are critical to support these efforts.

In addition, NISAC finds that the resources requested for the support of product-oriented meetings, training, and working visits for site information managers will address critical needs identified by the LTER information management community. These resources will improve CI functionality at sites and enable material participation of sites in network-level CI initiatives. These investments are the first step towards achieving a fully integrated research network capable of advances in social-ecological understanding and prediction at multiple scales.

Therefore, NISAC fully endorses the requests for Cyberinfrastructure and Information Management support made in the LNO renewal proposal, and we look forward to working with LNO towards implementing the Strategic Plan for Cyberinfrastructure in the LTER Network to support the visionary scientific and educational goals identified in the LTER Decadal Plan.

Sincerely yours,

Wade M. Sheldon
NISAC Co-Chair

ORGANIZATION OF BIOLOGICAL FIELD STATIONS
JMIE/NRS UC Davis, One Shields Ave, Davis, CA 95616
Est. 1967

March 18, 2008

Dr. R. Waide
LTER Network Office
UNM Biology Department
MSC03 2020
1 University of New Mexico
Albuquerque, NM 87131-0001

Dear Dr. Waide:

The Organization of Biological Field Stations (OBFS) enthusiastically endorses the LTER Network Office renewal proposal in which LTER is planning to continue the partnership with OBFS in developing of mutually beneficial research, cyberinfrastructure development, and training activities.

The Organization of Biological Field Stations represents over 200 field stations and marine laboratories throughout both North America and overseas. Approximately 150 of our member stations are in the continental US, and 17 of the 26 current LTER sites are member stations of OBFS. These field stations and marine laboratories are recognized as a national resource for environmental and biological research and educational activities. From the outset of the LTER program in 1980 there has been a tight link between OBFS and LTER and our organization has benefited greatly from this relationship. The activities proposed in this renewal will continue to strengthen these efforts.

To demonstrate an example of this relationship I note the successful NSF Research and Coordination proposal that was led by you to institutionalize ways of linking non-LTER members of OBFS with the LTER sites. This resulted in the establishment of a position in the LTER Network Office that functions as liaison between LTER and OBFS. Bill Michener, who has held this position, has worked to improve communication among OBFS and LTER stations and labs, fostered installation of research sites, provided educational programs open to all parties and improved data management and data sharing. Among other accomplishments, the LTER-OBFS liaison has, in consultation with OBFS members, developed a series of short courses addressing data management and networking among field stations and marine labs. These have been very successful and are consistently oversubscribed.

We look forward to continuing our relationship with the LTER program and enthusiastically endorse this proposal,

Sincerely,

Jan Hodder
Associate Professor
University of Oregon
Organization of Biological Field Stations President 2006-2008

UNIVERSITY OF CALIFORNIA, SANTA BARBARA

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NATIONAL CENTER FOR ECOLOGICAL ANALYSIS AND SYNTHESIS
735 STATE STREET, SUITE 300
SANTA BARBARA, CALIFORNIA 93101-5504

Dr. Robert B. Waide
LTER Network Office
University of New Mexico
Albuquerque, NM 87131

28 March 2008

Dear Dr. Waide:

I am writing to express strong support for the LTER Network Office's renewal proposal. We at NCEAS have greatly valued our interactions with the LTER Network Office. Numerous scientists from the LTER Network Office and LTER sites have visited NCEAS in a variety of research efforts, and our institutions have productively collaborated on multiple projects over the years. With the LTER Network's prolific generation of high-quality data sets, and a strong institutional investment in sharing data and in novel collaboration to face new frontiers in ecology, our partnership has been a natural one.

In particular, scientists from the LTER Network Office and NCEAS have collaborated extensively in ecological informatics. With both of our institutions involved in data-intense research, we each are confronted with informatics challenges on a daily basis. We have developed active communication to meet these challenges in tandem. For example, key LTER Network Office personnel collaborated with NCEAS in the Knowledge Network for Biocomplexity, a national network designed to facilitate ecological and environmental research on biocomplexity (NSF DEB-0072909). This project led to other productive collaborations through the Partnership for Biodiversity Initiatives.

Notably, NCEAS and the LTER Network Office collaborated on the SEEK project (NSF 0225665, Enabling the Science Environment for Ecological Knowledge) to create cyberinfrastructure for ecological, environmental, and biodiversity research, and providing ecoinformatics education to junior faculty. New cyberinfrastructure included an integrated data grid (EarthGrid) for accessing ecological and biodiversity data and analytical tools, as well as Kepler, an open-source scientific workflow solution (http://seek.ecoinformatics.org/; http://kepler-project.org/).

Another collaborative project focused on improving access to the resources of biological field stations (NSF DBI-0129792, Research Coordination Network: Resource Discovery Initiative for Field). Together with multiple other institutions, the LNO and NCEAS worked to facilitate storage, discovery, and access to the strategic environmental information resources held at North American biological field stations. Activities included implementing the OBFS Data Registry (which now contains more than 4,200 items), developing several key OBFS databases, revamping the OBFS web site (http://www.obfs.org/), and infusing informatics and geospatial technologies into field stations and marine laboratories. This latter activity was enabled via a series of innovative two-week-long training sessions that were held annually to disseminate software tools, knowledge, and resources. More than 140 field station personnel from more than a third of the field stations representing the United States, Canada, Costa Rica, Panama, the Bahamas, and French Polynesia participated in the training.

Our partnership with the LTER Network Office remains vibrant and productive. We presently have two proposals in review with NSF, focused on issues in ecological informatics with an emphasis on improving data archiving, usability and access.

We at NCEAS highly value our collaborations with the LTER Network Office and anticipate many more exciting opportunities to work together in the future.

Sincerely,

Stephanie E. Hampton
Deputy Director, NCEAS

NCEAS

National Coordinating Office
1955 East 6th Street
Tucson, AZ 85721
Phone: (520) 626-3821
Fax: (520) 621-3816
www.usanpn.org

28 March 2008

Robert B. Waide
Executive Director
LTER Network Office
UNM Biology Department
MSC03 2020
1 University of New Mexico
Albuquerque, NM 87131-0001

I am pleased to write this letter in support of renewal of the LTER Network Office (LNO) proposal. The LNO has been an important ally of the USA-National Phenology Network (NPN) and we look forward to mutually beneficial collaborations in the future.

The USA National Phenology Network (NPN) is an emerging and exciting partnership between federal agencies, the academic community and the general public to monitor and understand the influence of phenology on the nation's resources. The goal of the NPN is to establish a continental-scale science and monitoring program focused on phenology – the periodicity of plant and animal life cycles driven by seasonal variations in climate. The NPN will capitalize on integration with other monitoring efforts including networks of locally intensive sites focused on process studies, remote sensing platforms and products, emerging technologies and data management capabilities, formal and informal educational opportunities, and a new readiness of the public to participate in investigations of natural systems on a national scale.

As brief as our history may be, the National Phenology Network values its collaborations with the LTER Network Office, enjoys working with the LNO, and is fully committed to advancing and strengthening these collaborations in the future, as well as codifying our relationship with a Memorandum of Understanding. We particularly appreciate the impressive contributions of Robert Waide. He has provided invaluable support to the NPN both as a member of the NPN Implementation Team during the formulative stages of the NPN, and subsequently as a vibrant task force working group member at subsequent annual NPN workshops.

The February 2007 Phenology Workshop is a good example of successful collaboration. This week-long workshop, produced by the Network Office, brought researchers together to define the state of phenological research across the LTER and provide recommendations to advance the integrative use of phenological data within sites, across sites, and beyond sites.

In sum, the activities of the LTER Network Office and the NPN are closely aligned, and collaboration activities will inform critical ongoing and potential future science and environmental issues that face the nation. We greatly appreciate past collaborations and look forward to continued strong collaboration between the LTER Network Office and the NPN in the future.
Sincerely,

Jake F. Weltzin
Executive Director
USA National Phenology Network

CUAHSI
universities allied for water research

March 28, 2008

Dr. Robert Waide, Executive Director
LTER Network Office
Department of Biology
University of New Mexico
Albuquerque, NM 87131-1091

Dear Dr. Waide:

I'm pleased to submit this letter of commitment affirming CUAHSI's intention to continue to work closely with the LTER Network Office on areas of mutual interest. We have appreciated the participation of staff members of the LTER Network Office in CUAHSI's activities, such as Bill Michener's service on our Hydrologic Information Standing Committee from 2005 to 2008 and Mark Servilla's agreement to serve on the same committee beginning in 2008, sharing of data from the Serviletta site's for testing the HIS data publication system, and the collaboration of Bill with Jeff Horsborough on a DataNet proposal. In addition, Corinna Gries (Arizona State University, Phoenix LTER) has been an active participant in cross-observatory discussions on data sharing. I have been pleased to participate in LTER workshops on metadata standards and in special sessions at the LTER All Scientists meeting.

I am confident that these collaborations will continue and will benefit both the LTER Network and the CUAHSI community. Best wishes for a successful review of your renewal proposal.

Sincerely,

Richard P. Hooper
President and Executive Director

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Reston, Virginia 20192

March 27, 2008

Robert B. Waide
Executive Director
LTER Network Office
UNM Biology Department
1 University of New Mexico
Albuquerque, NM 87131-0001

Dear Dr. Waide,

It is a pleasure to write in support of our continued collaboration between the U.S Geological Survey National Biological Information Infrastructure (NBII) Program and the Long Term Ecological Research Network (LTER). The NBII has been extremely pleased with the significant developments that have resulted from our joint efforts over the past 5 years and fully support their continuing over the next several years.

The USGS NBII Program sees the continued presence of a strong, sustainable LTER Network Headquarters office as paramount to the overall networks success in not just data interoperability, but also its scientific endeavors. LTER activities in the past and future through pending joint activities further supports the NBII Programs overall objective of serving as an electronic gateway to biological data and information, both textual and spatial in nature, maintained by federal, state, and local government agencies; non-government institutions; and private sector organization in the United States and around the world.

The USGS NBII Program intends to continue its support to the LTER Network office, through continuing the existing joint NBII/LTER position. Through this joint position, metadata standards, development tools, data integration, and community buy-in activities have all substantially improved. The USGS NBII intends to continue allocating up to $150K per year in support of these activities. As one can easily see, the USGS NBII Program is strongly committed to this project, through the allocation of "real" dollars and continued involvement of several staff members in complementary NBII/LTER activities.

Efforts such as this capitalize on both the tremendous research and development activities ongoing at the various the institutions across the Nation and by leveraging existing federal programs through the participation in such research endeavors. Technologies, standards, and outreach products being developed by you and your partners, are key to the NBII in meeting its program goals and objectives.

Sincerely,

Mike Frame
Director, Research & Technology

National Evolutionary Synthesis Center
2024 West Main Street, Suite A200
Durham, NC 27705
http://www.nescent.org
Ph: 919-668-4551 Fx: 919-668-9198

March 28, 2008

Dr. Robert B. Waide
Executive Director
LTER Network Office
UNM Biology Department
MSC03 2020
1 University of New Mexico
Albuquerque, NM 87131-0001

Dear Bob

NESCent would like to enthusiastically reaffirm our interest in continuing our association with the LTER Network. We have initiated a number of important collaborations that will have a major impact on our sciences' efforts towards data repository and data deposition. This collaboration is critical to NESCent's efforts to create a long term data repository for Evolutionary Biology. Thus far our collaboration has resulted in three grant proposals, in which the LTER Network and NESCent are formal collaborators. These include:

- The INTEROP proposal submitted to NSF several months ago
- NESCent's DRYAD proposal for an evolutionary Biology data repository, submitted last July and awaiting final decision and
- Your DataNet proposal for an Observation Network for Earth (DataNetONE), recently submitted.

We feel these are important efforts and look forward to a long term relationship between NESCent and the LTER Network.

With all best wishes for continued success in funding your network, I am

sincerely yours,

Kathleen Smith, Ph.D.
Professor of Biology, Duke University
Director, NESCent

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