



NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
Arlington, VA 22230

October 7, 2011

Dear Dr. Michener,

Thank you for your participation and presentation at the recent Reverse Site Visit (RSV). The RSV is an important mechanism that the NSF EPSCoR Office uses for project management and oversight, and for providing feedback and guidance to awardees. The NSF EPSCoR Office would like to complement you and your fellow team members for your professional approach to the RSV activity.

The attached report is based upon the RSV panel's review of written materials (complete proposal, review panel summary, review analysis, original award letter, RII Track-1 strategic plan, most recent annual report, budget, previous RSV report, and your responses to that panel's recommendations) provided prior to the meeting, the oral presentation made by the project team, visual aids supporting that presentation, and subsequent discussion with the team. Please review the report and share it with the appropriate individuals in your jurisdiction to develop responses and action plans that address the issues and recommendations identified in the RSV report. Please contact Denise Barnes (NSF EPSCoR, Senior Staff Associate, dbarnes@nsf.gov), if you have any questions related to the panel's report or if you need further clarification regarding the requested responses.

The NSF EPSCoR Office would like to receive your plan to address each of the RSV panel's recommendations listed at the end of the report no later than November 7, 2011. This plan should address how you will respond to each recommendation, and the timeline for doing so. Responses should be sent to Denise Barnes. Please note that your next Annual Report for the RII Track-1 award (and subsequent reports, as appropriate) should include the progress on the RSV recommendation responses and action plans.

Sincerely,
Jeanne Small
On behalf of the NSF EPSCoR Office

Reverse Site Visit (RSV) Report

NSF EPSCoR Jurisdiction: New Mexico
RII Award Number: EPS-0814387
Principal Investigator: William Michener
RII Program Solicitation: NSF-08-500
Reverse Site Visit Date: August 11,, 2011

Précis

The New Mexico EPSCoR (NM EPSCoR), at the end of its third year, has continued to make significant progress on both its major research initiatives, particularly in instrumentation, monitoring and on education and outreach.

The major research initiatives of this project focus on observation, modeling, and analysis of high-elevation hydroclimatology where most of the water resources of the region are produced and to improve the understanding of the effects of global climate change on these resources, both in quantity and quality. The extensive cyber infrastructure (CI) effort builds on the high-performance computing infrastructure in the state. Education and outreach are well integrated with research and strategically engage K-12 schools and regional universities serving minority populations.

Additional attention to diversity planning at the NM institutions (especially at the faculty level), evaluation, and broader scientific/economic impacts will pay dividends. Special award conditions have mostly been met.

The project has also taken leadership in several aspects of the Tri-State Consortium (NV, ID, and NM) particularly in CI and faculty development.

Progress to Date

Intellectual Merit

The overarching science/policy issue – understanding and forecasting the effects of climate change on water supply and sources in arid regions, as well as the socioeconomic impacts – is well targeted to issues New Mexico and the region will face in the coming decades. The emphasis on instrumentation installation in early phases of the project will provide hydroclimatological and water quality data for New Mexico comparable to other western states, which will enhance capabilities for regional analysis. The *acequias* water management associations provide a unique research setting for arid region water management. Improved, process-based snowmelt

modeling for the high elevation regions of the upper Rio Grande basin will significantly improve water resource projections and planning capabilities in the state and region. Improved system dynamics modeling of hydrology and socioeconomic impacts and feedbacks can provide an important tool for policy makers and managers.

The project as presented appears to be operating with linear/sequential program implementation rather than synthesis and adaptive implementation. It appears to be activity centered rather than stakeholders' issues focused. Overall the planning and operation may benefit from a less linear operational model and more of a multiple parallel working hypotheses approach. A mid-term correction in the Strategic Plan may be appropriate and may be easily implemented.

Broader Impacts

This project has made significant progress in the integration of teaching, training, and learning with the research dimensions. The collaboration with the New Mexico Museum of Natural History and Science has an impact on hundreds of thousands of visitors to that Museum. The various facets of the project integrate outreach to Latino and Native American students and communities at multiple levels of the education experience. The integrated character of the project is exemplified by the laboratory developed at NMHU (New Mexico Highlands University). This produces project related research while enhancing the learning experience and leads to related curricular development. This is a contribution also characterized by forethought about post-funding sustainability.

With a hiring freeze, progress on diversifying the faculty has not been possible. However, the development and adoption of a Best Practices Guide by the presidents of the participating universities adds to the potential for faculty diversification in the future.

New Mexico's EPSCoR leadership in many areas of the Tri-State Consortium, including the cyber aspects of the consortium, is an important contribution. The research foci of the project also promise significant local, regional, and societal contributions.

Progress towards goals and objectives:

1. Strategic Fidelity and Impact

The connections to State/Federal/local governance are in the Strategic Plan. However, interactions appear to have been limited to the proposal preparation effort and the major effort with the upcoming Town Hall. It is now time to demonstrate definitively the value of the observing system and modeling capability in order to seek collaboration to fully integrate government and private agencies into continuing implementation and integration/synthesis of observations, models and policy.

The planned Town Hall is critical. Synthesis/integration working groups will result from the Town Hall meeting but it may be necessary to have pre-town-hall

working groups to ensure an agenda that serves the audience and demonstrates the latest and/or most significant outcomes of the project.

2. Value Added

The New Mexico EPSCoR project has created a well-monitored climate and hydrology network where one did not previously exist in sufficient detail to perform good science. The focus in the first few years was largely on instrument deployment and data streams are just now becoming viable.

Additional SNOTEL (SNOWpack TELEmetry) sites and meteorological stations have been established to enhance climate observation capacity. Several of these sites have been established on sovereign ground on the Navajo nation. These data collectors will transmit data to the National Resources Conservation Service under a memorandum of understanding. This capacity building through instrumentation fills crucial gaps in the climate data collection in New Mexico.

These new data resources combine with model development for snowmelt in sub-basins of the Rio Grande. New Mexico is a particularly difficult climate to model due to the bimodal precipitation regime with winter snowfall and summer monsoon precipitation. Climate models do not perform particularly well in this region, so these models should help considerably. A second runoff model (SLURP) is being developed and may be integrated into a hydro-economic model in the future. Much of the modeling is being done through EPSCoR funded graduate students and post-docs. A data portal is being developed to disseminate the data.

Another key data collection effort relates to water chemistry and water quality. Added sensors and monitors on tributary streams to the Rio Grande will help provide important detail on local and regional contributions to water chemistry. For example, the team presented data on arsenic levels that demonstrated diurnal and seasonal variations. Such data were not available before, hence the EPSCoR funding is providing new opportunities to understand the local environment. A mobile laboratory is being developed to provide additional monitoring capacity in areas where anomalies are noted and additional data needs to be collected. Also, an important addition has been the building of an aquatic chemistry research lab at New Mexico Highlands University. This lab provides an important resource to the state and should provide stronger infrastructure for New Mexico researchers to compete for future grants.

Finally, an important component to the New Mexico EPSCoR project is the focus on *acequias* water management systems. This interdisciplinary research effort involves stakeholders in the research as questions are being raised. The topic also became a NSF-funded CNH project recently. This project combines physical and socio-economic sciences.

The institutional benefits of the EPSCoR funding have not been limited to the main research institutions. Several other New Mexico universities have been brought into the project in numerous ways. The NM EPSCoR team has been a leader in the Tri-State Consortium. Through this working consortium, specific innovation working groups have been established around common issues. The New Mexico EPSCoR office sponsored a highly attended NSF day where many potential researchers learned more about NSF.

A key component of the EPSCoR effort has been junior faculty development and training. The project held workshops for junior faculty that proved highly valued and beneficial, especially in fostering teamwork. This has spread to the training of teachers through a second professional development program, and the training of local teachers in working with the monitoring equipment in their area. This spreads to the students and helps develop a stronger STEM pipeline.

Another interesting effort is the outreach through the New Mexico Museum of Natural History and Science where the project funded development of a climate change exhibit. This exhibit reaches approximately 250,000 people each year.

Finally, a commendable program in the New Mexico EPSCoR is the Undergraduate Research Opportunity Program (UROP). This month-long program involves undergraduate students in research project related to the climate change and water theme.

3. Cyberinfrastructure

This project has shown significant progress on cyberinfrastructure. The presented impact for scalable computing infrastructure is impressive. The strengths in the project for CI and data come across clearly using current best practices in data management, and adoption of open standards for their core services. They are also using emerging best practices for maximizing the opportunities for data use through CI-facilitated collaborations between researchers early in the data collection pipeline. Since this is not a scalable solution but a means to an end, the required culture shift and education will be critical. The data portal and the infrastructure for data ingest, and management especially for the more complex acequias data policy development and data distribution is very good. Impact is evident in the coordination with workforce development and introduction of data for remedial education.

- a. Support for Research and Education - Some of the complex infrastructure and interfaces will need to be adapted for non-expert use. As the examination of the evaluation metrics progresses in the coming period, the team is encouraged to assess how CI and data provision is providing value to the project participants and stakeholders. There is very good provision for web-based collaboration support for project participants.

- b. Data exchange – CI is providing good data dissemination and rich service capabilities via the data portal and is encouraged to document the benefits of data exchange. Additional data sources would clearly be a desirable direction. The move to integration with jurisdictional libraries and their institutional repositories is strongly encouraged.
- c. Alignment with other CI work in jurisdiction – there is excellent leverage and alignment with good jurisdiction network integration. The direction to expand further into state agencies and organizations especially around water management and policy is good. Further, there is good coordination/alignment with two major national programs; DataONE and CZO.

4. Dissemination and Communication

The partners of the project have an effective infrastructure for information sharing, which predates the current project. The use of CI is strong; the data are not yet available through the portal, which must be rectified.

The recommendation of the previous RSV panel that materials be produced in Spanish as well as English has been followed. The use of the Navajo oral tradition also reflects a sophistication about best ways to disseminate materials to local communities. A most notable aspect of the dissemination of project products is the collaboration with the New Mexico Museum of Natural History and Science, which appears to bring to the visitors the science of this project in a particularly engaging way.

5. Outreach Strategy and Diversity Plan

The project has been quite successful in its outreach to the education community at many levels. Work with the well-established Northern New Mexico network trains teachers in 27 schools.

The seed grant program for small research projects at tribal colleges and other two and four-year institutions is an effective way of involving large proportions of Native American and Latino students and their teachers.

The Undergraduate Research program appears to be an important route into further education, although systematic follow up is not yet occurring.

Because of the hiring freeze, the participating universities have not added new faculty. The multi-day workshop for some junior faculty is a strong feature of the project. Post-award funding of this workshop will be particularly important to recruiting a more diverse set of hires expected to result when the current hiring freeze ends. It seems that currently there is no significant work to improve the climates for faculty diversity at the participating campuses.

The Presidents of New Mexico's institutions of higher learning have adopted a set of best practices for diversity, addressing various bases of difference, and an

active diversity focused tri state working group has been an important source of ideas and recommendations.

6. Evaluation and Assessment

The program has three levels of evaluation: 1) External Advisory Board; 2) AAAS advisory group; and 3) External Evaluator. Combined, this plan provides the program broad to specific feedback, and suggestions appear to have contributed to the growth of the program. However, the nature of the assessment may be limiting the kinds of adjustments that would achieve benchmarks and goals for the Impact Areas.

An important assessment component is the evaluation done by the external evaluator. Based upon the report, this evaluation emphasizes qualitative data collection involving surveys and interviews. While an important component of a comprehensive evaluation plan, assessing activities in terms of participants ratings does not adequately address the real test of value, which would be measured by quantitative outcomes from participants over time. This longitudinal data collection is critical to knowing what impact the activity/initiative has had. In addition, longitudinal data provides key information on the efficacy of an activity and how it could be changed to be maximally effective. During the presentation when asked if longitudinal data collection was being done the PI responded that it was now occurring. Finally, the program has not collected baseline data for its quantitative outcomes, which will present challenges when interpreting impact of the EPSCoR funding.

In light of the above, the panel suggests that the program create a refined assessment plan that focuses on outcomes to ascertain if activities/initiatives are contributing to meeting Impact Area goals. This plan should cover all Impact Areas, including Research.

Another observation was that the program does not perform Internal Assessment, which places the burden of providing the program feedback and guidance on the shoulders of the External Evaluator. An internal assessment component would provide the program rapid turnaround on getting feedback for on-going refinement of initiatives.

7. Sustainability Plan

NM EPSCoR researchers have established collaborations and partnerships that have the potential to sustain many aspects of the research beyond EPSCoR funding. For example, funding of the aquatic chemistry lab at NMHU has already increased the research capacity at that institution. Additionally the project has forged research collaborations with researchers at UNM and UMT and is also providing training for graduate and undergraduate students in the area of water analysis. Research collaborations with Professor Martinez (NMHU) and his research group have expanded beyond NM to colleagues in other regions.

A long-term partnership for sustainability has already been developed with NRCS while others such as with Taos Ski Valley and the Acequias Association appear to be at negotiating stages. While there are many worthwhile collaborative efforts with federal, state and private agencies, it is not always clear the extent to which formal arrangements for sustainability beyond EPSCoR and/or other NSF funding has been developed.

The Junior Faculty Leadership Workshop is an innovative use of EPSCoR funding and is very valuable for faculty development. This workshop provides junior faculty with information on the nuances of proposal writing as well as networking opportunities. The expansion of this to include faculty in the Tri-State jurisdiction is beneficial and might have the potential to sustain this service beyond EPSCoR funding.

The AAAS review has very good recommendations for the sustainability of the EPSCoR activities and it is expected that the program is implementing them.

8. Management Plan

The overall management plan appears appropriate and multi-faceted. In addition to the State Governing Committee, which has representation from all major academic institutions and collaborating agencies, the Management leadership team has broad representation that includes Tribal Colleges and Hispanic serving institutions. Regular communication schedules of the different committees are in place: the State Governing Committee met twice during year 3 and has also met with the Tri-State counterparts. NM EPSCoR has planned a Town Hall meeting to "connect" research and policy involving multiple stakeholders. It is unclear if the PD is aware of the potential benefits as well as risks that this type of Town Hall forum could produce. Careful planning regarding expected outcomes, types of information to be presented, engagement levels and feedback are expected. Appropriate committees/teams need to work out effective strategies and logistics of this Town Hall meeting.

9. Fulfillment of Special Grant Conditions

As with the "Progress Relative to Strategic Plan" discussed in the next section, the panel suggests that the grantee provide specific responses to these questions so that the degree of fulfillment can be determined.

- a. Inclusion in the Strategic Plan of a revised cyber-infrastructure. This is discussed in section 3 of this report.
- b. Address the socio-economic impacts of basin-scale hydrologic changes. The project has started to address the socio-economic issues.
- c. Faculty diversity. This is addressed in section 5 of this report.
- d. Enhance research and collaboration with regional and tribal colleges. The project has made significant strides in this regard.

10. Progress Relative to Strategic Plan

The project Strategic Plan, as an evolving document, should be updated in relation to progress in each Impact Area (IA). Further as progress is made, a project should change relevant benchmarks associated with project goals and objectives in the Strategic Plan updates.

The project team should, for the next annual report, specifically report on the benchmarks for each IA. The information to be provided should be a summary of what was done to achieve the benchmark and in what way(s) this accomplishment contributed to reaching the IA's goals. If a benchmark has been modified or deleted, the project should briefly explain why and indicate what the implications of doing so have been. For changing benchmarks (add/ delete/ change/ reorder), a brief description on the reason and project impacts should be included.

Feedback to Project Team

Summary

How effective has the leadership team been in addressing barriers and challenges?

The leadership team is very aware of the barriers and challenges facing the project. A particular challenge is the hiring freeze in the State that has prevented new faculty hires that will promote diversity and also cover/extend some expertise areas. However, the other two states in the Tri-state consortium have been able to circumvent this challenge. A discussion with the other EPSCoR groups should be done to explore other avenues to address this challenge.

Is there sufficient integration of research and education?

There is significant integration of the research and education, both at the major universities but also at the other education institutions in the state. Providing equipment to educational institutions not only has increased the educational goal but also their research capabilities, e.g. NHMS as mentioned before.

Fully integrated portals with real-time streaming of data will enable educational outreach as well as campaign sampling and/or management decisions. This will also actively engage stakeholders in learning. Real time data streaming also informs with regard to instrument performance and leads to fewer data gaps and creates opportunity for citizen science sample collection.

Appropriateness Investments to Increase Research Capacity

The investments in instrumentation to cover information gaps and improve research capacity are very appropriate and on-target with the Strategic Plan.

Specific Recommendations

1. Hold pre-town hall project coordination meetings to ensure an agenda that serves the audience and demonstrates the to-date products of the project.
2. The panel advises that the universities need to do more with their faculties to enhance the climate for diversity. Once faculty are recruited, activity for retention involves development of mentoring programs (including training for mentors) and attention to faculty development of faculty members from traditional groups.
3. In their annual reports they should state a clear statement of the degree of completion on the benchmarks Strategic plan reporting.
4. Establish and utilize during the last two years of the project a parallel interactive working relationship with partners and stakeholders.
5. The program should create a refined assessment plan that focuses on outcomes to ascertain if activities/initiatives are contributing to meeting Impact Area goals. This plan should cover all Impact Areas, including Research.
6. The project should document the benefits of data exchange. Additional data sources would clearly be a desirable direction. The move to integration with jurisdictional libraries and their institutional repositories is strongly encouraged.
7. The Strategic Plan should be updated to address the above recommendations; including modifications to the linear operation approach to facilitate better interdisciplinary synthesis.