# External Advisory Board Review and Guidance To New Mexico EPSCoR RII3: Climate Change Impacts on New Mexico's Mountain Sources of Water

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Final Report – January 2011

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**Introduction:**

This is the final report of the findings and recommendations of the External Advisory Board (EAB), convened by the New Mexico EPSCoR leadership on October 25, 2010. The EAB was asked to give advice, insight, and guidance on the RII3, which just completed year two of a five year program, identify opportunities, and address challenges.

The overarching goal of the New Mexico EPSCoR RII3 is to enhance research competitiveness through the acquisition of critical climate change research infrastructure and cyberinfrastructure, and through strategic investment in human infrastructure. A second goal is to address a critical state problem of worldwide significance – understanding and forecasting the effects of climate change on water supply and sources in arid regions. The RII3 goals address two major issues critical to New Mexico's prosperity: (1) understanding climate changes that alter processes associated with water supply, critical to sustaining the economy and quality of life and (2) effectively engaging the diverse population (~ 40% Caucasian, 40% Hispanic and 20% Native American) in STEM career options.

**Overview:**

The EAB highly commends the New Mexico EPSCoR RII-3 team and specifically the team leaders, Bill Michener and Mary Jo Daniel, for excellent progress they have made in the ten months since the EAB last met. Year one was spent primarily on putting physical infrastructure in place. Year two has focused very successfully on engaging faculty and students in research and education programs. The review demonstrated very significant progress towards all major goals and objectives of the project since last year. The EAB very much appreciated the extensive involvement of research faculty in the review. They clearly demonstrated strong evidence of progress in collaboration and coordination within EPSCoR. The Integrated Working Groups (IGW) and the variety of EPSCoR meetings like the "All Hands Meeting" seem to have created a real sense of community, which was the key element that seemed lacking when the program was reviewed in January 2010. The IWG initiative has been used very successfully to help faculty and students to think strategically about their research and its implications to society. The EAB was impressed by the work done integrating the research with the socio-economic dynamics of local populations. The Socio-Economic model did show a more global and interdisciplinary look at EPSCoR, and that kind of perspective is quite important. Future work should expand this effort into education and outreach. The undergraduate education and outreach programs (UROP) are strong and continue to grow in value. Public Outreach programming is doing more than originally anticipated. This is most positive and these efforts (especially the museum exhibit) should be supported by, and connected with, the project as a whole. The faculty leadership workshop program provides high value to young faculty and should be showcased as a "best practice". EPSCoR has been serving NM well and has taken on the role of "filling gaps" in the existing infrastructure by providing equipment, human resources, and other means to expand projects and programs already in place.

The EAB has four recommendations for the Program leadership:

1. As evidenced in the reviews, very significant progress has occurred in the research programs, but the driving research questions in a number of the programs were not clearly articulated and their relationship to the key climate change/water issues in the Southwest region were not well defined. The EAB recommends further work by the leadership team in this area. This will enhance both the scientific merit of the program and the value by the external stakeholders.

As one example, the water quality study in Valles Caldera has many clear strengths with respect to developing collaborative partnerships, deploying cutting edge technologies for environmental monitoring, engaging students, and establishing a program that has substantial potential for public outreach, given its location. However, research questions tend to be basic, descriptive, and more academic in their focus. That is, there appears to be a missed opportunity by not pursuing questions related to climate-driven water quality problems that inevitably emerge in an arid, warming, water-stressed region (e.g., salinization, increased contamination due to water limitation).

2. As the program progresses into year three, the EAB recommends that the leadership articulate and formalize a sustainability plan. Many of the programs appear to have a natural sustainability pathway after RII-3 is complete, but there may be some significant gap areas. The formalization of a plan will allow the leadership to more clearly see gaps and enhance the long term impact of RII-3.

3. The Climate Change, water chemistry and hydrology themes of RII-3 have a lot of common elements to other programs across the nation and world. The EAB recommends that the program leaders and researchers pay more attention to connectivity to external research efforts, particularly in the sensor area and in the environmental data storage and analyses areas.

Some specific examples in this area include:

The review committee suggests that the cyberinfrastructure (CI) component of the New Mexico EPSCoR RII3 program interact more with existing CI programs in New Mexico. We recommend that you not "reinvent the wheel" by building a cyberinfrastructure program from the ground up. Rather, we suggest that you utilize and build on the strong CI programs that already exist in New Mexico. The advantage of partnering with these existing programs is that (1) cost savings by using existing CI programs and software; (2) the cost savings can be utilized to support data managers who can work directly with researchers to input the data that the researchers generate into the existing CI systems; and (3) The New Mexico EPSCoR RII3 data sets will be exposed to a much larger population of users. This same principle of not reinventing the wheel can also be applied to ongoing efforts to develop new sensor devices.

Furthermore, the temporally and spatially dense monitoring afforded by the proposed sensor development that is ongoing with the New Mexico EPSCoR RII3 will require new

cyberinfrastructure capabilities, methodologies, middleware, deployed infrastructure and a community of multidisciplinary scientists and engineers equipped to pose newly-enabled scientific questions. We urge you to partner with the organizations below to take advantage of their increasing strengths to provide CI capabilities for the sensor networks that you are developing.

The NSF-funded Long Term Ecological Research (LTER) program has invested heavily on existing strengths and partnerships in building new cyberinfrastructure. These strengths include the availability of existing long-term data and Network-level derived data products, use of community standards for metadata, policies for sharing data, broad eco-informatics expertise, active informatics research, and the LTER Network Office serving as the focal point for development efforts. Existing partnerships with the National Center for Ecological Analysis and Synthesis (NCEAS), the San Diego Supercomputer Center (SDSC), and the National Center for Supercomputer Applications (NCSA) are collaborative strengths, as are new and growing associations with emerging observatory platforms such as the National Ecological Observatory Network (NEON), the Ocean Observatory Initiative (OOI), and the Water and Environmental Research Systems (WATERS) Network. The LTER Network Office is based at the University of New Mexico in Albuquerque. Partnering with the LTER CI program is convenient and provides leverage for the New Mexico EPSCoR RII3 CI program. These groups will also be sources of information regarding efforts to develop new sensor hardware- and similarly may be interested in hardware being developed by the New Mexico EPSCoR group. The Center for Embedded Network Sensing (CENS) is an additional organization that develops wireless sensors and sensor network technologies for environmental monitoring.

The mission of the NSF-funded Data Observation Network for Earth (DataONE) is to be the foundation of new innovative environmental science through a distributed framework and sustainable cyberinfrastructure that meets the needs of science and society for open, persistent, robust, and secure access to well-described and easily discovered Earth observational data. The PI is Bill Michner. DataONE is also based in Albuquerque New Mexico. As with the LTER network office, partnering with the ongoing DataONE program is convenient and provides leverage for the New Mexico EPSCoR RII3 CI program.

4. It is still not clear "What is EPSCoR" and where it sits as an initiative unto itself versus where it sits as a means for leveraging other projects. There is no question that EPSCoR provides a means to integrate multiple projects and serves as a systems organizer; but, it would be useful for both EPSCoR and NSF to see how EPSCoR both fits into and serves the "big picture." For example, what would be happening without EPSCoR? Why is EPSCoR necessary to NM's progress? Answers to these questions would be useful toward building a case for the next proposal.

In summary, the EAB highly commends the New Mexico Leadership for their progress in year two of the program and looks forward to continued growth of the overall program and progress in the four recommended areas. Relative to topics for the next EAB meeting, the EAB would very much like to connect with the leaders of RII3 institutions beyond UNM, NM Tech and

NMSU that are collaborating on education and outreach activities. Ideally some of these institutional leaders might join in person for an EAB meeting, but teleconferencing would also work. The purpose would be to give these institutions an opportunity to report on the impact of NM EPSCoR activities on their campuses from their perspective, and to enable them to bring any questions or concerns directly to the EAB. These institutions include, but are not necessarily limited to, Diné College, Navajo Tech, New Mexico Highlands University, WNMU, ENMU, UNM Gallup, Santa Fé Community College, and San Juan College.