5550 W. Flamingo Road, Suite A2, Las Vegas, Nevada 89103
Phone (702) 522-7070

To: Jim Coleman, Chair; Michael Campana; Fred Choobineh; Jeff Gray; Malcolm Hughes; Ruby Leung; Young-Doo Wang; Mike McCaffrey

From: Gayle Dana, Project Director, Nevada NSF EPSCoR Program
Nick Lancaster, Tom Piechota, and Scott Mensing, Nevada NSF EPSCoR Climate Change Project Co-PI's

Re: Responses to ERTAB Final Report from the site visit of the Nevada NSF EPSCoR External Research and Technical Advisory Board (ERTAB), January 31, 2011

Date: May 13, 2011

The External Research and Technical Advisory Board (ERTAB) conducted a site visit and meeting at the Desert Research Institute in Reno, Nevada on January 31, 2011 in order to review the progress to date on Nevada's NSF EPSCoR project, "Nevada Infrastructure for Climate Change Science, Education and Outreach." The ERTAB submitted a report of their visit and recommendations for the project.

The Principal Investigators of the Nevada NSF EPSCoR Climate Change Program very much appreciate the valuable feedback and recommendations of the ERTAB. We have responded to each recommendation with specific strategies on how we plan to incorporate these recommendations. The responses are embedded after each recommendation in the ERTAB's Final Report dated March 6, 2011. If after reviewing our responses, the ERTAB has any concerns about our approaches, please do not hesitate to contact Gayle Dana (775-674-7538; Gayle.Dana@dri.edu).

To: Gayle Dana, Director, Nevada NSF EPSCoR Program

From: Fred Choobineh; Jim Coleman(Chair); Jeff Gray; Malcolm Hughes; Ruby Leung; Mark McCaffrey; Young-Doo Wang

Re: Comments from the site visit of the Nevada NSF EPSCoR External Research and Technical Advisory Board (ERTAB), January 31, 2011

Date: March 6, 2011

The Nevada NSF EPSCoR External Research and Technical Advisory Board (ERTAB) conducted a site visit and meeting at the University of Nevada, Reno on January 31, 2011 in order to review the progress to date on Nevada's NSF EPSCoR cooperative agreement, "Nevada Infrastructure for Climate Change Science, Education and Outreach." ERTAB members present at the review meeting included Dr. Fred Choobineh, Dr. James Coleman (Chair), Dr. Malcolm Hughes, Dr. Ruby Leung, Mark McCaffery and Dr. Young-Doo Wang. Dr. Michael Campana and Dr. Jeff Gray were unable to make the meeting, but Dr. Gray provided significant input into this draft. The agenda of the meeting consisted of presentations by the Nevada team on their EPSCoR program, including detailed reports of the progress made to date in the major focus areas of climate, water, ecology, cyberinfrastructure, policy and outreach, and education. ERTAB members were also given a virtual tour using the web of the transect infrastructure and were shown the progress made to date on the data portal.

The focus of this 2011 ERTAB report is a bit different than in our previous years. These comments are meant as suggestions to the Nevada team on how they can take maximum advantage of the time left in the cooperative agreement, as opposed to more detailed guidance on specific programs. The program has been reviewed numerous times in its first two years and the group has responded very well to the previous comments. Yet, the preparation for these numerous reviews, and the detailed responses needed to them, has taken a great deal of effort from the team.

Overall, the project, which is roughly half way through it's five year project period, is making excellent progress. ERTAB members were very impressed with the infrastructure that the Nevada team has put in place to date and with the progress made on the transects, climate modeling and data portal. The Nevada team has continued to conduct self-evaluations and to adjust the project as they learn. The re-direction of funds into the two new Interdisciplinary Science Projects (ISPs) is a good example of how they have evolved the program to respond to both external reviews and their own experience as the project matures.

An overarching point that the ERTAB members wanted to make is that a key to the sustainability of Nevada's project will be demonstrating the utility of the infrastructure in terms of not only cutting-edge research, but climate products and services with clear social impacts. The team needs to more actively broaden their focus to include products and services.

ERTAB members also felt that the tri-state project (that took advantage of additional EPSCoR funding) has greatly complemented this project. We were also impressed that Nevada took the lead in generating the dynamically downscaled climate scenarios for the western U.S. to focus the research in the three states.

ERTAB members offer the following points for the Nevada team to consider as mechanisms to help ensure that the project maximizes its potential over its last 2.5 years.

- The Nevada team needs to develop a sustainability plan. ERTAB members urge the team to continue to give serious attention to sustaining the programs they have developed after the fifth year. Looking in from the outside, we see that the Nevada team is close to completing the establishment of some truly world-class infrastructure in the transects, the modeling and the data portal. A sustainability plan is needed both so that Nevada can get the deserved scientific and institutional payoff for their efforts, and so that the broader scientific community can join Nevada in making best use of this infrastructure on a sustained basis. If sustained, this infrastructure will surely put Nevada on the map so far as these fields of science are concerned, just as, for example, facilities such as EcoCELLS have. We further urge the Nevada System of Higher Education to provide strong institutional leadership in identifying and acquiring the funds to sustain the transects, modeling and data portal. These are unique and significant scientific and educational assets. A wide range of agencies and programs are likely to have interest in sustaining these capacities. These include the LTER (Long Term Ecological Research network) and NEON (The National Ecological Observatory Network), the National Critical Zone Observatory Program (CZO) all funded by NSF, as well as NASA, USGS, NOAA (including climate services), other Federal entities, and foundations. NSHE federal relations officers should make sure that Nevada has a strategic effort in place to work with these various agencies to obtain sustainable funding. We also feel that this infrastructure should be a priority in fundraising/development efforts of Nevada's research institutions.

  Response: The Project Director, Gayle Dana, will take the lead in developing a Sustainability Plan. Plan development will involve forming a working group that will include key project members as well as NSHE institutional leads (e.g., VPRs), and NSHE federal relations officers. A

business plan would be integral to the sustainability plan. This effort will begin in Spring 2011 and completed by August 1, 2011.

- The sustainability plan must be scientifically exciting and credible. The Nevada team needs to think carefully about how they can use the final ISPs to demonstrate the value of the transects, modeling and data portal in a manner that builds confidence in partners, both those who could become partners in their use, and those who could provide the necessary resources. This should be the major function of the ISPs and their direction, structure and reporting should all serve this need. The ERTAB urges Nevada to take another look at both ISPs, but especially ISP #2 in this light. At this stage in the project, it is vital that the ISPs truly demonstrate the value of transects, data portal, real time data, etc. in an integrated fashion. This is essential so that the scientific colleagues from whom mail and panel reviews will be sought on any proposals to sustain and use the infrastructure will be both excited by its possibilities and confident that it will deliver as needed. Narrowing the projects to meet a more focused interest of the particular investigators might not generate the broader support that is needed for sustainability.

  Response: The leads of the ISP's are taking these comments into consideration as they continue to shape the two projects. In particular, the following changes have been made to incorporate the ERTAB's suggestions:

  - For the Urban Water Vulnerability ISP, two water agencies (Southern Nevada Water Authority, and Truckee Meadows Water Authority) are working with the project team to develop a scope of work that aligns with their interests in providing climate services. This is meant to build trust with key stakeholders and demonstrate the value of providing climate services to water utilities.
  - For the Ecohydrology ISP we will continue to revise the specific questions being asked to ensure that each researcher that utilizes sensors on the transects can articulate how their work links with the other questions being addressed. In trying to utilize as many different sensors on the transect as possible, we should help demonstrate the broad utility of the transects. The project needs to be sufficiently specific to answer relevant questions and we do need to work within the areas of expertise of our team, but at the same time better identifying how the different pieces overlap to show the larger possibilities. We appreciate the comment concerning using the spatial data of the transects to test against the PRISM model and thus improve such models for climate data. We have refocused some of our resources to support this goal, and several researchers on the team have already pursued some additional funding options to support students who can assist with this work.

- One mechanism that the Nevada team could use to understand what foci

might drive the scientific community to use and support the new infrastructure is to host a national or international workshop that would draw key scientists and sponsors together. ERTAB recommends that Nevada consider seeking funding from NSF EPSCoR to host a workshop specifically aimed at engaging the broader scientific community in understanding how the scientific community can maximally take advantage of the transects and the data portal. This would include engaging the broader scientific community in the value of having each transect station with wireless communication- ERTAB members felt that the wireless capacity gives the transects enormous potential to act as a "spine" allowing researchers from across the world to leverage the existing infrastructure.

Response: We think a workshop is an excellent idea and we are pursuing several different avenues, all of which are in the very early stages of discussion:

- There is interest in the NSF EPSCoR Community for putting on a workshop on environmental sensors, which could be used as a vehicle to accomplish the ERTAB suggestion on the transects. The workshop, if successful would be funded by NSF EPSCoR. Interested Project Directors from EPSCoR states will be discussing this workshop idea via a teleconference at the end of April 2011, with further discussions to take place at the 2011 Project Director's Meeting in Washington DC in May.
- We will explore convening a sensor network session at the 2012 Tri-State Consortium Meeting where national experts would be brought in.
- Work closely with Mountain Climate Group (Connie Millar) that meets alternately with PACLIM and try to bring together some of these folks in a workshop the day before or after the regular meeting, where we brainstorm projects from the live data and put together a team to develop a proposal that broadens our user group.
- The Policy, Decision Making and Outreach Component will host a conference in year 5, so it may be possible to develop a linkage here. This conference will focus on social science and climate change, but perhaps there could be synergies.

- The sustainability plan also needs to be accompanied by a business plan. Such a business plan should lay out the revenues needed to sustain the expenses associated with the effort over time. This plan should include a strategy for generating revenues from services in addition to research support and philanthropy. Public and private sponsors that might wish to support the sustainability of this infrastructure will want to see that Nevada has thought clearly about the financial model that can lead to sustainability.

  Response: A business plan will be integral to the sustainability plan.

- An example strategy for generating revenue from the data portal may emerge from recent national interest in the need to manage data across

many scientific disciplines. For example, beginning in 2011, the NSF requires projects to provide a detailed data dissemination plan. Most investigators do not have experience in developing and managing the cyberinfrastructure needs for a robust data dissemination plan. A more generalized data portal that can adapt to different dissemination needs across disparate scientific interests could be positioned as a valuable service to the scientific community, and serve as a potential revenue source. In addition to the NSF requirement, there is a growing realization that future scientific breakthroughs will need to discover links across different data sources of similar interest, rather than treating each effort as a silo (see *Chronicle of Higher Education*, "Dumped On by Data: Scientists Say a Deluge Is Drowning Research," February 10, 2011).

Response: The hardware and software developed by the cyberinfrastructure component have been architected to serve the immediate needs of this project, as well as the long-term needs of future projects. Specifically, the data systems are designed to incorporate any geospatial data, allowing a large number of future project data to be easily added to the existing systems. Further, the process of acquiring data has been compartmentalized into a layered model, allowing manufacturer hardware and software components to be utilized to speed the acquisition of data.

The web portal currently under development will be a multi-faceted point of dissemination for collected data. The generalized underlying data systems will allow data selection via the portal for any scientific or public interest, including selection by project and information type, for example. Further, the portal will allow data consumption (via web services and web pages) and visualization (via web pages) in various ways to suit the needs of various researchers and members of the public.

The NSF EPSCoR Track II project activities are playing a significant role in both developing and testing this broad functionality. Data sharing and metadata exchange activities will provide an exercise in making data available to various audiences. Specifically, the need to make hydrological information – a subset of the data collected as a part of this project – available to the CUAHSI system will illustrate the broad applicability of our data systems and web portal services.

Additionally, The GIS and Remote Sensing Laboratory at UNLV (partially supported by NSF EPSCoR) is already establishing data services for key stakeholders. For instance, the laboroatory is developing a Solar Portal for the City of Las Vegas so the community solar resources can be highlighted and the public can be educated about these investments.

- The Tri-State program can also help develop the sustainability of the

program by potentially conducting a synthesis from the three locations -- Idaho, Nevada, New Mexico. It is noted that each State has an extensive network of measurement sites dedicated to the study of ecological and hydrological processes. The Team should consider a synthesis study to compare lessons learned from the ecological and hydrological measurements made across the three EPSCoR regions under the very different environmental conditions of the Pacific Northwest, Intermountain West, and semi-arid Southwest. This could potentially lead to a significant publication.

Response: The Project Director will discuss this idea with the leadership team of the Tri-State Consortium.

- The EPSCoR team should consider forming a network of the measurement infrastructures for the tri-state collaboration to motivate the need to understand and monitor ecological and hydrological changes across a wide range of environments represented by Idaho, Nevada, and New Mexico. This could attract funding to sustain the transects for some broader science questions. The synthesis study discussed above can help formulate a white paper motivating the need for continued support to maintain the measurement capabilities.

  Response: The Project Director will discuss this idea with the leadership team of the Tri-State Consortium.

- ERTAB members believe the Nevada team needs to put greater emphasis on developing products and services in addition to the science goals. Sustainability will be driven ultimately to a large extent by how the science serves society in measurable ways, not how pure the science research is. As the de facto (if fledgling) Great Basin Climate Service provider, the project should actively seek partnerships and engagement with federal and state agencies (including all agencies in the US Global Change Research Program, such as DOE, DOD, DOI, Dept. of Commerce, EPA, etc.) education institutions, and other public and private stakeholders, including weathercasters, recreationists, environmentalists. This will likely help build community and capacity and support the long-term sustainability of the project by demonstrating the partnerships and benefits of the infrastructure. The above mentioned workshop can help engage a broad community of internal and external partners and potential supporters.

  Response: We think that the ERTAB comment is on target here. We have had preliminary discussions about products (and how to market them) with the Nevada Small Business Development Center. We will include this specifically as part of the Sustainability Plan.

  To do this effectively with the agency groups, we need to know who to talk with, have a good presentation to make, and begin having these meetings.

We might need muscle from our administrations, e.g., some entry through the VPR offices. One of the goals of EcoHydrology ISP is to have a field day with land agency people at the transects (maybe one in the north and another in the south) to get their field personnel involved in the potential of the transects for research. We have had many discussions about trying to engage stakeholders at the state level but ultimately the time commitment for doing this has held back progress on this endeavor.

Additionally, the Policy Component is working with energy and water purveyors this summer to help our project team understand the kind of outputs they need and partnerships that could be fruitful.

- The ERTAB members encourage the Nevada team to engage the broader community and evaluate user needs in order to create a data portal site that is geared for the needs of the users. By casting a big net through marketing and outreach to solicit potential users' input, the project will engage the broad science research stakeholder communities. This will provide valuable feedback on the ISPs and assist in developing appropriate products and services, as well as help in iterating and improving the portal site. Moreover, it will contribute to building the user community and its capacity to use the science and services. Usability and evaluation metrics will provide evidence of user needs for future proposals. Ideally, evaluation of user needs and experience could include capturing information on how data and other artifacts are or could be used, modified, enhanced.

  Response: This will be accomplished in part through the development of the business and sustainability plan.

  The cyberinfrastructure component frequently communicates with project members and components for various purposes. This communication focuses mostly on soliciting feedback and suggestions relating to the needs of the component and how those needs are or are not met by cyberinfrastructure systems. In addition, we have asked other project components to provide component-specific content ("artifacts") for the data portal. As components provide both feedback and the content they wish to be handled by CI systems, their pending and existing information and needs are re-examined.

  The CI component has attempted to use surveys to elicit requirements from component members and stakeholders to determine their specific requirements. While the response level was quite low at the beginning of the project, we intend to issue a new round of surveys once the portal nears public release and after that release. The establishment of points of contact within each component – as well as with Tri-state collaborators – allows the CI component to easily remain in contact with appropriate, informed stakeholders to ensure that their needs are understood and met.

- The data portal site, while clearly still in development has tremendous potential to engage a broad community of users. The data portal site could be more graphically rich, with the inclusion of maps, videos, thumbnails of webcams and perhaps graphic summary of real-time data. The library—which appears to be mainly a laundry list of other websites which are of modest value, could be enhanced with thumbnails or snapshots of some of the linked projects.

  Response: Significant graphical and styling changes are slated for the web portal in the coming months. The alpha and first beta version of the web portal were designed to host simple, prospective content, while collecting content from components and encouraging them to provide content for the portions of the portal that relate to them. As a result, little time was spent styling that information until a great deal of the collection process was complete.

  The second beta version of the portal, having aggregated information from components that they would like displayed, will better organize and present this information. This reorganization will entail redistributing information and adjusting the hierarchy of the portal to make the information most easily accessible to various audiences.

  The web portal has been designed such that the development of the portal and its features can progress independently of the styling (i.e. color, image, and layout) implementation. This has allowed the CI component to consult with independent user interface personnel (i.e. Lisa Wable at DRI and potentially some School of Journalism faculty and/or students at UNR) and allow them to suggest alterations to the display or organization of content to make it more appealing to various audiences. Their feedback and suggestions will form the basis of the reorganization that will be applied to the portal before its public release.

- Research and experience indicates that the public in general and educators in particular want to know: “How do scientists know what they know?” “ What’s going to happen locally?” and “What can we do about it?” To address these questions, using video and other digital media can be more effective than text to convey engaging stories about the science, how it is conducted, and the findings and implications. The social media tools, such as Twitter, Facebook, and YouTube, could be used to help market and provide outreach for the project.

  Response: Video is currently being developed for the project by UNLV TV. These videos are approximately 3-4 minutes are meant to educate broad audiences about the project and the new infrastructure. Videos are on the Summer Institutes, and Cyberinfrastructure activities are available on Nevada EPSCoR’s Youtube channel:
  http://www.youtube.com/user/nevadaepscor
  A video on the Environmental Transects and an overview video giving a

broad perspective on the project goals are currently being developed.

This past year we initiated the Nevada Climate Change Seminar Series featuring monthly talks by both project participants and scientists outside the project. A list of past presentations can be found at : http://digitalcommons.library.unlv.edu/climate_change/
Future presentations can be streamed live over the internet via UNLV TV: http://www.nevada.edu/epscor/nsf/climate1/seminar-series.html

The CI component plans to utilize videos taken by component members performing deployment of transect hardware to help make the climate monitoring process more accessible and understandable to various audiences. These videos, in addition to pictures gathered during these installations and pictures taken by transect web cameras, will allow the creation of more visually-oriented explanations of climate science.
In addition, images developed by the CI component and other project members will be incorporated into the portal as a part of explanations of climate science and infrastructure. Input from groups such as the School of Journalism at UNR will be very important in developing the combination of text and graphics that best appeals to interested audiences (i.e. educators, students, and the general public).

The Policy, Decision Making and Outreach Component is making DVDs that will integrate such concerns and also feature stakeholders representing their own point of view.

- The K12 Summer Institute, which reaches a small number of teachers, has a very limited reach. It could be partially or entirely repurposed to engage educators in developing education and outreach strategies for the data portal site, including activities and tutorials on the use of data in classrooms and other educational environments, and as a focus group to provide feedback on the portal site's usability and utility for non-technical audiences. The Summer Institute might also help develop strategies for marketing the portal to appropriate parties.

  Response: While it is true the K-12 Summer Institute reaches a relatively small number of teachers, the reach is ultimately great as those teachers take what they've learned back into their classrooms. To date, it is estimated that 2,160 students have been reached/influenced by the Summer Institute.

  At the tri-state meeting, one of the most compelling presentations we heard was from teachers in northern New Mexico, who through plugging away with programs similar to ours, are now finally reaping real benefits through teachers taking this into the classroom and their students becoming very involved. They are in their 3rd round of funding with their institute and have been at it for 10 years and this is what it probably takes to realize the benefits. We need to work hard to develop something that has some substance as an institute. Efforts at UNR have recently been

severely undercut with the proposed cuts to the graduate programs in the College of Education, which would may wipe out Jacquie's Ewing Taylor's STEM research center. We might want to take this then as an opportunity to build a self-funded science center and begin a new vision for this. The North and South have worked somewhat separately on these summer institutes because K-12 education seems to be fairly local. We argue for letting the north and south go forward with independent plans at sustainability and programs that appear to work best within their own districts.

Ultimately, we are not comfortable at this point in the project in repurposing the Summer Institutes as ERTAB suggests. What the ERTAB recommends in their report is a very different approach and would basically dissolve the Summer Institute concept and require a lot of effort to accomplish.

- The policy component is more of an integrating agent for the other components, such as the climate modeling, ecology and water, cyberinfrastructure, and education. During the first two years, the policy component has had some success in interacting with and integrating the other components. For example, the policy component of the ISP, "Vulnerability and Resilience of Urban Water Systems under Uncertain Changing Climate Scenarios," is timely and a good case of integration. ERTAB feels that the 3rd year is a critically important period for the policy component to establish concrete strategies for program success. In this respect, the following integrating strategies could be considered:

➢ Transforming scientific outputs from climate modeling and ecology/water components into digestible information for stakeholders, decision makers, and the public;

Response: This is a collaborative process that will depend on the nature and timing of their outputs, but we will have the networks developed i.e. Stakeholder Advisory Committee to perform outreach if this is possible.

➢ Adding the climate change survey data into the integrated model/analysis after the biophysical data from the ecology/water Component become available;

Response: We are certainly interested in exploring if this is possible.

➢ Converting the climate change survey data (6 surveys and a series of interviews) into useful information for stakeholders, decision makers, and the public;

Response: We are developing DVDs, pitching to National Public Radio and the newspapers, and will develop non-academic publications to share our work and host through the data portal.

- Integrating the survey results and other works (including review of best management practices, pilot outreach programs, workshop, etc.) to the other components, especially cyberinfrastructure and education.

  Response: We are unclear what this means but are interested in a detailed explanation so that we may determine how we could address it.

- Establishing a clear linkage between the climate change survey data and the policy analysis scheduled in 4-5th year of the project to explore the social, political, and economic dimensions of climate change;

  Response: We are currently working on this. We almost have our pilot study of this ready, and once the visualization equipment/capacity is in place we can begin demonstrating this.

- Prioritizing evaluation metrics of the policy component and establishing benchmarks for the project in year 3, as well as in years 4 and 5;

  Response: Our goal is to publish heavily over the next two years, and this is the primary way to measure our success, although stakeholder interactions are also a mechanism. We have very clear strategic goals and ways of measuring if we are meeting them.

- Building a sound model for the urban water demand scenarios that can be expected under climate change scenarios.

  Response: William J. Smith, Jr. and Derek Kauneckis, as well as Smith's graduate student Kiersten Miranda, and possibly his other student, Lauren Fossile focusing on energy, are contributing to the ISP on water vulnerability that considers demand, supply, policy and vulnerability dimensions. The ISP is also addressing some of the other bullets above.