Rio Grande Inter-Basin Roundtable
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July 22, 2013

Mr. Michael King, Executive Director
Colorado Department of Natural Resources

Ms. Rebecca Mitchell, Section Chief
Water Supply Planning Section
Colorado Water Conservation Board

Reference: Radar Monitoring & Hydrologic Modeling in the Upper Rio Grande Basin to Develop Accurate Stream Flow Forecasting

Dear Ms. Mitchell:

The Rio Grande Inter-Basin Roundtable (R.G.R.T) has determined that the single, most critical water issue confronting the Rio Grande Basin (Basin) is the current unsustainable management of surface and ground water. The R.G.R.T. has made the decision that water activities that address this issue be favorably considered for funding from the Water Supply Reserve Account, SB 2005 -179 (WSRA Funds), providing the proposed water activities meet the SWSI findings for the Basin and the CWCB & IBCC Criteria and Guidelines for funding.

The Radar Monitoring & Hydrologic Modeling in the Upper Rio Grande Basin to Develop Accurate Stream Flow Forecasting, (Project), is sponsored by the Conejos Water Conservancy District (CWCD). The Project consists of deploying a weather radar unit in the Conejos River watershed and additional instrumentation in the watershed to measure winter precipitation events and to calibrate a series of models to the data to predict the subsequent river run-off and flows during the irrigation season.

Effective water administration, and the associated Conejos River Compact, requires accurate streamflow forecasts and decision tools that enable the Colorado Division of Water Resources (CDWR) Division 3 Engineer and water users to obtain maximum beneficial use from existing water supplies. This Project will develop those tools, resulting in improved accuracy of streamflow forecasts.

The Project aligns itself with the CWCB's mission is to conserve, develop, protect and manage Colorado's water, as the intent of the Project is development of improved methods to account for snow as part of the hydrologic cycle. This in turn, may lead to better management of water and in the case of the Conejos River watershed, to meeting Colorado's obligation to accurately deliver flows to downstream states under terms of the Conejos River Compact. In addition, the Project directly addresses the National Center for

Atmospheric Research (NCAR) priorities related to improving the understanding and prediction of precipitation, snowpack and streamflow processes in the western U.S.

This Project will also advances radar methodologies to predict floods, severe weather, rain, and rain on snow events. It thus helps CDWR and CWCB to prepare for, respond to, and mitigate the effects of these events, supporting flood plain and flood protection missions in the watershed.

This project will develop the Rio Grande Compact Decision Support Tool, thus supporting DWR in its use of Ensemble Streamflow Prediction (ESP) forecasts to evaluate curtailment scenarios and to correctly estimate the probability of Compact compliance.

In these times of severe extended drought and with rising temperatures, general drying, and the increasing occurrence of forest fires and severe floods, there is a need to increase the accuracy of streamflow forecasts. This collaborative project will improve the data and the models which will significantly increase the accuracy of precipitation observations and improve hydrologic forecasts in the Conejos Basin in the Rio Grande Basin.

A recent analysis by CWCB and CDWR illustrated that seasonal water supply forecasts, which are currently based primarily on Natural Resources Conservation Service (NRCS) 'SNOw TELemetry' (SNOTEL) data, have struggled with high rates of inaccuracy, particularly in wet and dry years in the last several years. The high error rate in the annual April 1st. forecasts translates into millions of dollars lost annually due to excessive or premature curtailments of water used by irrigators and the resulting reduced agricultural productivity of irrigated lands.

Working with the Division 3 Engineer the CWCB helped determine that the economic impact of those water supply forecast errors was $15.1M in Water Year 2005 and $19.03M in Water Year 2007. According to Division 3 Engineer Craig Cotten, "Inaccurate streamflow forecasts can cause unnecessary curtailment of ditches, over- or under-delivery of Colorado's compact obligations, and a disruption of the priority system."

Because of such tight operating margins and the unequivocal, severe costs associated with erroneous projections, it is imperative that new data collection, data integration and modeling methods be evaluated and implemented to reduce the errors in water supply forecasts.

Methods, Procedures & Deliverable – CWCB's ongoing partnership

Over the last six years the CWCB worked with federal and private partners to improve the description of spring snowpack conditions and the use of hydrologic models. One of the snowpack models being used is the NOAA/National Operational Hydrologic Remote Sensing Center's snow model called SNODAS (SNOw Data Assimilation System). Data from SNODAS has been provided to the Division 3 Engineer since 2007. SNODAS is thirty years newer than some of the currently operational forecasting models and offers promise to provide another means of "assessing" the watersheds more comprehensively during the snowmelt part of the hydrologic cycle.

One of the recommendations after the final phase of the SNODAS project was to seek more inputs and forcing data for the SNODAS model, beyond SNOTELs and numerical weather prediction model forecasts. Although the CWCB has invested in additional SNOTEL stations, there presently exist only 7 stations in the entire Upper Rio Grande River basin which encompasses over 7,000 square miles. Due to the point nature of SNOTELs and limitations of model forecasts of precipitation, it is anticipated that precipitation radars can provide high-resolution spatial observations.

The consensus is that well-calibrated radar data has the potential to simulate the precipitation observations of hundreds of SNOTEL sites that are unfeasible to deploy in Colorado. While the deployment and collection of radar data is supported through a different CWCB contract, is Project seeks to obtain support for the deployment of a network of surface instrumentation which will be used to calibrate radar precipitation estimates and to monitor local snowpack and meteorological conditions in the Conejos River watershed of the Upper Rio Grande Basin.

The Project has technical input and support of the:

- CWCD: Will act as the lead in this study, providing administrative and fiscal management of the Project. CWCB has allocated $215,000 towards this project/concept and will contract with Riverside Technologies, Inc., with administrative support from the District. The role of CWCB is detailed under Task 2 of the Scope of Work.

- NSSL – National Severe Storms Laboratory's Dr. Steve Vasiloff, will be the Basin's go-to radar site expert, running and interpreting initial radar information. Dr. Vasiloff experience includes conducting the Southwest Colorado Radar Project, completed at the end of February, 2011, with deployment of the NOAA X-Pol mobile radar unit as part of the study to collect data on snowfall in the area.

- Riverside Technology Inc., headquartered in Fort Collins, will continue & expand current contracts for development of the modeling. Riverside is an internationally recognized engineering, science, and information technology company with more than 25 years of experience providing innovative information technology solutions for environmental decision support systems using a variety of different environmental data sources, from satellite sensors and imagery to stream gages in local rivers.

- NOAA – National Oceanic and Atmospheric Administration will provide direction and expertise for the implementation of the information that comes from the radar experiments.

- NWS – The National Weather Service will provide in-kind technical support, time, and personnel, with potential further involvement, depending on the findings and outcome of this project.

As further evidence of collaboration, the following personnel from the various entities will be directly involved in running this project:

State of Colorado Sponsors:

- Joe Busto, CWCB Watershed Protection & Flood Mitigation Program
- Kevin Houck, Section Chief, CWCB Watershed Protection & Flood Mitigation Program
- Steve Shull, CWCB Contract Specialist
- Maggie Van Cleef, Department of Natural Resources Purchasing

NCAR Project Contractor & Scientific Team

- David Gochis, Scientist III, Research Applications Laboratory, National Center for Atmospheric Research
- Martyn Clark, Scientist III, Research Applications Laboratory, National Center for Atmospheric Research

NCAR Contract Specialists

- Gina Taberski, National Center for Atmospheric Research

PROJECT AND AMOUNT REQUESTED	SOURCE SB 179
Radar Monitoring & Hydrologic Modeling	BASIN $37.000
Radar Monitoring & Hydrologic Modeling	STATEWIDE $200,000

The overall cost breakdown for the Project elements include:

BUDGET				
	WSRA GRANT FUNDS			
	Labor	**Direct Costs**	**Matching Funds**	**Total Project**
Task 1 – District Administration & Direct Costs Plus Matching funds (District's fund-raising and consciousness-raising campaign)	$27,000	(not known yet)	$ 20,000	$ 47,000
Task 2 – NCAR modeling and Interpretation – CWCB funds			$ 215,000	$ 215,000
Task 3 - Procurement, deployment, operation and maintenance of in-situ measurement systems		$ 60,000		$ 60,000
Task 4 - Production and evaluation of hydrologic forecasts	$150,000			$ 150,000
Matching Funds USBR-NCAR Technical Support and expertise – Estimated			$ 89,000	$ 89,000
Total Matching Contributions				
Total Costs:	$177,000	$ 60,000	$ 324,00.00	$561,000
GRANT REQUEST	**$ 237,000**			

As can be seen from the table above, the CWCB has committed $215,000, with the District contributing $47,000.

On behalf of the R.G.R.T. members, we appreciate the Board's consideration of this request and urge your support to the fullest extent possible. Enclosed are the application and supporting materials for the Project. If you require additional information, please notify me accordingly.

The R.G.R.T. appreciates the support of the Department of Natural Resources, the Colorado Water Conservation Board and the Interbasin Compact Commission in assisting in meeting the needs of all users of Colorado's water and in fostering intrabasin and interbasin communications and discussions. We believe that the above project will assist in this effort.

Sincerely,

Mike Gibson
Chair, Rio Grande Interbasin Roundtable

Enclosures (1)

cc: Conejos Water Conservancy District