Water Supply Reserve Account – Grant and Loan Program
Water Activity Summary Sheet
Agenda Item 32h

Applicant: Colorado Climate Center (with Colorado Division of Water Resources)

Water Activity Name: Improvement of Lysimeter Operations and Consumptive Use Quantification in High-Altitude, Irrigated Meadows in the Yampa /White Basin

Water Activity Purpose: Study or analysis of consumptive water project

Counties: Routt

Drainage Basin: Yampa River

Water Source: Yampa River

Amount Requested: $20,978

Source of Funds: Statewide Account ($10,978) and Yampa/White Basin Account ($10,000)

Matching Funds: $25,560 (in-kind from the Colorado Division of Water Resources and The Nature Conservancy's Carpenter Ranch staff)

Staff Recommendation
Staff recommends approval of up to $20,978 ($10,978 from the Statewide Account and $10,000 from the Yampa/White Basin Account) to partially fund the project: Improvement of Lysimeter Operations and Consumptive Use Quantification in High-Altitude, Irrigated Meadows in the Yampa /White Basin.

Water Activity Summary:
This project improves lysimeter data collection in the Yampa Basin. Historically, compensating lysimeters have been operated in the Yampa Basin by the Colorado Division of Water Resources. However, the validity of the DWR data has been questioned due to its failure to accurately represent meadow irrigation operations and adherence to potential evapotranspiration (ET) measurement criteria (water is limited in the lysimeter). The operation of these lysimeters has changed over time, but current procedures call for Division 6 staff to fill the lysimeters at intervals of up to a month, which means that the vegetation in the lyismeter may have been susceptible to plant stress which is not favorable when one is quantifying potential evapotranspiration (PET). In addition to this, the area surrounding the lysimeter site was also non-irrigated which can artificially inflate the calculated PET. Because the operation of the lysimeters is being questioned, so are the crop coefficients that were derived from these data.

This study will install new bucket type lysimeters and a full automated weather station on the Carpenter Ranch owned by the Nature Conservancy. The lysimeters that will be installed are weighing lysimeters instead of compensating lysimeters. This will allow for operation of the lyismeters to closely mimic the irrigation environment of the Yampa basin. Four lysimeters plots, buckets in this case, will be installed - two will be seeded with grass-reference vegetation and two will be seeded with vegetation representative of the surrounding irrigated meadow. This will allow for direct determination of crop coefficients that could be applied to any future weather-based calculations of grass-reference ET.

The purpose of the weather station is to collect the data necessary for the calculation of ET via the ASCE Standardized Penman-Monteith method (ASCE, 2005). Once these data are collected, the temperature based Hargreaves equation (Hargreaves and Samani, 1985) can be calibrated to the ASCE standard (Hargreaves and Allen, 2003). This would allow for accurate estimates of crop ET throughout the basin with use of only inexpensive temperature sensors.

As stated in the scope of work, the study has three main tasks:

1. **Installation**- will be conducted on the West end of Carpenter Ranch to minimize effects of the power plant. Two lysimeters will be seeded with Grass ET reference crop and two seeded with representative meadow species.
2. **Development of Crop Coefficients**- Use data from the bucket lysimeters to calculated crop coefficients. These coefficients can then be applied to any future weather-based calculations of ET.
3. **Calculate Crop ET-** Calibration of ASCE ET weather based calculations to temperature-based Hargreaves method.

Threshold and Evaluation Criteria
The application meets all four Threshold Criteria.

The application articulates how the project meets the Evaluation Criteria as summarized below:

Tier 1: Promoting Collaboration/Cooperation & Meeting Water Management Goals & Identified Needs: The project will enable the collection of data that can be used to monitor ET in the entire basin. In addition, it will provide quantitative assessments of irrigated hay meadow consumptive use and its relationship to local weather conditions. This type of information is essential for this basin to complete the current needs assessment by better quantifying consumptive water needs. The partnership between the Colorado Climate Center, the Colorado Division of Water Resources, and The Nature Conservancy is a model for how to accomplish this important work.

Tier 2: Facilitating Water Activity Implementation: The CCC and DWR do not have available funding to implement this important project. Both entities have a strong track record of successful projects. The project has also been designed in consultation with lysimeter experts at CSU. Adequate matching funds are provided.

Tier 3: The Water Activity Addresses Issues of Statewide Value and Maximizes Benefits: Research on high altitude consumptive use by native and cultivated vegetation is an issue of statewide interest and concern. The majority of Colorado's consumptive use goes to service the biological needs of irrigated vegetation. Weather conditions throughout the year, the variations in weather conditions from year to year, and potentially changing weather conditions over time have and will impact consumptive use of our State's water resources. Better documentation of evapotranspiration leads to an overall improved knowledge of water supply and water demand -- an important goal for all basins and an integral part of a comprehensive needs assessment. This has the potential for promoting greater water conservation and efficiency, help sustain agriculture and provide useful data for many other water resource applications of interest to CWCB. This project also stands to serve as a model for funding and conducting evapotranspiration monitoring statewide and will support efforts to assess ET from remote sensing technologies.

Funding Overview
Grant funding in the amount of $20,978 is requested ($10,978 from the Statewide Account and $10,000 from the Yampa/White Basin Account. In-kind matching funds in the amount of $25,560 will be contributed from the Colorado Division of Water Resources and The Nature Conservancy's Carpenter Ranch staff.

Discussion:
This project, in addition to updating lysimeter measurements in the Yampa basin, will provide quantitative assessments of irrigated hay meadow consumptive use and its relationship to local weather conditions. This type of information is essential for this basin to complete the current needs assessment by better quantifying consumptive water needs.

We have seen benefits from the Board's investment in the CoAgMet network in the Arkansas and North Platte basins in terms of better estimates of consumptive use as well as the collection of accurate and reliable weather data which can be used for many purposes in the future. This data can be used to assess climate trends as well as integration with efforts to obtain ET estimates through remote sensing.

Issues/Additional Needs:
No issues or additional needs remain.

Staff Recommendation:
Staff recommends approval of up to $20,978 ($10,978 from the Statewide Account and $10,000 from the Yampa/White Basin Account) to partially fund the project: Improvement of Lysimeter Operations and Consumptive Use Quantification in High-Altitude, Irrigated Meadows in the Yampa /White Basin.

All products, data and information developed as a result of this grant must be provided to the CWCB in hard copy and electronic format as part of the project documentation. This information will in turn be made widely available to Basin Roundtables and the general public and will help promote the development of a common technical platform. In accordance with the revised WSRA Criteria and Guidelines, staff would like to highlight additional reporting and final deliverable requirements. The specific requirements are provided below.

Reporting: The applicant shall provide the CWCB a progress report every 6 months, beginning from the date of the executed contract. The progress report shall describe the completion or partial completion of the tasks identified in the scope of work including a description of any major issues that have occurred and any corrective action taken to address these issues.

Final Deliverable: At completion of the project, the applicant shall provide the CWCB a final report that summarizes the project and documents how the project was completed. This report may contain photographs, summaries of meetings and engineering reports/designs.

Engineering: All engineering work (as defined in the Engineers Practice Act (§12-25-102(10) C.R.S.)) performed under this grant shall be performed by or under the responsible charge of professional engineer licensed by the State of Colorado to practice Engineering.