Water Supply Reserve Account – Grant and Loan Program
Water Activity Summary Sheet
September 11-12, 2014
Agenda Item 13(l)

Applicant: Colorado Climate Center

Program Sponsor: Colorado State University

Water Activity Name: Re-establishment of Lysimeters in North Park to Determine High Altitude, Hay Meadow Crop Coefficients.

Water Activity Purpose: Agricultural Needs Assessment

County: Jackson

River Basin: North Platte

Water Source: North Platte

Total Amount Requested: $194,102

Source of Funds: $97,051 North Platte Basin Account; $97,051 Statewide Account

Matching Funds: Basin Account Match ($97,051) = 50% of total grant request
Basin Account & Applicant Match ($134,647) = 69% of total grant request
Applicant Match ($37,596) = 16% of total project costs ($231,698)
(refer to *Funding Summary/Matching Funds*)

Staff Recommendation:
Staff recommends approval of up to $97,051 from the North Platte Basin Account; and $97,051 from the Statewide Account to help complete the project titled: Re-establishment of Lysimeters in North Park to Determine High Altitude, Hay Meadow Crop Coefficients.

Water Activity Summary: The funding requested is to further study crop consumptive use to provide additional information for the North Platte Basin Needs Assessment as well as various educational opportunities focused on agricultural water use, weather and climate. The project aims to re-establish lysimeter measurements in the high altitude, hay meadow environment of North Park. Although lysimeters have been historically operated in the basin, the data collected has been deemed questionable due to site exposure, infrequent watering and possible equipment failures. The project will build upon 5 years of data from three existent weather stations by providing ongoing support for the weather stations and installing and running two new lysimeters. Once fully installed the system is almost completely automated, and will mimic operations in the hay meadows (irrigation and cutting) to get an actual crop consumptive use to be used to calculate crop coefficients. The project will provide quantitative assessments of irrigated hay meadow consumptive use and its relationship to local weather conditions. The bulk of project costs will be installation and operation of the lysimeters.

Discussion:
WSRA Grant funds of $100,694 were expended from 2008 through 2014 to fund an earlier attempt to quantify crop consumptive use.

Issues/Additional Needs:
No additional issues or needs were identified.

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

Tier 1-3 Evaluation Criteria:

Tier 1: (a) The project is supported by the North Platte Basin Roundtable.

(b) The water activity has committed support from the Division of Water Resources Division 6 Office. The entities represented in the application include Colorado State University (CSU) and CoAgMet. The water activity is effective in addressing intrabasin or interbasin needs because the Yampa-White roundtable has a similar project to quantify consumptive use near Hayden. The combined results will cover a range of elevations in the two basins and could possibly be extended to other Colorado basins.

(c) This project will provide quantitative assessments of irrigated hay meadow consumptive use and its relationship to local weather conditions. This type of information is essential for the basin's on-going needs assessment and to better quantify consumptive water needs.

Tier 2: (d) This project will likely not be funded by any other entity but the Roundtable and Statewide funds. If this new lysimeter technology works as expected, other basins could benefit from this reach and perhaps invest in the technology.

(e) 16% of the total grant request has been contributed through the CSU's Unrecovered Indirect Costs.

Tier 3: (f) The project will help sustain agriculture in the basin by better understanding the crop water use requirements from irrigated hay meadows in North Park.

(g) This project has the potential to impact the interstate compact on the North Platte by quantifying actual crop consumptive use in the North Platte Basin. Once a better handle on crop consumptive use is understood, it may have an impact on the compact with Wyoming about the consumptive use of irrigated hay meadows in the Basin.

(h) n/a (not addressed)

(i) This project has a high cost/benefit for Colorado because lysimeter studies have been performed in the past, however methods and systems differ. The Rocky Ford

lysimeter that CSU installed was very expensive and requires a full-time staff person to operate and maintain, which is not feasible for many basins. If this smaller, lower cost system is proven to give reliable data, the state can benefit from this knowledge by using this system across Basins to quantify consumptive use. Additionally, if lysimeters cannot be funded in other Basins, relationships between the CoAgMet stations can be assessed and perhaps aid in transferring results based on the weather data and reported reference evapotranspiration.

(j) n/a

Funding Overview/Matching Funds:

	Cash	**In-kind**	**Total**
WSRA Statewide Basin Account	$91,051	n/a	$91,051
WSRA Arkansas Basin Account	$91,051	n/a	$91,051
CSU Cost-share	$37,596	$0	$37,596
Total Project Costs	**$231,698**	**$0**	**$231,698**

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 and Final Deliverable: 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. 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.

NORTH PLATTE BASIN ROUNDTABLE

Wm. Kent Crowder, Chair
P.O. Box 1019
Walden, Colorado 80480

FAX (970) 723-4706
(970) 723-4660

July 23, 2014

Craig Godbout - WSRA Application
Colorado Water Conservation Board
1313 Sherman St., Room 721
Denver, CO 80203
Craig.godbout@state.co.us

Re: Water Supply Reserve Account Grant Application for the re-establishment of lysimeters in the North Park basin to determine high altitude, hay meadow crop coefficients - North Platte River Basin - Total of $194,102 WSRA Funds Requested - $97,051 Basin Account Funds and $97,051 Statewide Account Funds

Dear Mr. Godbout:

This letter is to advise you that the grant application for WSRA funds from Basin and Statewide Accounts submitted by the Colorado Climate Center for the project to re-establish lysimeters in the North Park basin to determine high altitude, hay meadow crop coefficients was reviewed by the North Platte Basin Roundtable and was approved by a unanimous vote of the voting members present at the North Platte Basin Roundtable meeting held on the 22nd day of July, 2014. Because there were no dissenting votes on project funding, a minority report is not required.

This project will re-establish lysimeter measurements in the high altitude, hay meadow environment of North Park in order for the North Platte Basin to better quantify consumptive use in the basin,. Although lysimeters have been historically operated in the basin, the data collected has been deemed questionable due to site exposure, infrequent watering and possible equipment failures. The Climate Center was unable to quantify crop coefficients for the high altitude hay meadows due to various problems with these established lysimeters. This project will utilize the three existing weather stations to calculate ASCE reference ET and will build upon the 5 years of data collected already by providing ongoing support for the weather stations and installing and running new lysimeters adjacent to one of the stations in order to quantify crop consumptive use which will allow for the calculation of crop coefficients. Two lysimeters will be installed side by side for redundancy in case of failure. The conditions on the lysimeters will be treated to mimic operations in the hay meadows (same irrigation and cutting) in order to get at actual crop consumptive use in order to calculate crop coefficients.

This project 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's on-going needs assessment and to better quantifying consumptive water needs. The Yampa-White roundtable has a similar project to quanitfy consumpive use near Hayden. These results will cover a range of elevations in the two basins and could possibly be extended to other Colorado basins. The project will help agriculture in the basin better understand the crop water use requirements from irrigated hay meadows in North Park, and may have an impact on the compact with Wyoming regarding consumptive use of irrigated meadows in the North Platte Basin.

Please feel free to call me with any questions that you may have regarding the North Platte Basin Roundtable meeting or our level of support for this project.

Sincerely,

Wm. Kent Crowder, Chair
North Platte Basin Roundtable

COLORADO
DEPARTMENT OF NATURAL RESOURCES

COLORADO WATER CONSERVATION BOARD

WATER SUPPLY RESERVE ACCOUNT APPLICATION FORM

Today's Date: 29 May 2014

Re-establishment of lysimeters in North Park to determine high altitude, hay meadow crop coefficients.

Name of Water Activity/Project

Wendy Ryan and Nolan Doesken

Name of Applicant

North Platte

Approving Basin Roundtable(s)
(If multiple basins specify amounts in parentheses.)

Amount from Statewide Account: 97,051

Amount from Basin Account(s): 97,051

Total WSRA Funds Requested: 194,102

FEIN: 84-6000545

Application Content

Required Exhibits

A. Statement of Work, Budget, and Schedule
B. Project Map
C. As Needed (i.e. letters of support, photos, maps, etc.)

Appendices – Reference Material

1. Program Information
2. Insurance Requirements
3. WSRA Standard Contract Information (Required for Projects Over $100,000)
4. W-9 Form (Required for All Projects Prior to Contracting)

Instructions

To receive funding from the Water Supply Reserve Account (WSRA), a proposed water activity must be approved by the local Basin Roundtable **AND** the Colorado Water Conservation Board (CWCB). The process for Basin Roundtable consideration and approval is outlined in materials in Appendix 1.

Once approved by the local Basin Roundtable, the applicant should submit this application **with a detailed statement of work including budget and schedule as Exhibit A** to CWCB staff by the application deadline.

WSRA applications are due with the roundtable letter of support 60 calendar days prior to the bi-monthly Board meeting at which it will be considered. Board meetings are held in January, March, May, July, September, and November. Meeting details, including scheduled dates, agendas, etc. are posted on the CWCB website at: http://cwcb.state.co.us Applications to the WSRA Basin Account are considered at every board meeting, while applications to the WSRA Statewide Account are only considered at the March and September board meetings.

When completing this application, the applicant should refer to the WSRA Criteria and Guidelines available at: http://cwcb.state.co.us/LoansGrants/water-supply-reserve-account-grants/Documents/WSRACriteriaGuidelines.pdf

The application, statement of work, budget, and schedule **must be submitted in electronic format** (Microsoft Word or text-enabled PDF are preferred) and can be emailed or mailed on a disk to:

Craig Godbout - WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
Craig.godbout@state.co.us

If you have questions or need additional assistance, please contact Craig Godbout at: 303-866-3441 x3210 or craig.godbout@state.co.us.

Water Supply Reserve Account – Application Form
Revised October 2013

Part I. - Description of the Applicant (Project Sponsor or Owner);

1. Applicant Name(s): Colorado Climate Center

Mailing address: Colorado State University
1371 Campus Delivery
Ft. Collins, CO 80523-1371

FEIN #: 846000545

Primary Contact: Wendy Ryan Position/Title: Asst. State Climatologist

Email: Wendy.ryan@colostate.edu

Phone Numbers: Cell: Office: 970-491-8506

Alternate Contact: Nolan Doesken Position/Title: State Climatologist

Email: nolan@atmos.colostate.edu

Phone Numbers: Cell: Office: 970-491-3690

2. Eligible entities for WSRA funds include the following. What type of entity is the Applicant?

[x] Public (Government) – municipalities, enterprises, counties, and State of Colorado agencies. Federal agencies are encouraged to work with local entities and the local entity should be the grant recipient. Federal agencies are eligible, but only if they can make a compelling case for why a local partner cannot be the grant recipient.

[ ] Public (Districts) – authorities, Title 32/special districts, (conservancy, conservation, and irrigation districts), and water activity enterprises.

[ ] Private Incorporated – mutual ditch companies, homeowners associations, corporations.

[ ] Private individuals, partnerships, and sole proprietors are eligible for funding from the Basin Accounts but not for funding from the Statewide Account.

[ ] Non-governmental organizations – broadly defined as any organization that is not part of the government.

3. Provide a brief description of your organization

The Colorado Climate Center is a service and education arm of Colorado State University. We were founded in 1974 to monitor the climate of Colorado, archive climatic data and information, and provide information and expertise on climate matters affecting the citizens of Colorado. The majority of data that we use to monitor Colorado climatic conditions are collected by Federal agencies such as the National Weather Service and the USDA Natural Resources Conservation Service. However, we also coordinate independent monitoring efforts including the Colorado Agricultural Meteorological Network (CoAgMet) and the Community Collaborative Rain, Hail and Snow network (CoCoRaHS). We have the capacity and are currently involved in climate monitoring activities associated with determining water balances (precipitation and evaporation) including consumptive crop water use. Information about the Colorado Climate Center can be found at http://ccc.atmos.colostate.edu

4. If the Contracting Entity is different then the Applicant (Project Sponsor or Owner) please describe the Contracting Entity here.

The contracting entity is Colorado State University, an institution with a very long history of water resources research benefiting the citizens of the State of Colorado.

5. Successful applicants will have to execute a contract with the CWCB prior to beginning work on the portion of the project funded by the WSRA grant. In order to expedite the contracting process the CWCB has established a standard contract with provisions the applicant must adhere to. A link to this standard contract is included in Appendix 3. Please review this contract and check the appropriate box.

[ ] The Applicant will be able to contract with the CWCB using the Standard Contract

[x] The Applicant has reviewed the standard contract and has some questions/issues/concerns. Please be aware that any deviation from the standard contract could result in a significant delay between grant approval and the funds being available.

Colorado State University, if awarded, will expect to receive an Interagency Agreement from CWCB.

6. The Tax Payer Bill of Rights (TABOR) may limit the amount of grant money an entity can receive. Please describe any relevant TABOR issues that may affect the applicant.

Water Supply Reserve Account – Application Form
Revised October 2013

Part II. - Description of the Water Activity/Project

1. What is the primary purpose of this grant application? (Please check only one)

	Nonconsumptive (Environmental or Recreational)
x	Agricultural
	Municipal/Industrial
x	Needs Assessment
x	Education
	Other Explain:

2. If you feel this project addresses multiple purposes please explain.

The 3 existing weather stations funded by the roundtable previously (and continuously in this grant) can be used for a variety of purposes that benefit not only the basin but the state overall by providing a rich dataset in a rather data sparse area. These stations are part of CoAgMet and feed information into the State Decision Support System used for a variety of water related purposes. By further studying crop consumptive use, these data will provide additional information for the Basin Needs Assessment as well as various educational opportunities focused on agricultural water use, weather and climate.

3. Is this project primarily a study or implementation of a water activity/project? (Please check only one)

x	Study		Implementation

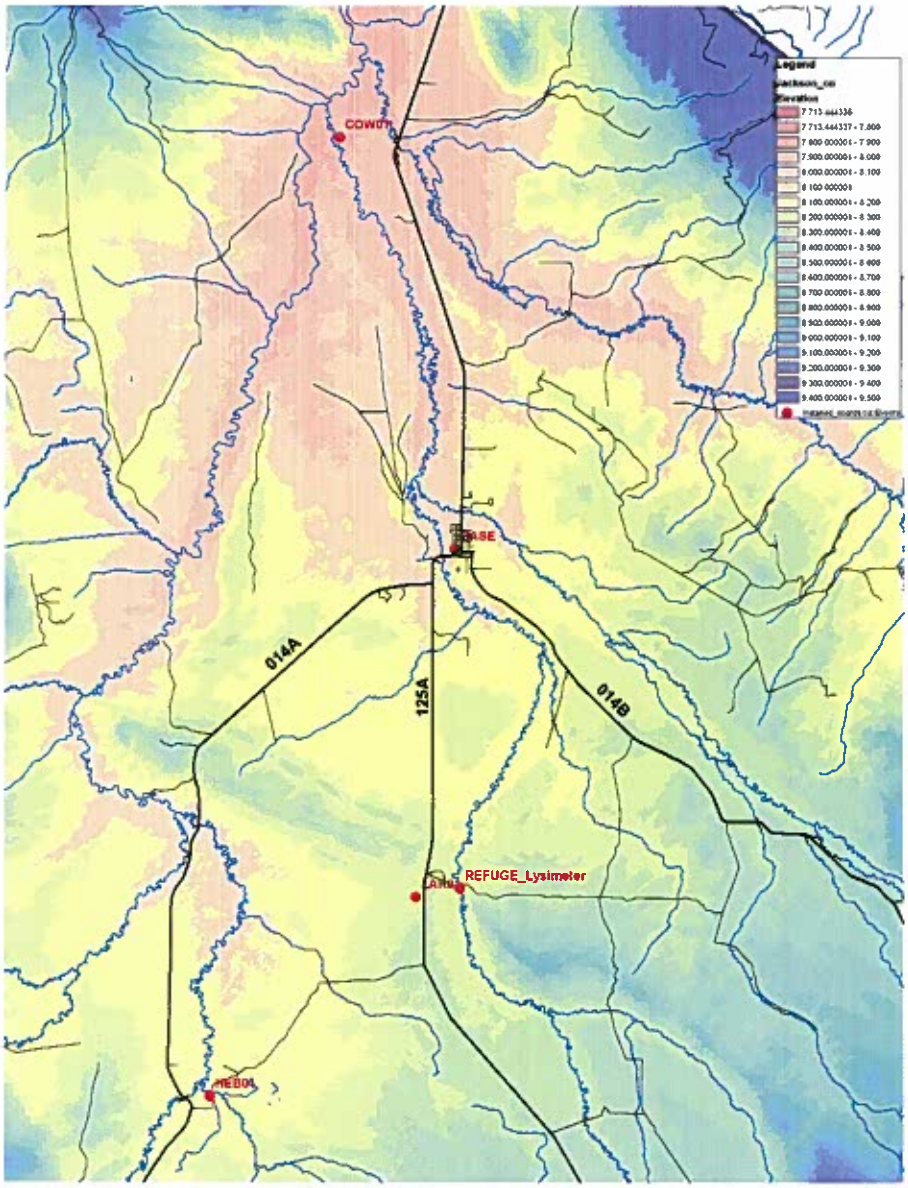
4. To catalog measurable results achieved with WSRA funds can you provide any of the following numbers?

	New Storage Created (acre-feet)
	New Annual Water Supplies Developed, Consumptive or Nonconsumptive (acre-feet)
	Existing Storage Preserved or Enhanced (acre-feet)
	Length of Stream Restored or Protected (linear feet)
	Length of Pipe/Canal Built or Improved (linear feet)
	Efficiency Savings (acre-feet/year OR dollars/year – **circle one**)
	Area of Restored or Preserved Habitat (acres)
	Other -- Explain:

4. To help us map WSRA projects please include a map (Exhibit B) and provide the general coordinates below:

Latitude: 40.8659 Longitude: -106.336

The new lysimeters will be installed adjacent to the current weather station at COW01.



5. Please provide an overview/summary of the proposed water activity (no more than one page). Include a description of the overall water activity and specifically what the WSRA funding will be used for. A full **Statement of Work** with a detailed budget and schedule is required as **Exhibit A** of this application.

As our last project with the North Platte roundtable ended, the Climate Center was unable to quantify crop

coefficients for the high altitude hay meadows due to various problems with the established lysimeters. This project will build upon the 5 years of data collected already by providing ongoing support for the weather stations and installing and running new lysimeters adjacent to one of the stations in order to quantify crop consumptive use which will allow for the calculation of crop coefficients. The bulk of the cost of this project will be installation and operation of the lysimeters.

Part III. – Threshold and Evaluation Criteria

1. Describe how the water activity meets these **Threshold Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines.)

   a) The water activity is consistent with Section 37-75-102 Colorado Revised Statutes.[1]

   This proposed water activity will not negatively impact or restrict the ability of any holders of water rights to use or dispose of that water right in any manner permitted by Colorado law.

   b) The water activity underwent an evaluation and approval process and was approved by the Basin Roundtable (BRT) and the application includes a description of the results of the BRTs evaluation and approval of the activity. At a minimum, the description must include the level of agreement reached by the roundtable, including any minority opinion(s) if there was not general agreement for the activity. The description must also include reasons why general agreement was not reached (if it was not), including who opposed the activity and why they opposed it. Note- If this information is included in the letter from the roundtable chair simply reference that letter.

   When I presented to the Roundtable in May as a conclusion to our last project, roundtable members were very interested in another proposal being submitted to run the lysimeter project.

[1] 37-75-102. Water rights - protections. (1) It is the policy of the General Assembly that the current system of allocating water within Colorado shall not be superseded, abrogated, or otherwise impaired by this article. Nothing in this article shal be interpreted to repeal or in any manner amend the existing water rights adjudicaion system. The General Assembly affirms the state constitution's recognition of water rights as a private usufructuary property right, and this article is not intended to restrict the ability of the holder of a water right to use or to dispose of that water right in any manner permitted under Colorado law. (2) The General Assembly affirms the protections for contractual and property rights recognized by the contract and takings protections under the state constitution and related statutes. This article shall not be implemented in any way that would diminish, impair, or cause injury to any property or contractual right created by intergovernmental agreements, contracts, stipulations among parties to water cases, terms and conditions in water decrees, or anyother similar document related to the allocation or use of water. This article shall not be construed to supersede, abrogate, or cause injury to vested water rights or decreed conditional water rights. The General Assembly affirms that this article does not impair, limit, or otherwise affect the rights of persons or entities to enter into agreements, contracts, or memoranda of understanding with other persons or entities relating to the appropriation, movement, or use of water under other provisions of law.

c) The water activity meets the provisions of Section 37-75-104(2), Colorado Revised Statutes.[2] The Basin Roundtable Chairs shall include in their approval letters for particular WSRA grant applications a description of how the water activity will assist in meeting the water supply needs identified in the basin roundtable's consumptive and/or non-consumptive needs assessments.

This project, in collaboration with previous and ongoing lysimeter measurements in North Park, 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.

d) Matching Requirement: For requests from **the Statewide Fund**, the applicants will be required to demonstrate a **25 percent** (or greater) match of the total grant request from the other sources, including by not limited to Basin Funds. A minimum match of 5% of the total grant amount shall be from Basin funds. A minimum match of 5% of the total grant amount must come from the applicant or 3rd party sources. Sources of matching funds include but are not limited to Basin Funds, in-kind services, funding from other sources, and/or direct cash match. Past expenditures directly related to the project may be considered as matching funds if the expenditures occurred within 9 months of the date the contract or purchase order between the applicant and the State of Colorado is executed. Please describe the source(s) of matching funds. (NOTE: These matching funds should also be reflected in your Detailed Budget in **Exhibit A** of this application)

Colorado State University is proposing Unrecovered Indirect Costs as matching funds from the applicant. Unrecovered Indirect Costs is the difference between the CWCB mandated indirect cost rate of 15% total direct cost and CSU's federally negotiated indirect rate of 48.7% modified total direct costs. UIC for this proposal is estimated to be $37.596 which is 16.23% of the total proposed cost of $231,698.

We are requesting a 50% match of the total requested WSRA funds from the basin funds.

Basin Funds Requested $97,051
State Funds Requested $97,051
Total WSRA Funds $194,102
CSU Cost-share $37,596
Total Project Cost $231,698

[2] 37-75-104 (2)(c). Using data and information from the Statewide Water Supply Initiative and other appropriate sources and in cooperation with the on-going Statewide Water Supply Initiative, develop a basin-wide consumptive and nonconsumptive water supply needs assessment, conduct an analysis of available unappropriated waters within the basin, and propose projects or methods, both structural and nonstructural, for meeting those needs and utilizing those unappropriated waters where appropriate. Basin Roundtables shall actively seek the input and advice of affected local governments, water providers, and other interested stakeholders and persons in establishing its needs assessment, and shall propose projects or methods for meeting those needs. Recommendations from this assessment shall be forwarded to the Interbasin Compact Committee and other basin roundtables for analysis and consideration after the General Assembly has approved the Interbasin Compact Charter.

2. For Applications that include a request for funds from the **Statewide Account**, describe how the water activity/project meets all applicable **Evaluation Criteria.** (Detailed in Part 3 of the Water Supply Reserve Account Criteria and Guidelines and repeated below.) Projects will be assessed on how well they meet the Evaluation Criteria. **Please attach additional pages as necessary.**

Evaluation Criteria – the following criteria will be utilized to further evaluate the merits of the water activity proposed for funding from the Statewide Account. In evaluation of proposed water activities, preference will be given to projects that meet one or more criteria from each of the three "tiers" or categories. Each "tier" is grouped in level of importance. For instance, projects that meet Tier 1 criteria will outweigh projects that only meet Tier 3 criteria. WSRA grant requests for projects that may qualify for loans through the CWCB loan program will receive preference in the Statewide Evaluation Criteria if the grant request is part of a CWCB loan/WSRA grant package. For these CWCB loan/WSRA grant packages, the applicant must have a CWCB loan/WSRA grant ratio of 1:1 or higher. Preference will be given to those with a higher loan/grant ratio.

Tier 1: Promoting Collaboration/Cooperation and Meeting Water Management Goals and Identified Water Needs

a. The water activity addresses multiple needs or issues, including consumptive and/or non-consumptive needs, or the needs and issues of multiple interests or multiple basins. This can be demonstrated by obtaining letters of support from other basin roundtables (in addition to an approval letter from the sponsoring basin).
b. The number and types of entities represented in the application and the degree to which the activity will promote cooperation and collaboration among traditional consumptive water interests and/or non-consumptive interests, and if applicable, the degree to which the water activity is effective in addressing intrabasin or interbasin needs or issues.
c. The water activity helps implement projects and processes identified as helping meet Colorado's future water needs, and/or addresses the gap areas between available water supply and future need as identified in SWSI or a roundtable's basin-wide water needs assessment.

Tier 2: Facilitating Water Activity Implementation

d. Funding from this Account will reduce the uncertainty that the water activity will be implemented. For this criterion the applicant should discuss how receiving funding from the Account will make a significant difference in the implementation of the water activity (i.e., how will receiving funding enable the water activity to move forward or the inability obtaining funding elsewhere).
e. The amount of matching funds provided by the applicant via direct contributions, demonstrable in-kind contributions, and/or other sources demonstrates a significant & appropriate commitment to the project.

Tier 3: The Water Activity Addresses Other Issues of Statewide Value and Maximizes Benefits

f. The water activity helps sustain agriculture & open space, or meets environmental or recreational needs.
g. The water activity assists in the administration of compact-entitled waters or addresses problems related to compact entitled waters and compact compliance and the degree to which the activity promotes maximum utilization of state waters.
h. The water activity assists in the recovery of threatened and endangered wildlife species or Colorado State species of concern.
i. The water activity provides a high level of benefit to Colorado in relationship to the amount of funds requested.
j. The water activity is complimentary to or assists in the implementation of other CWCB programs.

Continued: Explanation of how the water activity/project meets all applicable **Evaluation Criteria**.
Please attach additional pages as necessary.

Tier 1:
This project meets criteria by more accurately quanitfying actual crop consumptive use for the basin to be used in the basin needs assessment. The Yampa-White roundtable has a similar project to quanitfy consumpive use near Hayden. The Hayden lysimeters are completely manual requiring staff to weigh, fill, then re-weigh the buckets. They are labor intensive and time consuming. If this technology is proven to be viable, the units can be installed in other locations that could not support the manual bucket lysimeters. These results will cover a range of elevations in the two basins and could be extended to other basins using the relationship between the weather data from the CoAgMet stations and the lysimeter data.
This project has the potential to impact the interstate compact on the North Platte by quanitfying actual crop consumptive use in the North Platte basin.

Tier 2:
This project will likely not be funded by any other entitiy but the roundtable and statewide funds. It is benefiting the North Platte basin and the state overall. If this new lysimeter technology works as expected, other basins could benefit from this research and perhaps invest in the technology.

Tier 3:
This project will help sustain agriculture in the basin by better understanding the crop water use requirements from irrigated hay meadows in North Park. Once a better handle on crop consumptive use is understood, it may have an impact on the compact with Wyoming about the consumptive use of irrigated meadows in the basin.

This project also has a high cost/benefit for Colorado. Lysimeter studies have been performed in the past, however methods and systems differ. The Rocky Ford lysimeter that CSU installed was very expensive and requires a full-time staff person to operate and maintain the system which is not feasible in many basins in the state. If this smaller, lower cost system is proven to give reliable data, the state can benefit from this knowledge by using this type of system in other basins to quantify consumptive use. In addition, if lysimeters cannot be funded in other basins, relationships between the CoAgMet stations can be assessed and perhaps aid in transferring results based on the weather data and reported reference evapotranspiration.

Part IV. – Required Supporting Material

1. **Water Rights, Availability, and Sustainability** – This information is needed to assess the viability of the water project or activity. Please provide a description of the water supply source to be utilized, or the water body to be affected by, the water activity. This should include a description of applicable water rights, and water rights issues, and the name/location of water bodies affected by the water activity.

N/A

2. Please provide a brief narrative of any related studies or permitting issues.

CoAgMet is a statewide network of Evapotranspiration weather stations run by the Colorado Climate Center and this project will continue to run the three stations installed in the North Platte basin.

We currently have a similar project with the Yampa-White roundtable to run lysimeters adjacent to the CoAgMet station as well. Those lysimeters are proving to be a lot of work for the cooperators at Carpenter Ranch and CDWR. The design of the lysimeters for North Park will be more automated due to the lack of on the ground staff.

3. Statement of Work, Detailed Budget, and Project Schedule

The statement of work will form the basis for the contract between the Applicant and the State of Colorado. In short, the Applicant is agreeing to undertake the work for the compensation outlined in the statement of work and budget, and in return, the State of Colorado is receiving the deliverables/products specified. **Please note that costs incurred prior to execution of a contract or purchase order are not subject to reimbursement.** All WSRA funds are disbursed on a reimbursement basis after review invoices and appropriate backup material.

Please provide a detailed statement of work using the template in Exhibit A. Additional sections or modifications may be included as necessary. Please define all acronyms and include page numbers.

WATER ACTIVITY NAME - Re-establishment of lysimeters in North Park to determine high altitude, hay meadow crop coefficients.

GRANT RECIPIENT – Colorado Climate Center

FUNDING SOURCE –Water Supply Reserve Account

INTRODUCTION AND BACKGROUND

Provide a brief description of the project. (Please limit to **no more than 200 words**; this will be used to inform reviewers and the public about your proposal)

In order for the North Platte Basin to better quantify consumptive use in the basin, this project aims to re-establish lysimeter measurements in the high altitude, hay meadow environment of North Park. Although lysimeters have been historically run in the basin, the data have been deemed questionable due to site exposure, infrequent watering and what appears to be a leak in one of the compensating lysimeters.

This project will utilize the three existing weather stations to calculate ASCE reference ET. Two lysimeters will be installed side by side for redundancy in case of failure. They system is near completely automated once fully installed. The conditions on the lysimeters will be treated to mimic operations in the hay meadows (same irrigation and cutting) in order to get at actual crop consumptive use in order to calculate crop coefficients.

OBJECTIVES

List the objectives of the project

1.) Install lower maintenance lysimeters in North Park in a more representative location.
2.) Operate the weather stations and lysimeters side by side for 5 years.
3.) Annually calculate crop consumptive use and crop coefficients and then average over the years of the study.

TASKS

Provide a detailed description of each task using the following format

TASK 1 – [Weather Data Maintenance]

Description of Task

Continue operations and maintenance of the 3 weather stations in Cowdrey, Larand and Hebron.

Method/Procedure

Normal CoAgMet annual maintenance will be performed by CoAgMet staff. Each year, wind bearings will be change and other equipment checked. Every other year the temperature/RH probe and pyranometer will be replaced with recalibrated equipment to ensure data quality.

Deliverable

Publically available data access on the CoAgMet site: coagmet.colostate.edu
All weather parameters are archived on an hourly and daily basis. Reference ET is also calculated on the site.

TASK 2 – [Lysimeter Install and Operation]

Description of Task

Install, operate and maintain lysimeters at one of the weather station locations. Installation video of the lysimeters is available here:

http://www.decagon.com/products/hydrology/lysimeters/smart-field-lysimeter-weighable-controlled-tension-lysimeter/

Method/Procedure

Near one of the current weather stations (Carl Trick-COW01) a dual lysimeter setup will be installed that includes one base station. The lysimeters will be driven into the ground using a winch and anchor tool that will pull out an intact soil monolith. The soil monolith will be hooked up to the data collection platform. Soil matric potential and moisture sensors will be installed in the lysimeter to identify when water needs to be added. A local hourly employee will be hired to periodically check on the lysimeter status to ensure proper function. The current budget is for the 60cm depth units. A soil survey will be performed prior to purchase to see if the shorter 30cm units can be used. If they can, the difference in cost between the units will be returned to the roundtable/statewide funds.

Deliverable

Data archive of lysimeter data for use in crop coefficient calculation.

SCHEDULE

	Description	Start	End
Task 1	Weather Station Operations and Maintenance	Upon notice to proceed	Through end of project (2019)
Task 2	Lysimeter install and operation	Upon notice to proceed	Data collection continues through end of project (2019)

REPORTING AND FINAL DELIVERABLE

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 statement 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.

BUDGET

Provide a detailed budget by task including number of hours and rates for labor and unit costs for other direct costs (i.e. mileage, $/unit of material for construction, etc.). A detailed and perfectly balanced budget that shows all costs is required for the State's contracting and purchase order processes. Sample budget tables are provided below. Please note that these budget tables are examples and will need to be adapted to fit each individual application. Tasks should correspond to the tasks described above.

	Total Costs				
	Labor	Other Direct Costs	Indirect Cost (15% TDC)	Matching Funds (If Applicable) UIC	Total Project Costs
Task 1 – Weather Data Maintenance	48,284	15,292	9,537	17,898	91,011
Task 2 –Lysimeter Install and Operations	60,484	44,724	15,781	19,698	140,687
In-Kind Contributions					
Total Costs:	108,768	60,016	25,318	37,596	231,698

Project Personnel:	Project Manager	Project Supervisor	Hourly Technicians		Total Costs
Hourly Rate:	68.14	38.70	15.25		
Task 1 -	14,753	33,531	0		48,284
Task 2 -	14,753	33,531	12,200		60,484
Total Hours:	433	1733	800		2,966
Cost:	29,506	67,062	12,200		108,768

	Other Direct Costs						
Item:	Travel	Materials	Equipment/ Supplies	Mileage	Computer Network Fee		Total
Units:	Trips	Parts	Lysimeters	Miles	Person Months		
Unit Cost:	325	N/A	N/A	.54	40.40		
Task 1 -	1,625	10,598		2,817	252.50		11,418
Task 2 -	4,875		39,597	0	252.50		
Total Units:	20			5,200	12.5		
Total Cost:	6,500	10,598	39,597	2,817	505		60,016

PAYMENT

Payment will be made based on actual expenditures and invoicing by the applicant. Invoices from any other entity (i.e. subcontractors) cannot be processed by the State. The request for payment must include a description of the work accomplished by major task, and estimate of the percent completion for individual tasks and the entire water activity in relation to the percentage of budget spent, identification of any major issues and proposed or implemented corrective actions. The last 10 percent of the entire water activity budget will be withheld until final project/water activity documentation is completed. 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 help promote the development of a common technical platform.

The above statements are true to the best of my knowledge:

Signature of Applicant: Wendy Ryan

Print Applicant's Name: Wendy Ryan

Project Title: Re-establishment of lysimeters in North Park to determine high altitude, hay meadow crop coefficients.

Date: 29 July 2014

Return an electronic version (hardcopy may also be submitted) of this application to:

Craig Godbout – WSRA Application
Colorado Water Conservation Board
1580 Logan Street, Suite 200
Denver, CO 80203
303-866-3441, ext. 3210 (office)
303-547-8061 (cell)
craig.godbout@state.co.us

COLORADO
Division of Water Resources
Department of Natural Resources

Water Division 6 - Main Office
P.O. Box 773450
Steamboat Springs, CO 80477

July 30, 2014

Craig Godbout
Project Manager
Colorado Water Conservation Board
craig.godbout@state.co.us

Re: Letter in Support of Colorado Climate Center's Grant Application

Craig:

On July 22, 2014, the North Platte Roundtable approved Colorado Climate Center's grant application for the re-establishment of lysimeters in North Park to determine high altitude hay meadow crop coefficients. The purpose of this letter is to express my support in this project.

The Division of Water Resources Division 6 Office, has been involved in a lysimeter project for the purpose of measuring crop consumptive use for many years. In 1978, Energy Fuels Corporation (EFC) hired Leonard Rice Consulting to measure the evapotranspiration rate from flood-irrigated meadows. Four lysimeter plots total at two sites (Sites A and B) along Trout Creek of the Yampa River and a rain gage were installed to record locally calibrated crop coefficients. In 1983, the Division of Water Resource Division 6 Office took over the operation of these sites. In 1988, one of the two EFC sites (Site B) was abandoned. The lysimeter plots were maintained at Site A until May 1993 when they were moved to the Colorado Yampa Coal Company (CYCC) property. In 1996 another site with two plots was established at Lake Catamount and was maintained at this site through 1999. Due to the removal of a weather station in the area, the site was discontinued and plots were moved to a site at the Arapaho National Wildlife Refuge. The Refuge plots were operated by Division 6 staff from 2000 through 2012.

All of these plots were compensating lysimeters which consist of a closed system within which water is added by some type of metering system to compensate for the amount of water removed from the lysimeter system through evapotranspiration (ET). In this type of lysimeter, the water level within the system is maintained at a constant level, usually either at or just below the soil surface. Division 6 staff would manually add water at intervals of up to a month. This system of applying water was used to represent rotational application of irrigation water, which is widely practiced within the basins. This allowed for maintenance of appropriate vegetation within the lysimeters, but it also introduced the potential for plant stress. As a result the full potential consumptive use was not being measured.

A review of the Division 6 Lysimeter Project was conducted by Dan Smith of CSU in 2009 which concluded that the observations from the Arapaho National Wildlife Refuge site appeared to be more consistent with measurements from previous studies than did the CYCC observations. However, he recommended that several changes be made to the lysimeter program. The recommended changes included altering the design and location of the lysimeters and placement of a weather station capable of providing continuous measurements of temperature, humidity, wind

speed, solar irradiance, and precipitation near the site. The design change would involve use of weighing lysimeters rather than compensating lysimeters. The grant application proposes the installation of two Smart Field Weighable Controlled Tension Lysimeters which are weighing lysimeters.

In the fall of 2010, the Yampa/White/Green Roundtable approved a grant application submitted by the Colorado Climate Center and Division of Water Resources for the purpose of improving the lysimeter operations and consumptive use quantification in high-altitude irrigated meadows within the basins. Though this grant was for a much smaller amount (approximately $21,000), the costs exceeded the budget and the design of the lysimeters for this project are very labor intensive; which was considered an in-kind cost. These plots are located on the Carpenter Ranch outside of Hayden and are operated and maintained by the Division of Water Resources and The Nature Conservancy staff. The elevation of the plots is at approximately 6,400 feet whereas the elevation of the proposed site within the North Platte basin is at approximately 7,900 feet. This variation in elevation alone can make a difference in the crop coefficients let alone the difference in climate between the two locations.

Needless to say, the Division of Water Resources Division 6 Office has an interest in the continued study of high-altitude crop coefficients. This aside, it is also believed to be an important study as it relates to the Platte River Recovery Implementation Program and Colorado's Plan for Future Depletions. As described in this plan, irrigation of more than 134,468 acres within the North Platte River basin of Colorado will constitute new water related activities and it is assumed that the net depletions associated with the irrigation of additional acres is 0.83 AF/acre. This depletion factor however for the high mountain meadows of North Park is likely low. None-the-less, the current agricultural consumptive use baseline would be 111,608 AF (134,468 x 0.83), yet the greatest number of acres irrigated in the basin in many years is 117,148 in 2008; resulting in a difference in consumptive use of 14,375 AF. However if, for example, the net depletion was 1.67 AF/acre, the agricultural consumptive use baseline would be 224,562 AF, the 2008 consumptive use would be 195,637 AF; resulting in a difference in consumptive use of 28,925 AF. This of course would then allow for more water to be available under the basin's one-bucket concept.

For these reasons, I support the grant application submittted by the Colorado Climate Center. Additionally, because the Yampa/White/Green grant application for the evaluation of high-altitude crop coefficients received money from the Statewise Account and because there is high altitude grass hay meadow irrigated throughout the state, it is my opinion that the request for funds from the Statewide Account is appropriate.

If you have any questions, please do not hesitate contacting me (970-879-0272).

Sincerely;

Erin C. H. Light, P.E.
Division Engineer

Cc: Kent Crowder, North Platte Roundtable Chair
Dick Wolfe, State Engineer