STATE OF COLORADO

Colorado Water Conservation Board
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TO: Colorado Water Conservation Board Members

FROM: Tim Feehan, Assistant Director
Steve Biondo, Finance Manager

DATE: March 8, 2013

SUBJECT: **Agenda Item 15, March 19 - 20, 2013, Board Meeting**
Finance Section - Severance Tax Trust Fund Operational Account
Approval of Project Recommendations

Introduction

CWCB is entitled to an amount up to a 5% share of the Operational Account of the Severance Tax Trust Fund. In January 2013, CWCB received internal requests and outside applications for funding that becomes available from the Operational Account in July 2013 via the Long Bill enacted by the General Assembly. CWCB Staff reviews the applications and then recommends to the Board the projects that should receive funding. We expect to receive $1,275,500 in funding; however, should that amount be changed, the project funding will also need to be revised. Table 1 on page 2 provides a summary of the recommended and non-recommended projects by CWCB Staff. These projects are described in more detail following Table 1(see each write-up by the corresponding Project Number).

Recommendation

Staff recommends that the Board approve the proposed funding for each of the projects from the Operational Account of the Severance Tax Trust Fund as summarized as Table 1 to this memo. Recommended projects are numbered 1 – 26 and projects not recommended are numbered 27 – 34.

Table 1

SEVERANCE TAX OPERATONAL ACCOUNT PROJECTS

FOR FUNDING FROM JULY 1, 2013 TO JUNE 30, 2014

NO.	SPONSOR	PROJECT	AMOUNT
		INTERSTATE, FEDERAL & WATER INFORMATION	
1.	CWCB	Colorado River Tour for Colorado Basin State Leaders	$25,000
2.	CWCB	GIS Migration to the Cloud	$34,000
3.	CGS	County Groundwater Resources Series, Year 2	$46,000
4.	USGS	Groundwater-Monitoring Network in Cooperation with the Rural Water Authority of Douglas County	$19,960
5.	PRWCD	Purgatoire River WCD Enhanced Diversion Record Project	$25,000
		Finance	
6.	DWR	Republican River Basin Instrumentation	$25,000
7.	EDO	Regional Real-Time Monitoring of Oil and Gas Operations	$300,000
8.	DWR	Extreme Precipitation Analysis Tool Software Verification Project, Phase 2	$75,000
9.	DWR	Dam Safety Inundation Mapping Grant Program	$24,960
10.	BCRC&PC	Bull Creek Reservoir #4 Wetlands Study	$14,257
		Stream & Lake Protection	
11.	CWCB	Case Management and Litigation Support	$75,000
12.	USGS	Validation of Colorado StreamStats for Selected Locations	$75,000
13.	CWCB	Outreach and Education	$10,000
		Watershed & Flood Protection	
14.	CWCB	Flood Mitigation and Project Compliance	$50,000
15.	CWCB	Multi-Objective Watershed Protection and Restoration Projects	$50,000
16.	CWCB	Community Assistance Program	$47,650
17.	CSAS	Colorado Dust on Snow Program	$40,000
18.	DWR	Dam Failure Consequence and Vulnerability Assessments	$13,000

		Table 1 (Cont.)	
		Water Supply Planning	
19.	CWCB	Water Efficiency Planning Workshops	$40,000
20.	CWCB	Drought Preparedness and Response	$20,000
		Total for CWCB Program Projects	$1,009,827
		Higher Education	
21.	CSU	Investigation of the Effects of Whitewater Parks on Aquatic Resources in Colorado: Year 3	$43,796
22.	CSU	Modeling the Influence of Conjunctive Water Use on Flow Regimes in the South Platte River Basin	$50,000
23.	CSU	Bringing the Value of CDSS to Universities	$50,000
24.	CSU	Determination of Consumptive Water Use of Corn in the Arkansas Valley	$28,750
25.	CSU	Developing Metrics for Colorado Agriculture's Production and Efficiency with Water Resources	$43,131
26.	CSU	Assessing the Agronomic Feasibility of Single-season Irrigation Deficits on Hay as Part of a Western Slope Water Bank	$49,996
		Total for Higher Education Projects	$265,673
		Total Severance Tax Trust Fund Operational Account Recommendations	$1,275,500
		Projects Not Recommended for STOA Funding	
27.	CWCB	Work Related to Recreational Projects	$80,000
28.	WWA	Assessment of Tributary Flows in the Lower Colorado River Basin and their Potential to Reduce Risk of Water Shortages and Improve Storage	$25,000
29.	EPCC	El Paso County Groundwater Quality Study, Phase 2	$56,000
30.	USGS	Hydrodynamic Modeling of the Yampa River in Deerlodge Park	$39,000
31.	CWCB	Post-fire Flow and Sediment Response to Geomorphic Based Restoration	$50,000
32.	NCAR	Modeling Study of Seeding Plumes in the Weather Modification Program	$46,000
33.	Lamar	City of Lamar Levee Improvement Project	$108,400
34.	CSU	Impacts of Sago Pondweed Control on Water Flow and Canal Efficiency	$37,224
		Total Projects Not Recommended for STOA Funding	$441,624

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 1

Applicant: Ted Kowalski, IFWI Chief

Project Title: Colorado River Tour for Colorado Basin State Leaders

Recommended Amount: $25,000
Requested Amount: $30,000

Description of Project: CWCB will host a tour of the Colorado River within our state for leaders from the seven Colorado River Basin States. CWCB will host meals, lodging, guides and bus transportation during the tour.

Project Manager(s): Ted Kowalski

Program: Interstate Compact Compliance

Purpose: The tour will help leaders from the seven Colorado River Basin States become familiar with the various projects and infrastructure on the Colorado River within the state of Colorado, and the issues that are unique to Colorado. This increased familiarity should aid in discussions and negotiations related to various Colorado River compact issues.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 2

Applicant: Ted Kowalski, IFWI Chief

Project Title: GIS Migration to the Cloud

Recommended Amount: $34,000
Requested Amount: $40,000

Description of Project: DNR agencies currently have a need for a stable, scalable platform to provide web-based mapping applications to the public and for internal use. OIT recognizes that they do not have the resources or expertise to support DNR's GIS needs, and have pushed DNR agencies to look at other alternatives. This project will create a cloud-based platform for GIS activities that will enable DNR agencies to build and maintain web-based maps without the need for OIT support, which again is currently unavailable for GIS within the Department for the foreseeable future.

Project Manager(s): Carolyn Fritz

Program: Decision Support Systems

Purpose: To provide CWCB's cost-share to contract with a vendor to configure and build GIS capabilities in the Cloud for DNR agencies. This will provide a stable and scalable platform for web-based mapping activities. Funds will also be used to upgrade CWCB GIS licenses for compatibility with the Cloud based system, and for CWCB's cost-share for enterprise licensing and monthly cloud system fees.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 3

Applicant: Peter Barkman, Colorado Geological Survey

Project Title: County Groundwater Resources Series, Year 2 – Park County

Recommended Amount: $46,000
Requested Amount: $47,000

Description of Project: Patterned after county-wide groundwater resource series produced in the 1960s through mid-1970s, this new effort is intended to address counties omitted from the earlier series where development pressures are straining current water resources. It will support existing decision support and monitoring systems. This endeavor will generate publications tailored to inform the public, planners, and policy-makers about local geology and groundwater resources at the county level. The first publication of the series utilizing the previous year's funding will be for Douglas County. This second publication will address all aquifers utilized in Park County, including alluvial, sedimentary, and crystalline formations.

This builds upon other work by the CGS including the Ground Water Atlas of Colorado, which used Operational Account funding. It also builds upon the recent Groundwater Quality Scoping Study performed by the CGS and USGS for the Coalition for the Upper South Platte. In addition, in 2001 the CGS released *Geology and Mineral Resources of Park County* Resource Series RS-40 as a hard copy publication. Our intent is to use this as a base for the Geology and Groundwater Resources series publication.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information

Purpose: The intent of this endeavor is to generate information publications tailored to inform the public, planners, and policy-makers about local geology and groundwater resources. The work will address all aquifers utilized in the County including alluvial, sedimentary, and crystalline formations.

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 4

Applicant: Suzanne Paschke, U.S. Geological Survey

Project Title: Douglas County Groundwater-Monitoring Network in Cooperation with the Rural Water Authority of Douglas County

Recommended Amount: $19,960
Requested Amount: $19,960

Description of Project: A county-wide groundwater-level monitoring network was established for Douglas County in June 2011 to assess seasonal and long-term water-level changes. The network is a cooperative program between the U.S. Geological Survey (USGS) and the Rural Water Authority of Douglas County (RWADC) funded by a Water Supply Reserve Account grant, Severance Tax grant, and USGS Cooperative Water Program matching funds. The network consists of 36 domestic wells in Denver Basin aquifers throughout the county. Water levels are measured bi-monthly in all wells and 15 of these are equipped with pressure transducers for continuous (hourly) water-level monitoring. The time-series data collected by the pressure transducers have proven to be very valuable to the study. Currently the transducers and associated equipment are being rented at a cost of $1,200 per month. To reduce long-term equipment costs, the project proposes to purchase the equipment with funds from this Severance Tax Grant. The cost of 15 transducers, vented cables, and other related equipment is estimated to be $26,615; $19,960 is being requested with this application.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information

Purpose: These funds will be used to purchase equipment for a water-level monitoring network of domestic Denver Basin wells in rural Douglas County.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 5

Applicant: Jeris Danielson, Purgatoire River Water Con. District

Project Title: Enhanced Diversion Records

Recommended Amount: $25,000
Requested Amount: $25,000

Description of Project: CWCB funds will be used to purchase water level measuring equipment and data recorders for approximately 12 turnout structures on the Picketwire Ditch system located near Trinidad, Colorado. The Division 2 Engineer has ordered that water delivered through these turnouts be continuously measured to ensure compliance with multiple priorities carried in the Picketwire. The Purgatoire River Water Conservancy District (PRWCD) manages the water supply from the Trinidad Project, a portion of which is delivered through the Picketwire. The PRWCD will purchase and install the necessary equipment, as specified by Div. 2. Div. 2 will assist with installation and calibration of the equipment.

Project Manager(s): Steve Miller

Program: Interstate, Federal, and Water Information

Purpose: Improved administration of water rights through accurate measurement of diversions. Trinidad Project water use is regulated pursuant to strict Operating Principles to which the US Bureau of Reclamation and the State of Kansas are also parties. Reliable records of diversions will improve confidence that the Project is in compliance with the Operating Principles, as well as allow better administration of priorities by the Div. 2 Engineer.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 6

Applicant: Mike Sullivan, DWR

Project Title: Republican River Basin Instrumentation

Recommended Amount: $25,000
Requested Amount: $28,000

Description of Project: The Republican River Basin DWR field staff is requesting additional meter calibration equipment as well as field data collection systems (garmin, x-map) that will allow for seamless integration of that data to DWR's databases. Those databases, along with much other collected data, are used by the CWCB in the DSS models and as the basis for water supply needs/projections.

Project Manager(s): Tim Feehan

Program: Water Modeling

Purpose: Most of Colorado's River Basins have or are integrating groundwater use into the overall administration of water, including compacts. Once integrated, through the use of the DSS systems, this data can then be available for compact operations, water supply planning, and other uses. Proper instrumentation and data collection within the various river basins is critical to this effort.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 7

Applicant: DNR – Executive Director's Office

Project Title: Regional Real-time Monitoring of Oil and Gas Operations

Recommended Amount: $300,000
Requested Amount: $300,000

Description of Project: Considerable attention has been paid to the development of oil and gas resources in northeastern Colorado, particularly along the urban corridor from Colorado Springs to Fort Collins. Major concerns are the impact of the development on air and water quality, particularly in the areas with significant oil and gas operations. This project will establish a regional monitoring network that would provide real-time measurement of air and water quality pollutant surrogates. The surrogate analyses will measure in a continuous, real-time manner and need to have proven to correlate with the presence of criteria pollutants from oil and gas activity.

Project Manager(s): Jennifer Gimbel / Tim Feehan

Program: Water Modeling

Purpose: Heightened public concern regarding the safety of oil and gas development (particularly when accomplished with hydraulic fracturing) is partially related to a lack of easily understandable, current information regarding the presence of pollutants in air and water. The purpose of this project is to bridge the gap by involving social science faculty and students at CSU in the development of a web-based interface that will hopefully be an effective tool in providing information to the public regarding air and water quality related to oil and gas development.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 8

Applicant: Kirk Russell, Finance Section Chief

Project Title: Extreme Precipitation Analysis Tool (EPAT) Software Verification Project, Phase II

Recommended Amount: $ 75,000
Requested Amount: $100,000

Description of Project: The software was developed by HDR Consultants under contract with DWR, in order to develop modern meteorological techniques for evaluating the safe spillway size for High and Significant Hazard dams. The West Slope version of the program was released in September 2006. Later EPAT was released for the entire State, excluding areas below 5,500 feet in elevation east of the Continental Divide, and with a basin area upper limit of 500 square miles. Dam Safety Branch staff feels that the program requires more thorough testing. After several years of use, DWR staff has identified areas of concern with EPAT results, especially in areas along Colorado's Front Range. Phase I of this project included software development documentation and scientific justification and GIS validation. This work will be provided to a third party review board for assessment as the second phase in the project. This third party review will guide further EPAT development.

Project Manager(s): Anna Mauss

Program: Water Project Loan Program

Purpose: The EPAT software with a comprehensive third party review will allow spillways to be optimized for dam safety, resulting in minimizing cost to dam owners. This will help EPAT become an even more valuable tool for the CWCB Water Project Loan Program users.

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 9

Applicant: Bill McCormick, Chief DWR Dam Safety Branch

Project Title: Dam Safety Inundation Mapping Grant Program

Recommended Amount: $24,960
Requested Amount: $49,000

Description of Project: Funding to support the current Dam Safety Branch - Inundation Mapping Grant program that has been in place since 2010.

Project Manager(s): Kirk Russell

Program: Water Project Loan Program

Purpose: Dam Safety Rules require owners of high and significant hazard dams to prepare and maintain an Emergency Action Plan (EAP). A key component of the EAP is an inundation map which shows the calculated extends of the flood wave that would occur in the event the dam were to fail. Beginning in 2010, Colorado established the Inundation Mapping Grant Program with a significant portion of its FEMA National Dam Safety Program grant money to assist owners of high and significant hazard dams in updating inadequate inundation mapping. A typical grant provides a 50% cost share with the dam owner. Of the 654 High and Significant Hazard dams in the State, the majority will need updates to meet minimum standards or to be made GIS compatible. Through the work of the dam safety branch engineers, a large back log of projects exists. We are requesting this grant as a way to extend the impact of this important project to levels similar to those achieved in previous years.

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 10

Applicant: Bull Creek Reservoir Canal & Power Company

Project Title: Bull Creek Reservoir #4 Wetlands Study

Recommended Amount: $14,257
Requested Amount: $28,515

Description of Project: As a result of a Corp of Engineers Permit Stipulation during the approval for construction of a #4 Reservoir Dam, Bull Creek must monitor the effects of a periodic inundation of wetlands and fens associated within the reservoir basin for 3 years. This funding request is to perform the third and final year of monitoring. CWCB has funded a portion of the previous year's monitoring efforts.

This information can and will be used to develop future requirements for water development on the Grand Mesa.

Project Manager(s): Kirk Russell

Program: Water Project Loan Program

Purpose: This information will be beneficial to CWCB Loan Program borrowers with permitting water projects on the Grand Mesa.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 11

Applicant: Linda Bassi, ISF Chief

Project Title: Case Management and Litigation Support

Recommended Amount: $75,000
Requested Amount: $75,000

Description of Project: Hire temporary paralegal staff (two positions, each limited to 9 months) to assist the Section with ISF case management, including organizing and imaging case files, tracking court deadlines, prioritizing case review, and drafting pleadings, memos, correspondence and other documents as appropriate.

Project Manager(s): Kaylea White

Program: Instream Flow and Natural Lake Level Program

Purpose: Provide adequate staffing for legal protection of the State's ISF water rights until such time that a decision item can be obtained to fulfill this ongoing need.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 12

Applicant: Suzanne Paschke, U.S. Geological Survey

Project Title: Validation of Colorado StreamStats for Selected Locations

Recommended Amount: $75,000
Requested Amount: $97,300

Description of Project: The objective of the study is to independently validate the regional peak-streamflow equations that were developed by Capesius and Stephens (2009) and incorporated in the Colorado StreamStats program (http://streamstats.usgs.gov/colorado.html). The study would compare mean-monthly streamflow computed from daily values in the USGS National Water Information System (NWIS) to mean-monthly flows computed by StreamStats for selected streamflow gaging sites. The study area will include the Northwest, Southwest, Rio Grande, and Mountain hydrologic regions of Colorado as defined by Capesius and Stephens (2009).

Project Manager(s): Jeff Baessler

Program: Instream Flow and Natural Lake Level Program

Purpose: Verification of Colorado StreamStats results will increase confidence in application results that can be used by State and local official when making critical decisions about water availability for new ISF appropriations as well as the management of local water resources.

Funding Available: July 1, 2013 – June 30, 2014

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 13

Applicant: Linda Bassi, ISF Chief

Project Title: Outreach and Education

Recommended Amount: $10,000
Requested Amount: $10,000

Description of Project: This project is directed at increasing public awareness of new instream flow appropriations and acquisitions, and the Board's processes for both program areas. As the Basin Roundtables work to meet their identified non-consumptive needs, CWCB staff will need to conduct additional outreach and education activities and increase collaboration and coordination between various stakeholders. This project will involve the development and distribution of educational and marketing material in both electronic and paper form, and will cover the cost of providing advance public notice of meetings in various communities throughout the state. Furthermore, the project will provide a funding mechanism to aid staff in the increase in travel activities that be necessary for these efforts.

Project Manager(s): Linda Bassi / Jeff Baessler

Program: Instream Flow and Natural Lake Level Program

Purpose: Outreach and Education related to providing increased public notice, collaboration and coordination for ISF new appropriations and acquisitions. This includes a new effort to involve Basin Roundtable member participation in the program as a way to meet non consumptive basin needs.

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Project No. 14

Applicant: Kevin Houck, Chief, Watershed and Flood Protection

Project Title: Flood Mitigation and Project Compliance

Recommended Amount: $ 50,000
Requested Amount: $100,000

Description of Project: CWCB staff has identified a substantial need for identification of deficiencies to flood mitigation projects throughout Colorado. Funds from this program will be used to develop solutions to bring these projects back into technical or regulatory compliance. In some cases, some financial assistance may be provided to smaller communities to perform required one-time maintenance activities for regulatory purposes provided that the local governments and other entities benefiting from the project expend as many local resources as available to perform the work. The focus of this work will be to address local requests as well as identification and design of projects that can be implemented or upgraded to reduce the flood risk. The best example of the use of these funds are the current nationwide focus on the condition of levees, which has already impacted some Colorado communities and is expected to impact many more in the coming years. Many of these levees and other flood control/mitigation projects are located in small or impoverished communities throughout the state that are in need of both technical and, in some cases, financial assistance. Other projects being considered include ongoing post-wildfire analysis and mitigation as well as a long overdue update to the Statewide Floodplain and Stormwater Criteria Manual; last updated in 2006. CWCB staff is requesting this funding to provide a means of cost-sharing with local entities and other agencies to accomplish the much needed work. Cost-sharing will be emphasized when practicable to leverage the severance tax dollars.

Project Manager(s): Kevin Houck

Program: Watershed and Flood Protection

Purpose: To mitigate flood hazards throughout the state by partnering with local governments in plans, studies, and minor flood projects.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
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Project No. 15

Applicant: Kevin Houck, Watershed and Flood Protection Chief

Project Title: Multi-Objective Watershed Protection and Restoration Projects

Recommended Amount: $ 50,000
Requested Amount: $150,000

Description of Project: This program will provide funding to allow CWCB to support multi-objective watershed restoration and protection studies and/or projects in watersheds throughout the State of Colorado. In the past, the program has funded watershed plans, stream channel restoration design and construction, irrigation diversion design and reconstruction, riparian re-vegetation, and flood hazard mitigation. The studies and projects benefit both non-consumptive and consumptive uses of water by improving stream ecosystem function, water supply delivery and storage, and flood attenuation. Most of the studies and projects selected begin as grant applications submitted to the Colorado Healthy Rivers Fund and CWCB Colorado Watershed Restoration Program. The Severance Tax Multi-Objective Watershed Protection and Restoration Program is used to augment the funding for these competitive grant programs. The Statewide Water Supply Initiative has called for watershed restoration efforts in combination with water supply projects, and this program can help meet that objective. This program will use funds to first augment other CWCB competitive grant programs addressing watershed protection and restoration concerns. Remaining funds from the program will be used for restoration and protection studies and projects identified by watershed groups around the state.

Project Manager(s): Chris Sturm

Program: Watershed and Flood Protection

Purpose: To provide funding for watershed protection and restoration projects. Examples of past projects (2012-2013) include Upper Glen Cove Creek Erosion Control and Restoration, Boulder County Fourmile Fire Flood Mitigation, Lower Swan River Restoration, Coal Creek Diversion Dam Design, Chico Basin Riparian Re-vegetation, Uncompahgre River Riparian Health Improvement, and Colorado River Watershed Inventory and Assessment.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 16

Applicant: Kevin Houck, Chief, Watershed and Flood Protection

Project Title: Community Assistance Program

Recommended Amount: $47,650
Requested Amount: $47,650

Description of Project: Administer the Community Assistance Program, a 75/25 partnership with FEMA for administration of the National Flood Insurance Program in Colorado.

Project Manager(s): Jamie Prochno

Program: Watershed and Flood Protection

Purpose: Provide technical and administrative assistance for communities in the state for administering floodplain regulations and other related issues. Assist communities in adopting updated floodplain management regulations, including the requirements promulgated in the Rules and Regulations for Floodplains in Colorado.

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 17

Applicant: Chris Landry - Center for Snow and Avalanche Studies

Project Title: Colorado Dust on Snow Program

Recommended Amount: $40,000
Requested Amount: $50,000

Description of Project: The Center for Snow & Avalanche Studies serves the mountain system science community and regional land and water managers by conducting comprehensive weather, snowpack, hydrology, soils, and plant community monitoring at multiple study plots within the Senator Beck Basin Study Area at Red Mountain Pass, by monitoring and reporting on dust-on-snow conditions there and at ten additional locations throughout the Colorado mountains, and by hosting and conducting interdisciplinary research investigating processes affecting the ecological services provided by mountain systems, most notably water supplies.

Project Manager(s): Kevin Houck / Joe Busto

Program: Colorado Dust on Snow (CODOS) Program

Purpose: CODOS is designed to monitor hydrologic and ecologic conditions, including dust-on-snow. The program provides operationally useful snowmelt behavior information to stakeholders and supports snow hydrology and climate change research. The Senator Beck Basin Study Area at Red Mountain Pass is 10 miles north of Silverton, CO. Ten additional CODOS program snowpack sites are near SNOTEL sites at Park Cone, Spring Creek Pass, Wolf Creek Pass, Hoosier Pass, Grizzly Peak (Loveland Pass), Berthoud Pass, Willow Creek Pass, Rabbit Ears Pass, McClure Pass and on Grand Mesa. Recent years have highlighted the vulnerability of Colorado's snow-based water supplies to extreme variability in precipitation and drought, and to the increasingly 'constant' influence of dust-on-snow. Forest health and other watershed-scale, climate driven changes in hydrology are creating additional uncertainty in current and future water supplies. This program is capturing vital data and supporting high impact research that contribute to improved understanding and water resource management.

Funding Available: July 1, 2013 – June 30, 2014

STATE OF COLORADO

Colorado Water Conservation Board
Department of Natural Resources
1313 Sherman Street, Room 721
Denver, Colorado 80203
Phone: (303) 866-3441
Fax: (303) 866-4474
www.cwcb.state.co.us

Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 18

Applicant: Bill McCormick, Chief DWR Dam Safety Branch

Project Title: Dam Failure Consequence and Vulnerability Assessments

Recommended Amount: $13,000
Requested Amount: $13,000

Description of Project: This project will combine existing dam failure inundation mapping GIS files from Emergency Action Plans with GIS-based census information to develop dam failure consequence and vulnerability data for use by dam safety and emergency management professionals for prioritization of preparedness and dam safety activities.

The study will utilize interns from the Department of Geography and Environmental Sciences at the University of Colorado at Denver, through their Experiential Learning Center, under supervision of DWR GIS and Dam Safety staff.

Project Manager(s): Kevin Houck / Kirk Russell

Program: Flood Protection

Purpose: This project intends to use the inundation mapping limits with 2010 census data in a GIS environment to develop detailed information regarding the consequences of dam failures and the vulnerability of the populations that reside within the limits of dam failure inundation zones. By performing this analysis on a large number of the high and significant hazard dams in the Colorado dam portfolio, dam safety regulatory and emergency action planning activities can be prioritized and otherwise focused to further reduce the risk of dam failure floods to citizens of Colorado.

Funding Available: July 1, 2013 – June 30, 2014

STATE OF COLORADO

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 19

Applicant: Rebecca Mitchell, WSP Section Chief

Project Title: Water Efficiency Planning Workshops

Recommended Amount: $40,000
Requested Amount: $50,000

Description of Project: With the revision of the Municipal Water Efficiency Planning Guidance Document in 2012, CWCB staff will create several workshops to assist local water providers plan for water efficiency using the Guidance Document. The workshops will focus on how to organize a water efficiency plan, the planning steps that make up a plan, the integration of water efficiency with overall water resources management, and how to evaluate and monitor progress toward implementation. The workshop attendees will have a thorough knowledge of water efficiency planning to create their own plan at the end of the workshop.

Project Manager(s): Kevin Reidy

Program: Water Efficiency Planning

Purpose: To engage water providers in the water efficiency planning process in order to increase the number of state approved water efficiency plans and implementation of water efficiency activities.

Funding Available: July 1, 2013 – June 30, 2014

STATE OF COLORADO

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Department of Natural Resources
1313 Sherman Street, Room 721
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Phone: (303) 866-3441
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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 20

Applicant: Rebecca Mitchell, WSP Chief

Project Title: Drought Preparedness and Response

Recommended Amount: $20,000
Requested Amount: $35,000

Description of Project: For the last two years, Colorado has experienced exceptional and extreme drought and in 2013, conditions are forecast to continue and possibly worsen. We know that mitigation and proper preparedness can help to reduce costly impacts during times of drought but Colorado still has yet to address all the preparedness steps that have been identified as high priority. Should conditions worsen there will also be additional response requirements that are needed. These funds would help to address forecasting, mitigation and response efforts to ensure that Colorado is as prepared as possible to address ongoing and future droughts.

Project Manager(s): Taryn Finnessey

Program: Drought Planning and Response

Purpose: These funds will help in the support of long term drought preparedness efforts as well as 2013 drought relief and response efforts.

Funding Available: July 1, 2013 – June 30, 2014

Investigation of the Effects of Whitewater Parks on Aquatic Resources in Colorado: Year 3

Dr. Brian Bledsoe, P.E., Associate Professor
Department of Civil and Environmental Engineering
Colorado State University

Location of the work: The research will be focused on several hydraulic structures along the Arkansas River near Salida, CO to test hydraulic modeling approaches and data resolution necessary for designing whitewater parks that do not impede fish passage. In addition, innovative fish passage design concepts will be demonstrated in the collaborative design of an actual whitewater park in Fort Collins, CO.

Purpose: An improved understanding of the fundamental hydraulic processes and potential environmental effects of whitewater parks (WWPs) is needed to inform management decisions about Recreational In-Channel Diversions (RICDs). This is the first study of its kind that integrates actual fish passage data and computational fluid dynamic (CFD) modeling to assess how WWP structures may affect aquatic resources. Given the lack of data on the effects of WWP on fish movement, this analysis of the physical processes affecting passage at WWPs has provided important information on the effects of WWPs on longitudinal connectivity and how these effects can be mitigated through appropriate design.

Need: There is a pressing need for design recommendations for future parks and design modifications for in-place parks that can be used by WWP designers, reviewers, and decision makers.

Objectives: This study aims to address current knowledge gaps by extending direct measurements of fish passage and relating these data to detailed descriptions of hydraulic characteristics based on field measurements and CFD modeling at multiple sites. By testing controls on fish passage at two locations (Salida, CO and Lyons, CO), we can test the transferability of our findings to different river types and settings. In addition, innovative fish passage designs will be demonstrated in the collaborative design of an actual whitewater park. The objectives of this phase of the study are focused on demonstrating transferability of findings and demonstrating design techniques in an actual project.

Completion Date: One year after notice to proceed for each task. (Exception: task 5 will commence 14 months after notice to proceed.)

Budget Justification:

Task 1: PIT Tag Antenna Maintenance at the Salida, Colorado site: The use of PIT tag antennas allows for the collection of detailed fish movement data across specific structures with unique hydraulic characteristics. These systems require weekly

maintenance to change batteries, download data and verification that the system is functioning properly. It is anticipated that approximately 16 maintenance trips will be required throughout the course of the PIT tag deployment. Deliverables: n/a

Task 2: Field Data Collection: Measurements of stream velocity, depth and total hydraulic drop will be continued over the course of the next year to characterize these variables over a range of discharges. It is anticipated that additional measurements of approximately 7-10 discharges will be required at each structure in the study site to fully characterize the hydraulic parameters affecting fish passage. Deliverables: n/a

Task 3: Data Analysis and Review: Statistical analysis of the PIT tag data will relate measured probability of fish passage to spatial metrics that integrate the velocity field along potential swimming paths, as well as fish size. HEC-RAS, River2D, and FLO-3d (3-d model) will then be used to reproduce observed hydraulic conditions to determine the resolution needed to sufficiently resolve the complex flow fields around WWP structures to enable prediction of fish passage. Deliverables: n/a

Task 4: Design Case Study: The PI and students will work with the designers of an actual WWP on the Cache La Poudre in Fort Collins, CO to demonstrate the implementation of features that increase probability of fish passage for multiple species and life stages without diminishing the quality of boating experiences. This will provide a real world example that permitting agencies can point to in which fish passage was rigorously addressed. Deliverables: see Task 5 final report.

Task 5: Report Results: A report describing the results of the PIT tag study, hydraulic measurements, and measured effects of WWPs on fish passage will be provided to CWCB. The report will also discuss practical design recommendations that were implemented in the case study in terms of the analysis performed and the effects on costs and boating. Deliverables: Final synthesis report and two M.S. theses / technical reports on WWP/RCID effects on fish passage and design case study, respectively.

Table 1. Funds requested

Task	**Budget**
Task 1: PIT Tag Antenna Maintenance	$6,270
Task 2: Field Data Collection	$13,610
Task 3: Data Analysis and Review	$7,054
Task 4: Design Case Study	$7,700
Task 5: Report Results	$3,449
Facilities and Administrative @ 15%	$5,712
Total	$43,796

Modeling the Influence of Conjunctive Water Use on Flow Regimes in the South Platte River Basin Using the South Platte Decision Support System Groundwater Flow Model

Dr. Domenico Baú, Assistant Professor
Department of Civil and Environmental Engineering, Colorado State University

Location of the Work: South Platte River Basin, Colorado

Background

The surface watershed of the South Platte River Basin (SPRB) lies on alluvial deposits that form an unconfined aquifer system connected with the surface water, with a thickness that reaches 200 ft in the lower SPRB. The aquifer, which sustains the base flow in the river, is recharged by infiltrations from precipitation and irrigation canals, as well as seepage from surface water bodies and streams. The SPRB constitutes a major source of water for eastern Colorado and has allowed agricultural growth to approach 1 million acres of irrigated cropland. Conjunctive use of surface and groundwater resources in the SPRB is regulated accordingly with the 1969 Groundwater Administration Act [Senate Bill 81], which requires all non-exempt groundwater rights to come into priority. Prior to 2003, about 9,000 groundwater irrigation wells were active in the SPRB [Nettles, 2011] with augmentation requirements of 5-10% of their water consumptive use in order to protect surface water rights. Following legislative changes that occurred in 2003-2004, water resources have been administered following strict priority rules since 2006, with all non-exempt wells required to have a decreed augmentation plan that replaces 100% of their stream depletion. As a consequence of the increased cost for acquiring augmentation water, in the last six years, about 4,000 wells have been totally or partially curtailed from pumping [Nettles, 2011], potentially resulting in reduced aquifer drainage and rising water table levels in several areas of the SPRB.

Purpose

In 2012, CSU started a research project funded by the Colorado Water Conservation Board (CWCB) to study the critical linkages between groundwater pumping for irrigation and the coupled groundwater/surface water regimes in the SPRB. This study has relied on the use of the alluvial groundwater flow model developed as a fundamental component of the South Platte Decision Support System (SPDSS). The SPDSS was developed starting in 2001 by the Colorado Department of Natural Resources (DNR), the CWCB and the Division of Water Resources (DWR) in order to support State officials and water users in the optimal planning and management of water resources [Colorado Water Conservation Board, 2001]. The SPDSS groundwater flow model has been developed by Camp Dresser and McKee [2008, 2011] using the USGS finite-difference groundwater flow code MODFLOW [Harbaugh, 2005]. The model simulates, on a monthly step, flow regimes over the entire area of the SPRB in Colorado (~2,500 mi2) during the period 1950-2006 and constitutes a crucial tool to support and improve the planning and management of water resources in the SPRB.

The long-term goal of this project is to provide the Colorado Water Conservation Board (CWCB) with an independent evaluation of the SPDSS groundwater flow model, highlighting model capabilities, strengths and weaknesses. The proposed project will be carried out over three years. In the first year, CSU has focused on the review of the SPDSS groundwater flow model, which included:

a) Analysis of model grid and time discretization to provide general considerations and directions regarding the spatial and temporal scales for which the SPDSS model seems most adequate as water management simulation tool;
b) Analysis of hydrogeological parameter distributions used in the model (hydraulic conductivity; storage properties, streambed conductance) to gain a general understanding of the extent to which the parameter distributions are representative of the SPRB hydrogeological setting;
c) Analysis of representativeness of hydrological stress data used in the model (time series of surface boundary and lateral flow conditions, groundwater pumping, and aquifer recharge) with respect to the SPRB hydrogeology;

d) Preliminary runs performed to test the numerical robustness and stability of the model with respect to hypothetical, yet realistic, changes in hydrologic stress conditions, thus assessing its ability to provide reasonable water level distributions under hydrologic stress conditions different than those utilized during model development and calibration.

Completion Date

The proposed project is conceived to be three-year long. Since funding is available only on a yearly basis, a proposal for renewal of funding is submitted to the CWCB at the end of each year. This proposal concerns works envisioned for the second year of the project.

Proposed Tasks for Year 2

It is anticipated, in the fiscal year 2013, the SPDSS groundwater flow model will be applied to perform a sensitivity study on the effect of hypothetical water management scenarios on groundwater/surface water regimes in the SPRB. The SPDSS groundwater model will serve to the primary purpose of providing engineering-based evaluations of what-if scenarios, as a most crucial step in the decision- making process. These scenarios will focus on the following realistic conditions:

(i) Increased stream augmentation by aquifer recharge that reproduces quantitatively the changes in water administration practices enacted in 2006.

(ii) Changes in aquifer pumping based upon realistic estimates of the reduction in groundwater withdrawal and its spatial distribution across the SPRB that have occurred in the last six years.

(iii) Effects on groundwater and surface water flow regimes of hypothetical drought conditions in which snowmelt upstream inflows are reduced and evapo-transpiration is increased in relation to modified atmospheric conditions and rising water table levels.

Deliverables

At the end of the second year, a technical report describing project activities and findings will be submitted to CWCB. In particular, this report will include the results of the analysis conducted in the Tasks listed above. In addition, the PI will meet with CWCB representatives at least twice a year, either at the CSU campus, at CWCB offices or via teleconference, to best coordinate the project activities, discuss project progress and future direction.

Budget Justification

The following table shows a detailed budget for the fiscal year 2013:

Graduate Student Stipend[1] +Tuition[2]	$25,754
2 Month Post-Doc Salary[3]	$8,235
0.76 Month Faculty Salary[3]	$9,489
Indirect Cost (15% rate[4])	$6,522
Total Cost for Fiscal Year 2013	$50,000

[1]Includes 5.2% fringe; [2]In-state, two semesters (9 credits); [3]Includes 25% fringe; [4]Not applied on tuition.

One Post-doctoral fellow and one PhD student will be involved and financially supported in this study. The Post-doctoral fellow will work part-time on the project (2 months), while the PhD student will be full-time (12 months). In addition the student will take courses necessary to obtain the mandatory coursework credits required towards the completion of the PhD degree at CSU, and will work exclusively in this project.

Bringing the Value of Colorado's Decision Support Systems (CDSS) to Universities and Establishing Protocols for Integrating University Research with CDSS

Steve Malers, Open Water Foundation
Reagan Waskom, Director of Colorado Water Institute, Colorado State University

Location of the work and project team: Initially the focus will be on Colorado State University in Fort Collins. However, multiple water programs at universities in Colorado will be engaged as resources allow, for example:

- University of Colorado
- Colorado School of Mines
- One World One Water (OWOW) Center for Urban Water Education and Stewardship at Metropolitan State University
- Water Center at Colorado Mesa University.
- University of Colorado

Purpose and Need: There is a need to improve university access to and use of CDSS for research and education. There is also a need to incorporate research and innovation into CDSS. The purpose of this project is to formalize relationships and protocols to address these needs and build a foundation for future interactions. Such effort can result in greater leveraging of CDSS and help educate a new generation of water resources scientists, engineers, and policy-makers. This project also will enhance research by leveraging CDSS beyond this project.

Background: CDSS has been under development for twenty years and has resulted in a significant body of work related to understanding, planning for, and managing water resources in Colorado. CDSS components include the HydroBase database and spatial data layers, model data sets, software, documentation, and processes. However, the learning curve for understanding and using CDSS offerings is intimidating and to date CDSS has primarily been utilized by a few consultants with long-term involvement in State projects. Although universities have access to CDSS, the evolving nature of research and a student workforce presents challenges to utilizing CDSS to its fullest in research and education. Additionally, the CDSS development team is not well-positioned to incorporate university research in software enhancements and procedures. These limitations result in barriers to innovation and efficiency in using CDSS at a time when water resources problems are becoming increasingly urgent.

The constraints on State budgets limit CDSS maintenance and innovation. The State of Colorado will have difficulty maintaining CDSS software with internal resources and specific projects will not holistically address maintenance and enhancement of the CDSS core software tools. CWCB staff has recommended moving CDSS software to an open source software approach and in September of 2012 the Board directed staff to develop a plan to do so. The nonprofit Open Water Foundation (OWF) is being established as an option to fill the role of CDSS software maintenance, enhancement, and support. This new organization is expected to be in place by early 2013 as a project under the Colorado Water Innovation Cluster (http://www.co-waterinnovation.com) in Fort Collins.

Approach: The OWF will coordinate with the CWI to execute the project, with the OWF providing CDSS perspective and the CWI providing university perspective. Both organizations reside in Fort Collins and personnel have been collaborating on other efforts, such as the HB 1278 South Platte groundwater study. Activities that are envisioned in the project include:

1. Determine points of contact at universities to participate in the project, including program leaders and faculty that can benefit from CDSS.
2. Determine from universities their needs relevant to CDSS, for example:
    a. Larger programs such as the CWI may serve as a point of focus for CDSS interactions
    b. Water resources courses
    c. Research projects
    d. Grant proposals may benefit from CDSS collaboration
    e. Universities that house facilities for advanced visualization and discourse (such as the OWOW Decision Theatre and Google Liquid Galaxy installation at CSU)

    Determining university needs will be accomplished with face-to-face meetings, webinars, and email exchanges. On-campus workshops will be utilized if necessary to engage larger groups.
3. Develop a roadmap that will result in two-way benefits to universities and CDSS.
4. Take action on tangible efforts that will bring CDSS benefits to universities, for example:
    a. Create/improve CDSS documentation and training materials to be suitable for universities
    b. Help install CDSS tools in university systems, for access by students and researchers
    c. Help utilize CDSS tools and data in classes
5. Implement protocols for universities to improve CDSS, for example:
    a. Define how CDSS software and processes are structured so that researchers can collaborate
    b. Work with universities to contribute to the open source software effort
    c. Improve CDSS feedback mechanisms so that university questions and comments can be used to improve CDSS offerings
6. Scale the effort up within CSU and expand to other universities, depending on interest and specific needs and benefits

The result of this approach will be an enhanced network of university researchers and educators that can benefit from CDSS and can help to improve CDSS. It is envisioned that this project will illustrate a CDSS outreach effort for universities that can be adapted for other sectors, such as the consulting community, government agencies, and nonprofits. This outreach will benefit CDSS and the State of Colorado by enhancing understanding of water resource issues, elevating the discussion of issues to use additional science and data, and expanding opportunities for dialogue, collaboration, and funding.

Deliverables: The deliverables have been discussed in the approach and are summarized as follows:

- Improved CDSS documentation and training materials, suitable for universities
- Documented protocols for university/CDSS interaction, including lines of communication and technical guidelines
- CDSS data and tool installations at universities, with supporting documentation

Additionally, a summary memorandum will be provided to the CWCB to describe the results and benefits of the project.

Budget Justification: $50,000 is requested for this project. It is expected that funds will be focused on researcher, consultant and student time to achieve core deliverables (e.g., developing training materials and defining lines of communication and protocols for CDSS/university interaction) with remaining funds being used to apply results based on interest (e.g., more universities, more training workshops, more help with laborites and courses). The majority of the budget will involve labor, with ODCs for travel and meeting expenses.

Pre-proposal Submitted to the Colorado Water Institute at Colorado State University

PROJECT TITLE: Determination of Consumptive Water Use of Corn in the Arkansas Valley

PRINCIPAL INVESTIGATORS:

Dr. Allan A. Andales, Assistant Professor of Irrigation and Water Science; Department of Soil and Crop Sciences, Colorado State University; Tel. (970) 491-6516; Email: Allan.Andales@colostate.edu
(21 years of research and teaching experience in soil and water engineering; 4 years experience with the lysimeter project)

Dr. Michael E. Bartolo, Research Scientist; CSU-Arkansas Valley Research Center, Rocky Ford, CO;
Tel. (719) 254-6312; Email: Michael.Bartolo@colostate.edu
(Research Center Manager with expertise in horticultural and agronomic crop production; 7 years experience with the lysimeter project)

Mr. Lane Simmons, Research Associate; CSU-Arkansas Valley Research Center; Rocky Ford, CO;
Tel. (719) 254-6312; Email: Lane.Simmons@colostate.edu
(B.S. Agricultural Business with 2 years experience in construction, 10 years experience with data management and statutes enforcement for Colorado Department of Agriculture, and 5 years experience with the lysimeter project and the CoAgMet weather network)

LOCATION WHERE THE WORK IS TO BE CONDUCTED: This project will be conducted at the Colorado State University (CSU) – Arkansas Valley Research Center (AVRC), Rocky Ford, CO.

PURPOSE OF THE RESEARCH

The main purpose of this research is to improve the accuracy of crop evapotranspiration (ET; also called consumptive water use) calculations for the Arkansas River Basin of Colorado.

NEED FOR THE RESEARCH

One of the recommendations that came out of the Kansas v. Colorado Arkansas River Compact litigation is for Colorado to use the American Society of Civil Engineers (ASCE) Standardized Penman-Monteith equation (PME) to estimate crop ET in the Arkansas River Basin. This equation requires accurate measurements of hourly weather data (solar radiation, air temperature, humidity, wind speed) to calculate a reference crop ET (ET_r), which is a measure of local atmospheric demand for water. Crop ET (ET_c) is then calculated by multiplying ET_r by a crop coefficient (K_c) that varies with crop growth and development.

This proposed project will continue the long-term research to date, to more accurately calculate the ET_c of major irrigated crops in the basin, by defining the crop coefficients (K_c) used to convert ET_r to ET_c values and by validating (ground-truthing) the ET_r values calculated by the ASCE-PME for local conditions in the Arkansas River Basin. Corn is a dominant irrigated crop in the basin and will be the focus of this project for years 2013 to 2014. The more accurate calculations of ET_c will ultimately improve the estimates of river flow that are used to determine compliance with the Arkansas River Compact. Related to this, accurate hourly weather data from 12 automatic weather stations in the basin are continuously needed to calculate ET_r and ET_c for the entire basin. These weather stations are part of the Colorado Agricultural Meteorological Network (CoAgMet).

This work will also capitalize on the progress to date in validating calculated ET_r from ASCE-PME with measured alfalfa ET_r from the lysimeters.

Andales: Lysimeter

OBJECTIVES

1. Develop a seasonal crop coefficient curve for corn that accounts for local environmental conditions in the Arkansas basin.
2. Assess the agreement between calculated alfalfa reference ET values from the ASCE-PME and measured alfalfa ET values from the reference lysimeter.

DELIVERABLES:

The objectives will be achieved in close collaboration with engineers in the Colorado Division of Water Resources (CDWR). Updates on the project will be given to local stake holders, including the Lower Arkansas Valley Water Conservancy District, Arkansas Basin Roundtable, and local growers. The following will be the major deliverables of the project.

1. Seasonal crop coefficient curve that characterizes corn ET_c (2013 growing season) at different developmental phases; and is appropriate for local conditions in the Arkansas Basin.
2. Observed seasonal consumptive water use (ET_c) of corn (2013).
3. Accurate hourly weather data from 12 CoAgMet stations in the basin, made available through the CoAgMet online database.
4. Comparison of calculated alfalfa ET_r from ASCE-PME and measured alfalfa ET from the reference lysimeter. A comprehensive analysis will be done of the behavior of the ASCE-PME under varying weather conditions in the Arkansas Valley. The analysis will reveal differences between ASCE-PME ET_r and lysimeter-measured alfalfa ET in standard conditions. The specific weather conditions that cause significant differences will be characterized.
5. One technical report published by the Colorado Water Institute detailing the methods and findings of the CSU research team.

COMPLETION DATE

This project will be conducted from July 1, 2013 to June 30, 2014.

BUDGET AND JUSTIFICATION

We are requesting $28,750. This amount includes a 15% Indirect of $3,750. This budget will partially pay for one full-time research associate, who will manage the day-to-day operation of the lysimeters, take all measurements, and process the data. The budget will also cover travel of CSU investigators, software, field and lab supplies, publication, and other miscellaneous expenses. The CSU Agricultural Experiment Station will provide matching funds for management of land and facilities at the Arkansas Valley Research Center and salary of CSU investigators.

Developing Metrics for Colorado Agriculture's Production and Efficiency with Water Resources

Principal Investigators: James Pritchett, PhD and Chris Goemans, PhD

Contact: James Pritchett, Agriculture and Resource Economics, Colorado State University, email: james.pritchett@colostate.edu, ph: 970-491-5496

Location of work and project team: This project's scope is focused on Colorado, but metrics will be developed for individual watersheds within the state. The project team will consist of researchers at the Colorado Water Institute located at Colorado State University, Fort Collins, CO.

Purpose and Need: Water is a scarce resource in Colorado whose rights are (nearly) fully allocated. Demand for water resources is expected to increase as population grows in Colorado. Moreover, climate change is increasing water requirements for the environment and the production of irrigated crops. While conservation, water pricing and infrastructure may play a role in meeting Colorado's increasing water demands, it is generally accepted that water rights will be transferred in ownership and use from agriculture to urban water suppliers.

Colorado agriculture blossomed with the development of water resources used for growing crops, which, in turn, spurred value-added production in the meat, sugar and dairy sectors. Agriculture is currently an important base industry in Colorado generating more than $6 billion dollars of farm gate receipts and contributing broadly to the state's economic activity – nearly 20% of Colorado's gross domestic product can be traced to agriculture or allied industries. It is also a sector in transition with new markets developing, technological innovations improving efficiency, laws and institutions evolving and, importantly, agriculture is seeing increasing competition for key resources such as land and water. New urban development is assumed to spur the reallocation of an additional six hundred thousand to one million acre feet of agricultural water to new municipal, industrial and energy demands by 2040 (SWSI 2010).

The reallocation of water from agricultural to other uses is a voluntary, market based transaction. Both the buyer and seller are suitably compensated in water transactions else they would not occur. In spite of compensation, the changes in water use and/or diversion are very contentious to the public because of third party effects. These effects include the disruption of the rural, regional economic base – irrigated agriculture contributes to a host of allied industries for farm inputs (fertilizer, chemical and seed) and value added industries with its outputs (feed, raw products for sugar, dairy, energy, etc.). The lost agricultural economic base may mean that future opportunities in crop production or value added enterprises are foregone. Lastly, the reallocation of water resource may impact the productivity of the agricultural sector – less water may reduce sector's overall value of goods produced, but the efficiency with which water is used to produce crops (or crop value) could potentially increase with management adaptation.

The purpose of this study is to create a simple metric(s) that proxies the level of production and efficiency with which agriculture uses its water resources.

Readily available data resources will be used to construct the metric so that agriculture's output and efficiency are easily benchmarked. The utility of the metric(s) will be demonstrated by describing the historical evolution of irrigated cropping and allied industries. The metric can also be used to gauge the impacts of potential water scenarios posed by stakeholders such as the IBCC.

Methods and Project Outline: Economists use metrics and indices to gauge changes in economic activity in industries, local economies and macroeconomics. Examples include measures such as the consumer price index, the Malmquist index and the Gini coefficient. This study's metric will focus on gauging irrigated cropping productivity and intensity with easily obtainable data. The index will be comprised of no more than 3 to 5 data series.

The methods begin with a review of the economic literature concerning productivity measures and indices used to measure agricultural activity. As an example, Griliches has written extensively regarding agriculture indices and productivity growth. Data sources used to construct the metric/index will be reviewed and obtained. Example data series sources include but are not limited to:

(a) USDA Census of Agriculture data series: a 5 year census of agriculture producers.
(b) USDA National Agriculture Statistic Series Annual Bulletin: a single year survey sample
(c) USDA Farm and Ranch Irrigation Survey (FRIS): a 5 year sample of census respondees
(d) Colorado Department of Revenue Property Tax Assessment and Valuation Data

The data series will be collected into spreadsheets for ease of use and charting. Data series will extend for as long a period as appropriate given reporting conventions and availability. It is anticipated that data series will begin in and around 1970. Hyperlinks to online data sources will be embedded in the spreadsheet for updating.

Alternative metrics will be constructed for major Colorado watersheds across the time period, and then changes in the metrics will be interpreted. Results will be reviewed by an advisory group of professionals including scientists, CDM and CWCB staff. Adjustments will be made as appropriate.

Deliverables: The deliverables for this report will include the data series and metric construction within a spreadsheet, a technical fact sheet describing the construction of the metric, assumptions and potential limitations, a fact sheet using the metric to interpret historical data for Colorado agriculture.

Timeline: Work will begin March 1, 2013 and conclude on or before February 28, 2014.

Budget: We are requesting a total of $ to fund faculty time, a graduate research assistant, travel, survey materials and publications.

Personnel		
	1 month faculty time + fringe	$11,160
	9 months graduate research assistant (plus fringe and tuition)	$25,034
Other		
	Travel*	$1, 311
Indirect		
	15% Indirect Rate	$5,626
Total		$43,131

*Travel expenses include resources sufficient for approximately data collection and results presentations.

Proposed Project: Assessing the agronomic feasibility of single-season irrigation deficits on hay as part of a Western Slope Water Bank.

Co-PI's: Denis Reich [Denis.Reich@Colostate.edu] – Research Associate III/Extension Water Specialist; Joe Brummer – Associate Professor/Extension Forage Specialist.

Location: Six established hay fields with a full season of irrigation water normally available in four Western Colorado drainages: Colorado, Gunnison, Yampa, and White.

Purpose of the research: To determine potential water savings, crop response, and salient environmental impacts from strategic deficit irrigation on hay fields in Western Colorado agricultural environments (Lower Valley, Mid Valley, and Mountain Meadow).

Need for the research: Under the 1922 Colorado River Compact, the four Upper Division States may not allow the flow at Lee Ferry to drop below a 10-year running average of 75 million acre-feet (MAF) or else be subject to curtailment. The current 10-year average is about 90 MAF, and while the threat of curtailment is not imminent, there is growing concern in Colorado that a combination of factors may conspire to hasten the onset of curtailment[1]. These factors include the possibility of a new trans-mountain project, full use of existing systems, new demands from energy development including oil shale, and growth in demands and water use stemming from climate change.

Western Slope water users account for about 1.3 million acre feet of Colorado River Basin (CRB) Water of which about 1 million are pre-1922 and exempt from compact administration[2]. The populated Front Range diverts about a half-million acre feet of CRB water of which the majority are junior to 1922[2]. A possible curtailment scenario is Colorado's post-1922 water rights forgoing use (or a negotiated fraction) until all of the 75 million acre feet 10-year running average non-depletion requirements to the Lower Division States[3] are restored. A water bank arrangement might consist of short term leases allowing pre-1922 agricultural rights to be used temporarily by post-1922 municipal and industrial – mostly Front Range - water right holders.

Collectively the study area includes about 360,000[4] acres of irrigated grass and/or alfalfa hay. *Many Colorado CRB water bank discussions focus on legal framework, administration logistics, and return flow implications. Still to be determined is the agronomic feasibility for individual irrigators* within this area. Without addressing these concerns water bank participation from private producers would be problematic.

Objectives: "Deficit irrigation" refers to withholding water during non-critical crop growth stages. For this study mid to lower elevation environments would deficit irrigate by seasonally irrigating alfalfa and/or grass hay as normal up to the first cutting *only*. For higher elevation mountain meadows, where only one cutting of hay is taken per season, a "deficit" treatment means *no* water is applied to the field for the entire growing season.

Using side-by-side i.e. "deficit" versus "business as usual" irrigation treatments[5] this project will answer three basic questions about these approaches: 1) What is the likely impact on hay stand life, productivity (measured as tons per acre per year), and quality

[1] Kuhn, E. 2012. Risk Management Strategies for the Upper Colorado River Basin. *Colorado River District.*

[2] Huggins, L. Colorado River Water Bank: Making Water Conservation Profitable. *Property and Environment Research Center*.

[3] It's assumed the United States would be honoring its 1.5 million acre-foot per year treaty deliveries to Mexico.

[4] 2007 USDA Census of Agriculture acreages for the four West Slope basins hosting the six study sites.

[5] Some sites will include additional treatments: a) hay cuttings after the deficit period; b) fallowed annually cropped ground.

due to a single-season deficit? 2) What is the potential range of marketable, saved (otherwise consumed) water per acre of single-season deficit irrigated hay in Western Colorado? And 3) are there any obvious environmental benefits or concerns to deficit irrigating hay? For example, what are the benefits of deficit irrigating perennials versus fallowing annually cropped ground? What are the implications for in-stream salt and selenium concentrations in Mancos shale areas?

Timeline and completion date: This proposal is a request to fund the first year (Mar-1-2013 to Feb-28-2014) of a two-year project. Preliminary reporting of the 2013 project would be submitted in time to support a second proposal with a similar budget for 2014.

Project	Full Proposal		Site prep		Monitoring, Data Collection, Preliminary Report				2nd Year Proposal	Analysis, Evaluation		1st Year Report		Start 2nd Year
Year	**2013**											**2014**		
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Student	Recruit/ Hire		With Co-PIs		Summer on West Slope				With Co-PIs						

Budget:

Item	Request	Indirect 15%	Request Total	Match	Project Total
Graduate Student	$21,204	$3,181	$24,385		$24,385
Fringe (5.1%)	$1,081	$162	$1,243		$1,243
In-State Tuition	$8,392	$1,259	$9,651		$9,651
Team Travel	$7,398	$1,110	$8,508	$1,500	$10,008
Accomodation Stipend	$1,950	$292	$2,242		$2,242
Data Collection	$3,450	$517	$3,967	$3,500	$7,467
Totals	$43,475	$6,521	**$49,996**	$5,000	**$54,996**

Budget justification: Total Request = $49,996

Graduate Student ($30,677): Covers salary, fringe benefits, and tuition.

Travel and Accommodation ($9,348 + $1,500 cash match): Allows Co-PIs and student to travel to six West Slope sites (mileage at $0.50/mile); some overnights ($105 incl. tax); and per diem ($45/day). 4 months of $150/week accommodation stipend included for student's summer on West Slope.

Data Collection ($3,450 + $3,500 cash match): Provides instrumentation to monitor crop water use (atmometers and soil sensors for ground-truthing CoAgMet data collection). Also three soil samples per treatment, per site for the season; includes complete fertility and soil characteristic analysis with salt and selenium tests where applicable. Also two forage quality tests per treatment, per site for the season.

Match ($5,000 or 10%): Cash match provided by Environmental Defense Fund specifically for water bank related work. $3,500 would pay for additional monitoring and instrumentation, $1,500 would pay for additional travel. Student supervision, extension support, and monitoring/data collection of hay yields also provided in-kind.

Accompanying Projects: In addition to related work and proposals (modeling by Colorado River District, drought resilient irrigation strategies by Trout Unlimited), an accompanying CWCB-Alternative Agricultural Water Transfer Methods proposal will be submitted by the Co-PIs this winter. The Colorado River District, Northern Water, The Nature Conservancy, and private landowners were consulted on this pre-proposal.

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 27

Applicant: Ted Kowalski, IFWI Chief

Project Title: Work related to Recreational projects

Recommended Amount: $0
Requested Amount: $80,000

Description of Project: CWCB staff has typically requested funds each year to either: 1) fund work associated with the litigation of RICDs; or 2) fund projects that have benefits to recreational interests. In the next fiscal year, the CWCB is expecting to receive requests from both Pitkin County and Grand County to assist in the design or construction of their proposed whitewater courses. Products may include: 1) finalization of design drawings and permitting for these communities to move toward building a Recreational In-Channel Diversion (RICD) and/or, 2) construction of RICD structures. The funds may also be used to obtain data or information related to stream-related recreation that could be used to assure Colorado could fully use its compact entitlements and support the tourist recreation-based economy that exists in Colorado.

Project Manager(s): Suzanne Sellers

Program: Recreational Project

Purpose: These funds will help assist mountain communities with their economies by increasing tourism, recreation-based tourism in particular. Wild and scenic rivers and RICD water rights, and the structures themselves, affect water planning in many important ways. The statutes and CWCB's policies on recreational use of water and on RICD's demonstrate a need to ensure compliance by local communities and to help protect Colorado's compact entitlements and to assure maximum utilization of Colorado's water resources. To the extent that recreational uses of water and RICD structures are designed and constructed in a manner that promotes maximum utilization of Colorado's water resources and that allows Colorado to fully use its compact entitlements, then CWCB's missions are being fulfilled.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 28

Applicant: Jeff Lukas, Western Water Assessment

Project Title: Potential to Improve Storage and Reduce Shortage through Coordination between Reservoir Operations and Tributary Flows in the Lower Colorado River Basin

Recommended Amount: $0
Requested Amount: $25,000

Description of Project: The United States Bureau of Reclamation (Reclamation) operates several mainstem reservoirs in the lower Colorado River basin. Reclamation has also recently completed its Colorado River Basin Water Supply and Demand Study (CRBS) to assess imbalances between supply and demand in the Colorado River basin. Current and future imbalances are notable in the lower basin. Both modeling and actual reservoir operations in the lower basin lack important information about tributary flows, leading to excess reservoir releases that deplete much-needed storage.

Reclamation has committed to improve their modeling of the tributary flows. Western Water Assessment (WWA) has significant expertise in using multiple hydrologic and statistical techniques and data sources to better estimate natural flows on streams with limited amounts of streamgage and water use data, including the Gila River. WWA also has constructed a model assessing reservoir storage and risk of dryup of storage in the Colorado River Basin. WWA proposes to work with the CWCB and other stakeholders in the CRBS to develop the natural flow data needed by Reclamation and to help assess the potential for conserving storage through better coordination of reservoir releases with downstream tributary flows.

Project Manager(s): Michelle Garrison / Ted Kowalski

Program: Colorado River Compact

Purpose: Research the ability to improve reservoir storage in Lake Powell and Lake Mead and reduce risk of shortage in the lower Colorado River by coordinating reservoir operations with expected downstream tributary inflows.

Funding Available: July 1, 2013 – June 30, 2014

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 29

Applicant: Elaine Kleckner, El Paso County Bd. of Commissioners, Groundwater Quality Study Committee

Project Title: Groundwater Quality Study, Phase 2

Recommended Amount: $0
Requested Amount: $56,000

Description of Project: Cost-share assistance for a $321,000 groundwater quality study in the Upper Black Squirrel Creek designated basin. Phase 2 consists of locating and/or installing additional monitoring wells to establish a baseline network in conjunction with USGS and measuring various water quality parameters. Data on groundwater age and flow paths will be analyzed and used to produce maps of areas susceptible to potential contamination.

Project Manager(s): Steve Miller / Andy Moore

Program: Interstate, Federal, and Water Information

Purpose: The stated purpose of study is to support future land use planning decisions and to determine the potential for further conjunctive use and storage in the aquifer. This study is not recommended for STOA funding since water quality is not a core mission of CWCB and because the applicant has already received $35,000 from WSRA.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 30

Applicant: Cory Williams, U. S. Geological Survey

Project Title: Hydrodynamic Modeling of the Yampa River in Deerlodge Park

Recommended Amount: $0
Requested Amount: $39,000

Description of Project: The lower Yampa River in northwestern Colorado is the largest, relatively unregulated river system in the upper Colorado River basin. Water from the Yampa River basin continues to be sought for a number of municipal, industrial, and energy uses; specifically, development and storage of peak streamflows during the snowmelt-runoff hydrograph. It is anticipated that future water development within the Yampa River Basin above the amount of water development covered under the Upper Colorado River Endangered Fish Recovery Implementation Program and the Programmatic Biological Opinion may require additional National Environmental Policy Act (NEPA) compliance and analysis of the effects of sediment transport on species. It has been shown in previous investigations by Elliott and others (1984) that reductions in peak streamflow magnitude and duration can significantly change the transport and storage of sediments within important reaches of the Yampa River. This change in transport and storage may lead to changes in channel geometry, riparian vegetation, and aquatic habitat. This study proposes the calibration and publication of hydrodynamic model simulations that can be used by stakeholders to understand the potential effects of altered peak streamflow on sediment transport and storage in Deerlodge Park, an important alluvial-park reach of the Yampa River identified by the National Parks Service.

Project Manager(s): Jeff Baessler

Program: Instream Flow and Natural Lake Level Program

Purpose: The study will provide published hydrodynamic simulations and analysis examples that can be used by stakeholders to evaluate the effects of streamflow-alteration scenarios on sediment transport, a process that is critical to maintaining the geomorphology and function of the Yampa River in Deerlodge Park.

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 31

Applicant: Kevin Houck, Watershed and Flood Protection Chief

Project Title: Post-fire flow and sediment response to geomorphic based restoration: Waldo Canyon, Hayman and High Park Fires, Colorado

Recommended Amount: $0
Requested Amount: $50,000

Description of Project: The stormflow response of a post-fire restoration site suggests that the flow and sediment regime are changed by rerouting the stormflow runoff from channelized, entrenched gullies onto alluvial fan surfaces associated with braided channels. The restoration approach appears to increase lag time, decrease peak flow magnitude, and store sediment that occurred within the basin on the braided channel surface. Surface and sub-surface water exchange also appear to have increased baseflow at the toe of the fans as evidenced by oxbow channel outflows from sub-surface increases. To develop an empirical flow model to predict or simulate flow response to similar treatments, detailed field observations are needed. The installation of streamflow gages are required to monitor stormflow runoff for various precipitation events for streams above versus below the sediment detention basins and fans in addition to a nearby untreated reach. A recording precipitation gage must also be installed in the vicinity of the streamgages. This restoration approach of reconnecting streamflows to alluvial fans, filling gullies, and re-establishing stable stream types is actively occurring in the Hayman burn area, and it is likely to occur in the Waldo Canyon and High Park burn areas. Thus, a good opportunity presently exists to design a research project to evaluate the effectiveness of such work. Future recommendations can then be made to better advise those responsible for post-fire rehabilitation and restoration efforts.

Project Manager(s): Chris Sturm
Program: Watershed and Flood Protection

Purpose: To predict stormflow response of a geomorphic, post-fire restoration treatment. To predict changes in sediment transport and sedimentation resulting from post-fire restoration treatment. Determine effectiveness of treatments designed to dissipate stream energy and store sediment in the watershed (as opposed to the nearest downstream reservoir).

Funding Available: July 1, 2013 – June 30, 2014

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Severance Tax Trust Fund Operational Account
Proposed Project for Fiscal Year 2013 – 2014
Project No. 32

Applicant: Dan Breed, University Corp. for Atmospheric Research

Project Title: Modeling Study of Seeding Plumes in Colorado Weather Modification Programs

Recommended Amount: $0
Requested Amount: $46,000

Description of Project: The National Center for Atmospheric Research (NCAR) is a federally funded research and development center sponsored by the National Science Foundation (NSF). NCAR's mission is to plan, organize, and conduct atmospheric and related research programs and provide state-of-the-art research tools to the atmospheric sciences community. This Project will be modeling to assess the effectiveness of the ground-based generators. The WRF model will run many cases of seeding events, attempting to cover a representative range of seeding conditions. Trajectories (i.e. plumes) from each generator would be calculated and displayed. One or two plume models will be output for an entire winter season for all the seeding programs. Scientist will compare (i.e. validate) these model results to the trajectories from the select cases run with the 4-km WRF model and the high-resolution (1-km) WRF model runs.

Project Manager(s): Joe Busto

Program: DNR/CWCB Weather Modification Permitting Program

Purpose: The State's WM Rules were updated in 2012 requiring evaluation proposals be submitted to sponsors. The CWCB is helping permit holders implement these new Rules by developing meaningful evaluations. The total proposal was $92,000 and the other half will need to be raised by sponsors in the seven different target areas in Colorado. Cloud Seeding is a $1M/year program collectively in Colorado and evaluations can increase effectiveness and credibility and give us scientific evidence to help refine our programs if needed.

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 33

Applicant: John Sutherland, City of Lamar

Project Title: City of Lamar Levee Improvement Project

Recommended Amount: $0
Requested Amount: $108,400

Description of Project: ICON Engineering was hired by the CWCB through FEMA to perform a flood map study for a new Flood Insurance Rate Map (FIRM) for communities along the Arkansas River. As a result, levees along Willow Creek that had been installed after the 1965 flood event were found to need from three to live feet of freeboard addition in order to come into compliance with the new FEMA requirements. The City of Lamar spent $15,000.00 for their part of the new FIRM study; $56,510.00 for a levee study from Olsson Associates; and have hired Clark Engineering as consultant. Olsson Associates have estimated the cost to bring the levees up to FEMA specifications at $621,660.00 which does not include property or easement acquisition. This study will give us an exact plan in order that we may budget the funding yearly.

Project Manager(s): Jamie Prochno

Program: Watershed and Flood Protection

Purpose: Certification of the Willow Creek levee is necessary in order to continue showing the levee is protecting against the 100-year flood event on the updated FEMA flood maps. This certification process will involve extensive research on existing conditions and available data, construction and continued operations and maintenance. The success of this project will prevent approximately 1692 people or 21.7% of the population from being placed in the floodplain and reduce the flood insurance rates for homeowners who will still be strongly encouraged to purchase flood insurance.

Funding Available: July 1, 2013 – June 30, 2014

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Proposed Project for Fiscal Year 2013 – 2014
Project No. 34

Applicant: Reagan Waskum, CSU - Colorado Water Institute

Project Title: Calculate the Effects of Sago Pondweed on Evaporation in Canals

Recommended Amount: $0
Requested Amount: $37,244

Description of Project: This is ongoing lab research and field experimentation project to look at different types of management strategies to address canal efficiency issue through the emerging issues with Sago Pondweed and Eurasian Water Millfoil.

Project Manager(s): Joe Busto / Ray Alvarado

Program: Watershed and Flood Protection

Purpose: While sago pondweed has been a problem for irrigation districts for many years, EWM is an emerging threat that could have more significant impacts. EWM is considered the hydrilla of temperate climates. It is a very serious submersed aquatic weed species infesting many areas of the USA. EWM interferes with recreational activities (boating and swimming), power generation, and sport fishing. In Colorado, EWM is moving from Boulder Creek into irrigation systems supplied by Boulder Creek. The State of Idaho provided 4 million dollars to assist various state and local agencies with efforts to map and manage EWM infestations, as well as increase public awareness of how this invasive weed species can be spread by boating and fishing activities. That is a good indication of how serious this problem could be. In contrast to Idaho's situation, Colorado is in a much earlier stage of the invasion process and many of the sites currently infested have limited access. This provides Colorado with an opportunity to mount a coordinated effort of containment, management and education.

Funding Available: July 1, 2013 – June 30, 2014