STATE OF COLORADO

Colorado Water Conservation Board
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TO: Colorado Water Conservation Board Members

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

DATE: March 7, 2014

SUBJECT: **Agenda Item 34, March 18 - 19, 2014, Board Meeting**
Finance Section - Severance Tax Operational Fund Grants
Approval of Project Recommendations

Introduction

CWCB is entitled to an amount up to a 5% share of the Severance Tax Operational Fund. In January 2014, CWCB received internal requests and outside applications for funding that becomes available from the Operational Fund in July 2014 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 pages 2 and 3 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 Severance Tax Operational Fund as summarized as Table 1 to this memo. Recommended projects are numbered 1 – 27 and projects not recommended are numbered 28 – 32.

Table 1

SEVERANCE TAX OPERATONAL FUND PROJECTS

FOR FUNDING FROM JULY 1, 2014 TO JUNE 30, 2015

NO.	SPONSOR	PROJECT	AMOUNT
		INTERSTATE, FEDERAL & WATER INFORMATION	
1.	CWCB	3D Visualization of So Platte Alluvial Aquifer	$50,000
2.	CWCB	Colorado River Contingency Planning	$50,000
3.	CWCB	Trinidad Project Irrigated Acres Map Reconciliation	$25,000
4.	CWCB	Work Related to Recreational Projects	$50,000
5.	USGS	High Precision GPS Survey of Observation Wells	$69,000
6.	USGS	Countywide Groundwater Monitoring Network	$49,000
7.	UAWCD	Water Commissioner Daily Report – Grape Creek	$ 9,000
8.	UAWCD	Water Commissioner Daily Report – Taylor Creek	$ 7,300
		Finance	
9.	DWR	Dam Safety Inundation Mapping Grant Program	$25,000
10.	BCRC&PC	Bull Creek Reservoir #4 Wetlands Study	$14,250
11.	Fraser	Town of Fraser Firming Project	$50,000
		Stream & Lake Protection	
12.	CWCB	Case Management and Litigation Support	$65,000
13.	CWCB	Stream and Lake Protection Operational Budget	$ 5,000
14.	USGS	Computing Discharge Under Ice	$100,000
		Watershed & Flood Protection	
15.	CWCB	Flood Mitigation and Project Compliance	$75,000
16.	CWCB	Community Assistance Program	$47,650
17.	CSAS	Colorado Dust on Snow Program	$40,000
18.	CSU	Building Mitigation Capability	$65,000
		Water Supply Planning	
19.	CWCB	Surface Water Supply Index Automation and Web-based Public Access	$50,000
20.	CWCB	Water Planning and Operational Needs	$82,751
		Total for CWCB Program Projects	$929,851

		Table 1 (Cont.)	
		Higher Education	
21.	CSU	Determination of Consumptive Water Use of Corn in the Arkansas Valley	$46,137
22.	CSU	Modeling the Influence of Conjunctive Water Use on Flow Regimes in the South Platte River Basin	$50,000
23.	CSU	Developing an Unmanned Aerial Remote Sensing of ET System	$50,000
24.	CSU	Data Collection and Analysis in Support of Improved Water Management in the Arkansas River Basin	$50,000
25.	CSU	Development of Visualization Tools for South Platte	$50,000
26.	CSU	Assessing the Agronomic Feasibility of Single-season Irrigation Deficits on Hay as Part of a Western Slope Water Bank	$49,512
27.	CSU	Colorado Agricultural Meteorological Network	$50,000
		Total for Higher Education Projects	$345,649
		Total Severance Tax Operational Fund Recommendations	$1,275,500
		Projects Not Recommended for STOF Funding	
28.	CGS	County Groundwater Resources Series, Year 3	$45,000
29.	USGS	Modification of USGS Groundwater Model Program	$25,000
30.	USGS	Groundwater-level Monitoring	$16,300
31.	USGS	Post-Wildfire Effects on Snow Accumulation, Sublimation and Snowmelt	$98,500
32.	OWF	Surface Water Supply Index Web Tool	$50,000
		Total Projects Not Recommended for STOF Funding	$234,800

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 1

Applicant: Tim Feehan, Deputy Director

Project Title: Three-Dimensional Visualization of South Platte Alluvial Aquifer

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

Description of Project: CWCB and CDWR, in conjunction with Brown and Caldwell, propose to develop a series of three-dimensional (3D) visualizations of the data compiled for the Sterling and Gilcrest/LaSalle pilot studies and the HB 12-1278 study. This effort would include acquiring and reviewing the existing data collected for these studies along with additional spatial data, including data extracted from the existing South Platte Decision Support System (SPDSS) Alluvial Groundwater Model. These data would then be reduced to the appropriate spatial extents as necessary and entered in to the 3D visualization software packages EVS and Leapfrog.

Project Manager(s): Tim Feehan/Ray Alvarado/Andy Moore

Program: Interstate, Federal, and Water Information Program

Purpose: This three-dimensional visualization will be used to display the data to show changes in groundwater surfaces and volumes over time, geologic/lithologic information, surface water flows, recharge augmentation volumes, irrigation applications, and groundwater extraction from wells.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 2

Applicant: Ted Kowalski, IF&WI Chief

Project Title: Colorado River Contingency Planning

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

Description of Project: The last 13 years in the Colorado River have been the driest 13 year period in the last 1000 years. The main reservoirs within the Colorado River system sit at 50% full and if the recent hydrology continues, there could be very detrimental effects on Colorado. In particular, if Lake Powell was to drop below minimum power pool, power rates could increase dramatically. In addition, the Endangered Species Fish Recovery Programs in the Upper Colorado River Basin, the Salinity Control Program, the Adaptive Management Work Group for Glen Canyon Dam, and other important programs could see funding completely evaporate. As such, additional modeling work could help the State prepare contingency plans for the possibility that we may continue to see very dry hydrology.

Project Manager(s): Ted Kowalski / Michelle Garrison

Program: Interstate, Federal, and Water Information Program

Purpose: This modeling work will be used to assist the State of Colorado in developing a contingency plan of action for low reservoir conditions within the Colorado River Basin. Any contingency plan that would be developed would be vitally important to the State's future use of its Colorado River Compact entitlements, and to the State's future compact compliance within the Colorado River Basin.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 3

Applicant: Ted Kowalski, IF&WI Chief

Project Title: Trinidad Project Irrigated Acres Map Reconciliation

Recommended Amount: $25,000
Requested Amount: $50,000

Description of Project: In cooperation with the Purgatoire River Water Conservancy District and the Division 2 Engineer reconcile historical irrigated acreage served by the Trinidad Project with recent GIS mapping of irrigated acres within the project area. The approximately 20,000 "Project Irrigated Acres" were defined in a series of contracts from the 1960's, but those descriptions don't align with more recent mapping based on aerial photography. This project will research the original parcel descriptions and locate them accurately on new GIS map products. Field verification of actual irrigated parcels will identify any discrepancies. Work will be accomplished using a combination of consultant services, temporary field technicians, and potentially summer interns.

Project Manager(s): Steve Miller

Program: Interstate Federal and Water Information Program

Purpose: Reconciliation of the parcels authorized to use project water with up to date GIS mapping will allow better monitoring of project operations, remove a potential source of controversy with the State of Kansas, and incorporate project historical documents into the new ArkDSS database.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 4

Applicant: Ted Kowalski, IF&WI Chief

Project Title: Work Related to Recreational Projects

Recommended Amount: $ 50,000
Requested Amount: $120,000

Description of Project: 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 anticipating that it may receive requests to assist local governments (i.e. Town of Lyons, Gunnison County, etc.) in the design, construction or repair of their whitewater courses. Products may include: 1) finalization of design drawings and permitting for these communities to move toward building and/or repairing their Recreational In-Channel Diversions structures (RICD) and/or, 2) construction or repair of RICD structures. Staff may also use these funds for expert testimony in the upcoming Glenwood Springs RICD application. The funds will 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 Colorado's tourist recreation-based economy.

Project Manager(s): Suzanne Sellers

Program: Recreational Projects Program

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, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 5

Applicant: U.S. Geological Survey

Project Title: High-Precision GPS Survey of Observation Wells in the South Platte Alluvial Aquifer

Recommended Amount: $69,000
Requested Amount: $69,000

Description of Project: This project will utilize real-time kinematic (RTK) global positioning system (GPS) to accurately measure the latitude, longitude, and elevation of the measuring points of observation wells located in the South Platte alluvial aquifer. The USGS is providing matching funds of $29,500.

Recent water-table rise observed in some parts of the aquifer have caused concern regarding water management in the basin. In 2013, water-level data sets from various federal, state, and local agencies were compiled and analyzed. The accuracy of the location and elevation of these wells varied greatly and the datum information was inconsistent. To compare data sets and analyze groundwater flow patterns throughout the aquifer, it is essential to accurately measure the locations and elevations of observation wells.

Project Manager(s): Tim Feehan/Ray Alvarado/Andy Moore

Program: Interstate, Federal, and Water Information Program

Purpose: Data collected from this project will provide the basis from more accurate long-term monitoring of South Platte alluvial aquifer water levels.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 6

Applicant: U.S. Geological Survey

Project Title: Implementation of a County-Wide Groundwater-Monitoring Network for Denver Basin Aquifers, Elbert County, Colorado

Recommended Amount: $49,900
Requested Amount: $49,900

Description of Project: The objectives of this study are to establish a well network for long-term monitoring of groundwater levels in the Denver Basin aquifers throughout Elbert County and to use the network to collect frequent groundwater-level data. The network will utilize about 30 existing wells and will include wells completed in each of the Denver Basin aquifer units: the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers. The USGS is providing matching funds of $26,900.

Groundwater levels will be measured bi-monthly in all wells and a portion of the wells will be instrumented with pressure transducers and data loggers to record more frequent water levels. Data collected will be used to describe seasonal and long-term water-level trends in the Denver Basin aquifers within Elbert County.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information Program

Purpose: A detailed program to monitor groundwater levels in the Denver Basin aquifers throughout the county is needed to assist the Elbert County Board of Commissioners with making informed policy decisions about limited groundwater resources.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 7

Applicant: Upper Arkansas Water Conservancy District

Project Title: Water Commissioner Daily Report – Grape Creek

Recommended Amount: $9,000
Requested Amount: $9,000

Description of Project: The applicant will work with the Division 2 Engineer and his staff to design and install a web posting for DWR's web site, displaying the Grape Creek water rights administration information, and to provide timely notification to water users of its posting. The posting will include in-priority water rights, location of Grape Creek and Arkansas River calls, exchangeable flows at control points and operating exchanges.

This type of report has already been used successfully on the South Arkansas River and Cottonwood Creek.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information Program

Purpose: The project will significantly improve the flow of water rights administration information from the water commissioner to Grape Creek water users. The water commissioner will be able to immediately communicate water call and exchange potential to all water users.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 8

Applicant: Upper Arkansas Water Conservancy District

Project Title: Water Commissioner Daily Report – Taylor Creek

Recommended Amount: $7,300
Requested Amount: $7,300

Description of Project: The applicant will work with the Division 2 Engineer and his staff to design and install a web posting for DWR's web site, displaying the Taylor Creek water rights administration information, and to provide timely notification to water users of its posting. The posting will include in-priority water rights, location of calls, exchangeable flows at control points and operating exchanges.

This type of report has already been used successfully on the South Arkansas River and Cottonwood Creek.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information Program

Purpose: The project will significantly improve the flow of water rights administration information from the water commissioner to Taylor and Grape Creeks water users. The water commissioner will be able to immediately communicate water call and exchange potential to all water users.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 9

Applicant: Colorado Division of Water Resources, Dam Safety Branch

Project Title: CO Dam Safety Inundation Mapping Grant Program

Recommended Amount: $25,000
Requested Amount: $50,000

Description of Project: Colorado's 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. To ensure the mapping products are consistent, a guideline and sample scope of work are provided to the dam owner which outlines the minimum requirements of the Rules for use in selecting a qualified engineer to complete the project

Project Manager(s): Jonathan Hernandez

Program: Water Project Loan Program

Purpose: Provide additional funding to continue the current Dam Safety Branch inundation mapping grant program that has been in place since 2010.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 10

Applicant: Bull Creek Reservoir Canal & Power Company

Project Title: Bull Creek Reservoir #4 Wetlands Study

Recommended Amount: $14,250
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 request was approved in last fiscal year's list but due to an inability to inundate the wetlands the study could not be accomplished.

This information can and will be used to support develop future water projects 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.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 11

Applicant: Town of Fraser

Project Title: Fraser Firming Project

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

Description of Project: The Town of Fraser will identify and evaluate new facilities to address the community's need for a sustainable water supply that can be funded by the existing limited customer base.

In 2013 the Town Board concluded several years of annexation negotiations in which a proposed development was to be obligated to provide water storage facilities for augmentation of the Town's well field, but in November of 2013, Fraser voters overturned the annexation. As a result, the Town now needs to study the feasibility of facilities alternatives in the Upper Fraser River Valley of Grand County.

Project Manager(s): Derek Johnson

Program: Water Project Loan Program

Purpose: Prepare an Engineering Study for implementation of water storage facilities for augmentation of the Town's well field.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 12

Applicant: Linda Bassi, S&LP Chief

Project Title: Case Management and Litigation Support

Recommended Amount: $65,000
Requested Amount: $65,000

Description of Project: Hire temporary paralegal staff (two positions, each limited to 9 months) to assist the Section with instream flow ("ISF") water rights 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): Linda Bassi/Jeff Baessler/Kaylea White

Program: Instream Flow and Natural Lake Level Program

Purpose: Provide necessary support to section staff for legal protection of the State's ISF water rights.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 13

Applicant: Linda Bassi, S&LP Chief

Project Title: Stream and Lake Protection Section Operational Budget

Recommended Amount: $5,000
Requested Amount: $5,000

Description of Project: In most years, the Stream and Lake Protection Section has budgeted between $12,000 and $16,000 to fund operating expenses such as travel, telecomm, printing, equipment, official functions, and conference registrations. However, those funds have been supplemented in most years by the Section's Severance Tax Operational Fund outreach and education project, which historically has been funded at $10,000 - $15,000.

The Section's operating budget needs can vary significantly from year to year, depending on the amount of outreach activities that are required to address issues associated with new appropriations, acquisitions, legal protection and involvement in the Basin Roundtable processes related to non-consumptive needs and projects. The Section is requesting supplemental operating funds for these important activities. It is estimated that approximately $5,000 of supplemental funding will be required to address travel associated with Basin Roundtable meetings and outreach associated with several new ISF appropriation recommendations, including the Board's recent 2014 ISF appropriation on the Dolores River.

Project Manager(s): Linda Bassi/Jeff Baessler

Program: Instream Flow and Natural Lake Level Program

Purpose: Supplemental funding for the Stream and Lake Protection Section's annual operating budget to address outreach and education needs.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 14

Applicant: U.S. Geological Survey

Project Title: Computing Discharge Under Ice

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

Description of Project: USGS, in collaboration with CWCB, will develop a method for computing discharge under ice using hydro-acoustics (up-looking acoustic Doppler current profiler) and an efficient computational scheme based on the Probability Concept (PC) developed by Chiu and others (2001). The method suggests that the location of the maximum velocity in a channel cross-section and the ratio of the average velocity and maximum velocity remain constant for a cross-section regardless of variations in stage, velocity, streamflow, channel geometry, bed form and material, slope, or alignment. This observation is important because it allows one to install hydro-acoustic equipment at a single location that is capable of measuring discharge over a wide range of environmental and flow extremes.

Project Manager(s): Jeff Baessler/Brian Epstein/Brandy Logan

Program: Instream Flow and Natural Lake Level Program

Purpose: Current methods for computing winter flows and the quality of those methods is typically rated as "Poor" by USGS because of: 1) an inability to collect a sufficient number of velocity measurements; 2) variations in water depth; 3) occurrence of a non-standard velocity distribution; and 4) the occurrence of pressure flow when the free surface is in contact with ice. Developing a method for measuring discharge under ice allows decision makers to monitor temporal variations in streamflow throughout the year by providing a more comprehensive accounting of water.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 15

Applicant: Kevin Houck, W&FP Chief

Project Title: Flood Mitigation and Project Compliance

Recommended Amount: $ 75,000
Requested Amount: $150,000

Description of Project: CWCB has identified a substantial need for identification of deficiencies to flood mitigation projects throughout Colorado, a point vastly reinforced by the devastating floods of September 2013. 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. The CWCB staff is requesting this Severance Tax non-reimbursable investment 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 Program

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

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 16

Applicant: Kevin Houck, W&FP Chief

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 Program

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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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 17

Applicant: 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. This is accomplished by monitoring and reporting on dust-on-snow conditions at Senator Beck and 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): Joe Busto, W&FP

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, 2014 – June 30, 2015

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www.cwcb.state.co.us

Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 18

Applicant: Tim Feehan, Deputy Director

Project Title: Empowering Future Management and Conservation of Water in Colorado by Building Mitigation Capacity

Recommended Amount: $65,000
Requested Amount: $65,000

Description of Project: This proposed study would increase the breadth and depth of the tools available to provide the compensatory mitigation required to implement the projects needed to meet Colorado's growing water demands, by:

Task 1. Developing "In-Lieu Fee" mitigation protocols for the state;
Task 2. Rigorously testing, calibrating and validating the FACStream method;
Task 3. Providing three training classes on the use of the FACStream for agency staff and professionals; and
Task 4. Developing stream mitigation debiting protocols.

FACStream is a stream banking protocol designed to further the State's capacity to utilize a watershed approach to mitigation planning and review through a cooperative effort.

Project Manager(s): Tim Feehan/Kevin Houck/Chris Sturm

Program: Watershed and Flood Protection Program

Purpose: Provide specific tools and a means by which water suppliers can provide compensatory mitigation for stream channel impacts caused by water supply projects.

Funding Available: July 1, 2014 – June 30, 2015

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 Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 19

Applicant: Rebecca Mitchell, WSP Chief

Project Title: Surface Water Supply Index (SWSI) Automation & Web-based Public Access

Recommended Amount: $50,000
Requested Amount: $55,000

Description of Project: The SWSI is an index of surface water supply conditions in Colorado watersheds. It provides a numeric "score" of water supply in Colorado watersheds and is considered by the Governor's WATF at monthly meetings when evaluating drought conditions. The preferred version of the SWSI was developed by NRCS and is calculated using spreadsheets by an NRCS employee who retired in 2013. Due to staffing shortages at NRCS it is unclear that this labor-intensive duty will be taken on by other NRCS staff. This project would continue the development of a TSTool-based SWSI generator and allow public access to the tool, results, and hydrologic data behind the results through the internet to calculate and display the SWSI for all Colorado watersheds each month.

Project Manager(s): Taryn Finnessey, CWCB & Tracy Kosloff, DWR

Program: Drought and Flood Monitoring Program

Purpose: Due to staffing shortages at NRCS, it is unclear that collecting data for the SWSI index will be taken on by other NRCS staff. By funding the SWSI automation, the information gathered would be reliably and publicly available on the web and to WATF members, such as municipal water suppliers, to improve the monitoring of Colorado's surface water supplies and inform decision making.

Funding Available: July 1, 2014 – June 30, 2015

STATE OF COLORADO

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 20

Applicant: Rebecca Mitchell, WSP Chief

Project Title: Water Planning and Operational Needs

Recommended Amount: $82,751
Requested Amount: $90,000

Description of Project: CWCB needs funding to meet immediate needs for water planning. CWCB is implementing a number of water planning efforts since the inception of the Statewide Water Supply Initiative and has the responsibility to address other water planning needs that emerge during the fiscal year, but for which no other funding source is available. These funds will also be used to supplement any operational needs of the Water Supply Planning Section.

Project Manager(s): Rebecca Mitchell

Program: Water Supply Planning Program

Purpose: To provide funding for water planning efforts and associated operational expenses not covered by any other funding. Without these funds, immediate cooperative efforts needed may be delayed or postponed.

Funding Available: July 1, 2014 – June 30, 2015

Project No. 21

Determination of Consumptive Water Use of Corn in the Arkansas Valley (Year 2)

Dr. Allan A. Andales, Associate Professor of Irrigation and Water Science; Department of Soil and Crop Sciences, Colorado State University
Dr. Michael E. Bartolo, Research Scientist; CSU-Arkansas Valley Research Center, Rocky Ford, CO;
Mr. Lane Simmons, Research Associate; CSU-Arkansas Valley Research Center; Rocky Ford, CO;

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

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, and 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 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 has been the focus of this project in 2013. At least 2 growing seasons of data are required to develop a seasonal crop coefficient curve that is representative for the area. Therefore, a second growing season (2014) of corn data will be collected using the large (crop) lysimeter. 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 reference (small) lysimeter.

OBJECTIVES and METHODS

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.

The objectives will be achieved in close collaboration with engineers in the Colorado Division of Water Resources (CDWR). Corn ET_c from the large lysimeter and alfalfa ET_c from the reference lysimeter will be calculated by mass balance (from automated

weighing scale readings) and aggregated to 5-minute, 15-minute, and hourly totals. A full time research associate will manage the daily operations, crop management, maintenance, and data quality control of the 2 lysimeters. The following will be the major deliverables of the project: (1) Seasonal crop coefficient curve that characterizes corn ET_c (2014 growing season combined with 2013) at different developmental phases; and is appropriate for local conditions in the Arkansas Basin; (2) Observed seasonal consumptive water use (ET_c) of corn (2014); (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. A draft of the report shall be provided to CDWR and CWCB by June 30, 2015.

This project will be conducted from July 1, 2014 to June 30, 2015.

BUDGET AND JUSTIFICATION

This agreement is for a maximum of $46,137 budgeted as follows.

Salary (one research associate; $5445/mo x 6.0 mo)	$32,670
Fringe benefits (@ 22.8%)	$ 7,449
Subtotal	$40,119
Indirect cost (@ 15%)	$ 6,018
Total	$46,137

These funds will pay for 6.0 months of work by one full-time research associate, who will manage the day-to-day operation of the lysimeters, take all measurements, and process the data. The CSU Agricultural Experiment Station will provide matching funds for 6 additional months of salary and fringe, management of land and facilities at the Arkansas Valley Research Center, and salary of CSU investigators.

Project No. 22

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 CDM-Smith [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 mi^2) 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 overarching 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 is carried out over a three-year period. In the first two years, CSU has focused on the following tasks:

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.
e) Sensitivity study on:

- Effects of hypothetical increased stream augmentation by aquifer recharge that reproduces quantitatively the changes in water administration practices enacted in 2006.
- Changes in aquifer pumping based upon realistic estimates of the reduction in groundwater withdrawal and its spatial distribution across the SPRB that have occurred since 2006.
- Effects on groundwater and surface water flow regimes of hypothetical drought conditions producing reduced snowmelt upstream inflows and increased evapo-transpiration in relation to modified atmospheric conditions and rising water table levels, respectively.

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 third year of the project.

Proposed Tasks for Year 3: It is anticipated, in the fiscal year 2013, the SPDSS groundwater flow model will be applied to verify the adequacy of analytical, semi-analytical and numerical models currently used to assess:
(a) The impact of well pumping from alluvial formations on the flow in hydraulically connected to streams and irrigation canals.
(b) The plans for stream augmentation that permitted wells are currently required to meet for consumptive use of groundwater.

In both tasks, the SPDSS groundwater model will be applied to simulate the effects on stream flows of hydrological stresses (well pumping and artificial recharge) applied to the alluvial aquifer system. The results of the model will be compared to corresponding stream-aquifer interaction laws used for water administration. Since the SPDSS groundwater model simulates realistic conditions of unconfined subsurface flow and, given its considerable spatial extent, uses an upscaled griblock size (1000×1000 ft^2) this study will also focus on the influence that effects that local heterogeneity and unconfined-flow related non linearity may have on the calculation and the adopted constitutive laws for stream depletion and recharge. It is worth mentioning that this proposed application of the SPDSS groundwater flow model is one of the goals originally specified by the CWCB in their original SPDSS feasibility study (CWCB, 2001).

Deliverables: At the end of the third year, a final technical report describing project activities and findings will be submitted to CWCB. In particular, this report will include all 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 2014:

0.75 Month Faculty Salary[1] $9,292
6.5 Month Post-Doc Salary[1] $34,186
Indirect Cost (15% rate) $6,522
Total Cost for Fiscal Year 2013 $50,000
[1]Includes 25% fringe.

Project No. 22

In addition to the Project Principal Investigator, Dr. Domenico Baù, one Post-doctoral fellow will be involved and financially supported in this study. The Post-doctoral fellow will work part-time on the project (6.5 months).

Project No. 23

Developing an Unmanned Aerial Remote Sensing of ET System

José L. Chávez, Assistant Professor, Civil and Environmental Engineering Department, Colorado State University,

Location: Greeley, La Salle, Fort Collins, and Rocky Ford, CO

Purpose: The proposed research will integrate proven remote sensing (RS) sensors into a small unmanned aerial system (sUAS). Data derived from the aerial RS platform will be used to develop a suitable RS of crop evapotranspiration (ET) method for Colorado.

The grant will make possible the development of a sUAS and in addition it will allow collaborative and will make future proposals more competitive (state, federal).

The type of information to be gained include: a) suitable (accurate) RS of crop ET algorithm for CO; b) ability to map (monitor) ET at high spatial resolution on demand; and c) documentation of spatial crop water stress and ET not used, for water rights, court, transfer purposes.

Considering an increase competition for water, the development of a sUAS for RS of ET purposes will be highly beneficial for irrigation ditch companies, water conservation districts, crop growers assoc., cities (landscape ET), and state and federal agencies.

Objectives, methods, timeline, completion date:

Remote sensing ET models are being used in agricultural irrigation water management. These models either rely on distributed information on surface vegetation indices (visible and near infra-red bands) or on surface temperature images. RS of ET models perform better on certain regions, environments and surface conditions. Therefore, there is a need to develop a reliable RS of ET model for Colorado. Furthermore, a main challenge regarding RS imagery, is that the temporal resolution of multispectral satellite images is not adequate (e.g., every 16 days in the case of Landsat 8) to estimate daily crop ET. If there is cloud cover during a satellite overpasses then estimates of ET for a month will not be possible. Using airborne RS platforms may be cost-prohibited (~$5,000 per campaign/farm) and may not be available on demand (due to the nature of their commercial applications and commitments). Therefore, it is believed that with the integration of multispectral sensors in a small unmanned aircraft system (sUAS), a robust and dependable high spatial resolution ET model can be developed.

The sensors (multispectral scanner and infra-red thermometer) that will be mounted on the new sUAS have been used at ground level. The collected data have proved to be useful in promoting a more efficient and sustainable management of agricultural water. However, a major critique is the time difference between data points collection. Mounting sensors on a sUAS will enable the collection of needed high resolution (~30 m) crop water use data on a spatial fashion on demand. Hence, with the development of the sUAS larger areas will be able to be covered and the evaluation and development of a suitable RS of ET method will be more efficient since a wider range of surfaces/conditions will be covered on demand (i.e., not depending on the limitation of ground-based sensors, satellite overpass, or costly aircraft imagery).

Project No. 23

Objectives

The objectives of the proposed research include: a) integrating multispectral remote sensing sensors in a sUAS, b) development of a suitable remote sensing of crop evapotranspiration (ET) method for Colorado, and c) evaluation of items (a) and (b).

Methods

A small Unmanned Aerial Vehicle (sUAV) will be acquired from UASUSA and multispectral RS sensors will be mounted on the aerial platform. The PI has secured funds from a Borland Grant (CEE Dept.); thus requesting $15,000 from CWI to complete funds to purchase the aerial system.

A graduate research assistant (GRA) will help operate the system to acquire high spatial resolution data (~30 m footprint diameter by flying ~50 m from the ground) over research fields. The GRA will be trained in remote sensing of ET methods. The different research locations include: a) corn and alfalfa fields, managed under center pivot (CP) full and deficit irrigation, near La Salle, CO (Collaborator: Randy Ray, CCWCD); Randy has funded an in-field soil moisture sensor network to estimate crop ET; b) corn and alfalfa fields, fully furrow irrigated, near Rocky Ford, CO (Collaborators: Mike Bartolo/Lane Simmons/Allan Andales, CSU AES AVRC); where two weighing lysimeters are located; c) limited drip irrigated corn fields near Greeley, CO (Collaborators: Jon Altenhofen, Northern Water; and Tom Trout, USDA ARS); and potentially d) limited CP irrigated corn near Fort Collins, CO (R. Khosla, A. Andales).

RS data will be used in three ET algorithms: a) a two-source energy balance (EB) model, b) a surface aerodynamic temperature EB model, and c) a crop water stress index (CWSI) model. Resulting ET values will be evaluated with ET derived from soil TDR, neutron probe, and lysimetric ET data. The model that better performs will be enhanced for the conditions found in CO. For instance, the CWSI approach could be enhanced by modeling the canopy temperature based on the sUAS data. Similarly, the aerodynamic temperature could be modeled based on the accurate characterization of percent vegetation cover, etc.

Timeline and Completion Date

It is proposed to start the project on March 1st of 2014 and end it by February 28th of 2015. March/April: acquisition of sUAV and recruitment of GRA; May/June/July/August: sUAS development, field tests and data acquisition and analysis; September, October, November: ET model development, evaluation; December, January, February: research article production; and March/April 2015: Report due to CWI.

Budget

Graduate Research Assistant:	$22,281
Fringe:	$1,107
In-State Tuition for GRA:	$5,090
EQUIPMENT:	$15,000
TOTAL DIRECT COSTS:	$43,478
Facilities & Administrative: 15% TDC	$6,522
TOTAL:	$50,000

Budget Justification

Project No. 23

Funds are requested to: a) cover the salary and fringe benefits ($23,388) of a graduate research assistant for 12 months; b) pay for partial in-state tuition credits ($5,090); c) complete funds to purchase a sUAV ($15,000); and d) cover CSU indirect costs ($6,522). The total amount requested is $50,000 for a period of one year.

Project No. 24

Data Collection and Analysis in Support of Improved Water Management in the Arkansas River Basin

PI: Timothy K. Gates, Professor, *Department of Civil and Environmental Engineering, Colorado State University*
Co-PI: Jeffrey D. Niemann, Associate Professor, *Department of Civil and Environmental Engineering, Colorado State University*

Location: Arkansas River Basin, Colorado
Purpose: Colorado's Arkansas River Basin, the largest in the state, comprises a varied and complex water system. Emerging as a snowmelt-fed alpine stream, it extends about 165 miles and drops more than 4900 ft before gathering into Pueblo Reservoir to be released again onto the southeastern plains. Along the remaining 195 miles of its course before it flows into Kansas, the river winds through a broad and varied alluvial valley that supports extensive irrigated agriculture. In the Upper Arkansas River Basin (UARB), above Pueblo Reservoir, the water resources of the stream-aquifer system supply the demands of mountain communities and Front Range cities, recreation and fisheries, and some irrigated agriculture. In the Lower Arkansas River Basin (LARB), irrigated agriculture is the predominant water consumer with a growing municipal and industrial demand. In addition to natural snowmelt and rainfall, the Colorado River Basin provides inflow to the Arkansas River Basin via the Fryingpan-Arkansas and Twin Lakes trans-mountain diversions.

Water managers and users in the Arkansas River Basin need information to help them enhance overall beneficial water use, redress serious problems of water quality degradation (e.g., salinity, selenium, and uranium), conserve water, and find innovative ways (e.g., the Super Ditch) to address mounting pressures for increased diversions out of the Basin. Sound water management requires a good database to characterize the stream-aquifer system and to undergird existing and future modeling tools. For over fourteen years in the LARB and three years in the UARB, Colorado State University (CSU) has conducted extensive field monitoring to build such a database. *The purpose of the project proposed herein is to collect and analyze key field data in representative regions of the Arkansas River Basin needed to maintain and enhance the Arkansas River Basin database in support of improved water management. Thereby, the project will provide funds needed to prevent interruption of long-term data collection efforts.*

Objectives: The data-focused objectives of this one-year project are:

(1) Gather data on water table levels and water quality in existing groundwater monitoring wells distributed over representative study regions in the UARB and LARB, for characterization of the aquifer system and to support flow and transport models developed by CSU, the Lease-Fallowing Accounting Tool currently under development, and the proposed Arkansas Basin Decision Support System to be developed over the coming years by the Colorado Water Conservation Board;
(2) Gather data on water quality and flows at selected sites along canals, tributaries, and the main stem of the Arkansas River in the UARB and LARB to characterize the stream system and to support current and future models;
(3) Conduct quality-control tests of the gathered data and enter them into the SQL database for the Arkansas River Basin developed and maintained by CSU; and
(4) Conduct a preliminary analysis of the data gathered under this project and summarize in a final report for use in system characterization and model support.

Methods: About 150 landowners have cooperated with CSU to provide access to sampling sites for water and related characteristics in the UARB and LARB. *Availability of these sites provides valuable in-kind matching support for this proposed project.* Field data on water table depth and in-situ water quality parameters (electrical conductivity, temperature, pH, dissolved oxygen, and oxidation reduction potential) will be gathered at about 22 existing groundwater monitoring wells in a study region in Chaffee County in the UARB and about 140 groundwater monitoring wells in two study regions within Otero, Bent, and Prowers Counties in the LARB. Four to five sampling events will be conducted in each of the three study regions. Water samples will be extracted from the wells in the UARB during one of the sampling events for analysis of major dissolved ions, nutrients, and selected metals. During two of the sampling events in both regions of the LARB, water samples will be extracted from a subset of about 50 wells and analyzed for major dissolved ions, nutrients, selenium, and uranium. In-situ water quality parameters will be measured during the sampling events at about 24 surface-water sites in the UARB and at about 145 sites in the LARB. Flow rates will be measured at about 18 of the surface-water sampling sites in the UARB. Water quality samples will be analyzed by EPA-approved laboratories.

Standard procedures and protocol will be followed in maintaining, cleaning, and calibrating probes and pumping equipment for field measurements and sample collection. Field data will be checked to insure that values are physically reasonable and will be subjected to statistical outlier tests in comparison with data previously collected at the same locations.

Data will be added to CSU's SQL database (compatible with Colorado Division of Water Resources HYDROBASE). Preliminary data analysis will describe spatiotemporal variability of measured values and basic statistical characteristics in relation to previous data gathered in the study regions. Field measurement methods, along with procedures and results of preliminary analysis, will be documented in a final project report.

Timeline & Completion Date: Data collection will commence shortly after the proposed start date of 1 Mar 2014. Three irrigation season sampling trips and one to two off-season trips are planned for each of the study regions in the UARB and LARB. Data will be checked and entered into the database over the course of the one-year project. Final data analysis will commence on about 1 Oct 2014 and final report preparation will begin on about 15 Jan 2015. The project is scheduled for completion on 28 Feb 2015.

Budget: An estimated budget is summarized in Table 1.

Table 1. Estimated Budget ($) Project Budget (Mar 2014 – Feb 2015)

Salaries	15392
Travel	8539
Materials and Supplies	7417
Laboratory Analysis	12130
Indirect Costs (15%)	6522
TOTAL	50000

Budget Justification: Included are about 750 person-hours of undergraduate student effort and 0.5 person-months of faculty effort; mileage, per diem, and accommodations; parts/maintenance for multi-probes, sampling pumps, acoustic Doppler velocimeters; monitoring well maintenance; water sample filters; sample bottles and preservatives; calibration solution; field books; and other miscellaneous supplies. Costs of laboratory analysis are based upon recent quotes from respective laboratories.

Project No. 25

Development of Visualization Tools for the South Platte

Principal Investigator: Steve Malers, Open Water Foundation

Location of the work and project team: The work will be performed in Fort Collins utilizing CSU faculty, students, and in collaboration with the Open Water Foundation (OWF), a nonprofit that focuses on open source software for water resources and specifically Colorado's Decision Support System (CDSS) software.

Purpose: The South Platte River Basin system is complex, involving aspects of natural and engineered physical systems, water law and administration, operations, and many other factors. A water manager in the South Platte Basin recently stated "People need to understand systems and the space/time/water quality continuum." It is challenging to present complex water resource data in a way that can be understood by a variety of interests. This project will build on South Platte Decision Support System (SPDSS) data and tools to create reusable and operational data visualization tools that can be used to educate the public, public servants, and professionals about water resource issues in the basin.

Objectives:

1. Leverage SPDSS data and software to develop enhanced data visualization tools applicable to SPDSS and other State data
2. Demonstrate use of visualization software tools that are accessible to the public, for example Google Earth, Tableau Public (Tableau was used in Colorado River Study), Mapstory, Gapminder, and open source web visualization tools
3. Apply tools to system-wide data visualizations in ways that increase understanding of interactions in the system, for example:
    a. Online integrated map of current South Platte River conditions, such as calls, free river conditions, reservoir levels, suitable for State website
    b. System-wide summary of historical trends focusing on identifying sustainable systems
    c. Visualization of water rights transfers and diversion coding "water color" over time
    d. Interactive line diagrams and "snake diagram" that can be efficiently updated
4. Demonstrate collaboration that leverages the technical capabilities and funding potential of multiple organizations, for example students and staff from:
    a. Integrated Decision Support Group – The IDS Group combines advanced techniques with software engineering to create Decision Support Systems for water and natural resources management.
    b. Geospatial Centroid - The Centroid is a resource and research center at Colorado State University established to provide students, faculty, and the Colorado community with information about GIS at CSU and how these activities link to broader statewide, regional and global initiatives
    c. CitSci - CitSci.org is a website that allows citizen science organizations and their volunteers to streamline data collection, management, mapping, and analysis

Project No. 25

Method (Approach): If awarded, one or more students will be identified to work with CSU and OWF technical leadership to develop visualization tools and techniques:

1. Meet with key CWCB staff to identify needs for data analysis and visualization. For example, requirements from the Colorado Water River Availability Study (CRWAS), SPDSS modeling, and Colorado Water Plan may provide guidance.
2. Evaluate the needs identified in the previous task and determine tools that can be leveraged, such as Google Earth, Tableau, CDSS software, and open source visualization tools.
3. Identify CSU student(s) that have technical skills and interest to develop tools.
4. Develop/configure visualization tools and apply to the identified visualization needs.
5. Make tools available to the State and public for SPDSS data.

The result of this approach will be working data visualization tools appropriate for the South Platte and other basins. The results will be suitable for use by a variety of organizations that need to visualize and understand complex water resource data.

Timeline and Completion Date:

- Within 1 month of award, meet with CWCB to determine visualization needs
- Within 2 months of award, determine technologies and identify student(s)
- Within 10 months of award, develop visualization tools and demonstrate implementation to meet needs that have been identified
- Within 12 months of award, integrate tools with SPDSS software and make available to State and public for general use, provide project overview to State

Budget: $50,000 is being requested for this project due to many visualization options. Actual costs and distribution will be adjusted based on feedback from the proposal evaluation and availability of student hires:

- $5,000 – project management
- $20,000 – CSU student(s) cost
- $25,000 – Open Water Foundation technical resources for DSS software development, testing, integration, and student oversight

Budget Justification: Implementing effective data visualization tools and processes can be a labor-intensive effort and consequently hiring students at low rates is a cost-effective solution. Additionally, there is an opportunity for CSU faculty and students to work with OWF staff to move research into production. Demonstrating success on this project will facilitate future tool development efforts that benefit CSU and the State. Various projects are ongoing that can utilize improved visualization and could potentially be leveraged to supplement funding.

Project No. 26

Continuation of Project Funded in 2013: Assessing the Agronomic Feasibility of Single-season Irrigation Deficits on Hay as Part of a Western Slope Water Bank

Joe Brummer, Associate Professor/Extension Forage Specialist, Soil and Crop Sciences, Colorado State University
Calvin Pearson, Professor/Research Agronomist, Colorado State University, Western Colorado Research Center – Fruita
Abdel Berrada, Research Scientist, Colorado State University, Southwestern Colorado Research Center

Location: Seven irrigated, established hay fields (4 grass and 3 alfalfa) located in six Western Colorado counties: Delta, Montezuma, Gunnison, Mesa, Grand, and Routt.

Purpose and Need: To determine potential water savings, crop responses, and environmental impacts from strategic deficit irrigation of hay fields in Western Colorado.

Under the 1922 Colorado River Compact, the four Upper Division States may not allow the flow at Lee's 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. 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. The populated Front Range diverts about a half-million acre feet of CRB water of which the majority is junior to 1922. 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 average delivery requirements to the Lower Basin States 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.

Western Colorado includes the headwaters of the Colorado and numerous tributaries, such as the Yampa, White, and Gunnison. Together, these four basins include about 350,000 acres of irrigated grass and alfalfa hay. Many water bank discussions focus on the legal framework, administration logistics, and return flow implications of a possible water bank. Still to be determined is the agronomic feasibility for individual irrigators.

Objectives: "Deficit irrigation" refers to withholding water during non-critical crop growth stages. In mid to lower elevation environments, deficit irrigation is typically carried out by seasonally irrigating alfalfa and/or grass hay 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.

Project No. 26

Using side-by-side, i.e. “deficit” versus “business as usual” irrigation treatments, 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), and quality 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?

Timeline and completion date: This proposal is a request to fund the second year of a two-year project that was initiated in the spring of 2013. Completion of data collection and reporting of final results will occur in the fall of 2014. A graduate student was recruited in the spring of 2013 and she has completed the first year of data collection and is now in the process of analyzing and summarizing the data. We plan to collect data at the seven sites established in 2013 and hope to add several additional sites if possible to make the data set more robust.

Budget:

Item	Request	Indirect 15%	Request Total
Graduate Student	$21,204	$3,180	$24,384
Fringe (4.9%)	$1,039	$156	$1,195
In-State Tuition	$8,811	$1,322	$10,133
Travel	$8,500	$1,275	$9,775
Sample Analysis	$3,500	$525	$4,025
Totals	$43,054	$6,458	**$49,512**

Budget justification:

Graduate Student ($31,054): Covers salary, fringe benefits, and tuition.

Travel, Motel, and Per Diem ($8,500): Mileage to cover student travel to collect data at West Slope sites (mileage for pickup truck at $0.62/mile for estimated 12,000 miles); approximately six overnight stays ($85 incl. tax); and twelve days of per diem ($45/day).

Sample Analysis ($3,500): Approximately 20 soil samples (2 to 3 samples per site) will be analyzed each year for basic soil properties and nutrients at $25/sample ($500 total). Forage quality analyses will be run on 10 samples per treatment per cutting (3 to 4 cuttings per alfalfa site and 1 to 2 cuttings per grass site) for an estimated total of 400 samples ($7.50/sample for lab supplies or $3,000 total)

Matching ($5,000 or 10%): Cash provided via CSU Soil and Soil Crop Sciences donated by the Environmental Defense Fund specifically to support research in the area of water banking. Matching funds will be used to compensate cooperating landowners for lost hay production.

Project No. 27

Improving data quality for an enhanced climate data delivery system for CoAgMet (Colorado Agricultural Meteorological) network

Nolan J. Doesken, State Climatologist, Colorado State University
Wendy A. Ryan, Assistant State Climatologist, Colorado State University

Location: Work will be conducted throughout Colorado.

Purpose: CoAgMet is a statewide weather network that was mainly designed to support Colorado's agricultural industry. With this funding request, the Colorado Climate Center will continue to develop, improve and maintain a climate data system for Colorado. Use of CoAgMet data to schedule irrigation is the most prominent use of this network, but without quality data as inputs to evapotranspiration (ET) equations, questions arise about the validity of ET estimates. The new eRAMS irrigation scheduling tool and the Arkansas Valley lysimeter projects rely heavily on ET estimates from CoAgMet stations and improved quality control is essential for these efforts. These funds will be used to build more robust data quality control into the CoAgMet database so that users are aware of potential problems with data inputs. This is a large undertaking but a worthy effort to increase reliability of the data being distributed.

Objectives, Methods, Timeline and Completion Date: The objectives of this work are to create a more reliable climate data delivery system for CoAgMet by improving upon both quality control of data and updating equipment to be used throughout the network. Researchers at the Colorado Climate Center will build automated quality control standards following the standards set by the FAO in Irrigation and Drainage Paper 56 for both weather data integrity and statistical analysis for filling in missing/suspect data. This will result in complete time series with flags for the data that is deemed questionable. The data flags will alert users to raw data that has been changed and for what purpose.

New sensors will be purchased and installed where it is deemed necessary during routine maintenance. Equipment will mainly include wind sensors, rain gages, pyranometers, and temperature/humidity probes.

Timeline:

July, 2014: Procure equipment and begin database investigations for programming quality control and data completeness algorithms once funds become available.

July - September 2014: Annual maintenance is performed on all stations; equipment will be installed at locations where sensors are found to be failing. Begin testing and implementation of data QC/completeness algorithms.

October 2014 - June 2015: Once testing of the data QC is completed internally, users will be solicited to test the algorithms. After the work is completed, the new database will be rolled out on the website and through web services. Final report writing begins.

June 30, 2015: Project completed and final report submitted to Colorado Water Institute.

Project No. 27

Budget & Budget Justification:

Salary - $23,704:
Nolan Doesken, (0.1 of a person month (pm)) Senior Research Associate, will serve as Principal Investigator and oversee project tasks.
Wendy Ryan, (2 pm) Research Associate III, will procure equipment and perform annual maintenance on CoAgMet stations. She will also assist in the quality control upgrades.
TBD, (3 pm) Technical Support, will mainly focus on database upgrades with quality control and completeness routines.
Fringe - $5,405: Fringe benefits for administrative professional staff cover Medicare, unemployment insurance, worker's compensation, DCP, and BenPay, excluding sick leave. Fringe is estimated to be 22.8% of salary in all years of the project.
Domestic Travel - $3,000: Travel costs are requested for annual maintenance visits to sites across Colorado
Materials and Supplies - $11,185: Supplies are requested to replace aging sensors throughout the network including: pyranometers, temperature/humidity probes, anemometers and rain gages.
Other Direct Costs - $184:
ATS computer charges are for department Ethernet connections. This charge is $36/PM and 3.1PM are budgeted. The computer service charge is a rate developed using Section J-47 (Specialized Service Facility) of OMB Circular A-21 and Colorado State University's internal policy for computing, charging and auditing such Service Facilities.
Facilities and Administrative Costs (Indirect Costs) - $6,522:
The indirect cost rate will be 15% TDC in all project years.
CWI Total - $50,000
Matching Funds - $14,652
Unrecovered indirect costs (UIC) are proposed as matching funds. UIC is the difference between the CWI mandated F&A rate of 15% TDC and CSU's federally negotiated F&A rate of 48.7% MTDC.
Total - $64,652

STATE OF COLORADO

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 28

Applicant: Colorado Geological Survey

Project Title: County Groundwater Resources Series, Year 3

Recommended Amount: $0
Requested Amount: $45,000

Description of Project: Patterned after county-wide groundwater resource series produced in the 1960s through mid-1970s, this 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 publications of the series utilizing previous year's funding are for Douglas and Park Counties. This third publication would address all aquifers utilized in Gunnison 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. In addition, in 1999 the CGS released *Geology and Mineral Resources of Gunnison County* Resource Series RS-37 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 Section

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.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 29

Applicant: U.S. Geological Survey

Project Title: Modification of USGS Groundwater Model Program MODFLOW-NWT

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

Description of Project: When developing and running a model of a complex groundwater system, specification and tracking of a wide range of simulated stresses on groundwater systems can be time-consuming and prone to errors. The proposed project would enhance a recent version of MODFLOW to enable users to enter and track individual components of various types of aquifer stresses, as well as avoid deactivation of model cells under conditions of thin saturated thickness.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information Section

Purpose: The enhanced groundwater modeling program would facilitate accurate simulation and analysis of groundwater flow in Colorado's aquifers, particularly the alluvial aquifer system of the South Platte River and its tributaries.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 30

Applicant: U.S. Geological Survey

Project Title: Groundwater-Level Monitoring, Grandview Estates, Colorado

Recommended Amount: $0
Requested Amount: $16,300

Description of Project: The USGS began monitoring water levels in Grandview Estates during 2009 in response to local concerns that pumping in the surrounding area might affect water levels in domestic wells of Grandview Estates. In 2010, Chambers Reservoir was constructed by United Water and Sanitation adjacent to Grandview Estates, and additional domestic wells were added to the water-level monitoring network to assess any potential water-level changes in response to reservoir construction.

Funds from this grant would be used to continue monitoring during 2014 and 2015, to conduct a GPS survey of the wells, and to instrument one additional well with a pressure transducer, specific conductance probe, and data logger.

Project Manager(s): Andy Moore

Program: Interstate, Federal, and Water Information Section

Purpose: Groundwater-level monitoring in Grandview Estates would provide current data on the seasonal and long-term water-level trends in the uppermost part of the Denver Basin aquifer system.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 31

Applicant: USGS - Colorado Water Science Center

Project Title: Post-Wildfire Effects on Snow Accumulation, Sublimation, and Snowmelt

Recommended Amount: $0
Requested Amount: $98,500

Description of Project: The study objective is to evaluate the net effect of wildfires on snow accumulation, sublimation, and snowmelt using a combination of field observations, modeling, and remotely sensed data. This is a two year study and the applicant was looking for the funding for the first year. Year one will collect field observations in burned and unburned forested areas. Measurements taken will be solar radiations, snow spectral albedo, wind speed, air temperature, and snow depth. Year two will take the field data as inputs to SnowModel a high resolution snowpack modeling system that will simulate the accumulation and snowmelt in burned and unburned study areas. Satellite imagery will also be used to evaluate changes in snowpack properties that also commonly occur after wildfires and place the field and modeling study results into a broader context. The study results will be published n a peer reviewed journal article.

Project Manager(s): Joe Busto, W&FP

Program: Watershed and Flood Protection Program

Purpose: Wildfires in the forests of Colorado can affect winter snow accumulation and spring snowmelt by decreasing albedo, reducing canopy interception, increasing light transmission to the snowpack surface, and changing the surface energy balance. This type of study would be interesting for water resource management, including reservoir operation and timing of streamflow diversions.

Funding Available: July 1, 2014 – June 30, 2015

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Severance Tax Operational Fund
Proposed Project for Fiscal Year 2014 – 2015
Project No. 32

Applicant: Open Water Foundation

Project Title: Surface Water Supply Index (SWSI) Web Tool

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

Description of Project: The project will develop a web tool to view Surface Water Supply Index (SWSI) data products, which indicate the history, current status, and severity of drought. This information is useful to water providers, the public and Water Availability Task Force (WATF) for water supply planning and drought response.

The majority of project activities will occur in Fort Collins (Larimer County). However, the results of the project will have impact statewide because SWSI is used for statewide water planning and drought response.

Project Manager(s): Taryn Finnessey, WSP

Program: Drought and Flood Monitoring Program

Purpose: This effort will result in a production tool that can be used directly by the State of Colorado and its staff within DNR's computer system as well as providing software that is compatible with the NRCS computer environment. The resulting web tool will support the activities of CWCB and DWR staff, WATF, and other organizations and public throughout the State of Colorado. The tool also can be leveraged for other CDSS projects.

Funding Available: July 1, 2014 – June 30, 2015