Colorado Water Institute

2013 - 2014 Annual Report

Contents

Message from the Director

This has been another dynamic year at the Colorado Water Institute, with the completion of the HB1278 South Platte groundwater project report for the Colorado legislature among the year's accomplishments. CWI continued to serve its research, outreach, and training mission through funding research projects and student internships in cooperation with the Colorado Water Conservation Board and the U.S. Geological Survey. Several of our projects are highlighted in this annual report, including our longstanding commitment to the large weighing lysimeters at the Arkansas Valley Research Center.

CWI staff had the opportunity this year to collaborate with U.S. Department of State and U.S. Army Corps of Engineers on providing U.S. inputs to the international dialog on the water-energy-food nexus. Additional work on hydraulic fracturing and agricultural conservation put CWI in the middle of currently controversial water topics in Colorado. Regional Water Specialist Perry Cabot moved from the Arkansas River Basin to the Colorado River Basin and immediately began working on agricultural efficiency, water conservation, and water banking efforts. Brad Udall, formerly the University of Colorado Natural Resources Law Center Director, joined CWI to provide expertise in water and climate science and policy.

Next year will mark the 50th anniversary of CWI. Through the work of outstanding past leaders such as Robert Ward, Neil Grigg, and Norm Evans, the institute has worked with faculty and students from all of Colorado's institutions of higher education to produce many important projects that provide water managers with new information to improve decision-making. While the societal context of water management continues to evolve, we confront the same water management, quality, and quantity problems as Colorado seeks to cope with limited water supplies punctuated with periodic drought and flood. CWI will continue to support the training of the next generation of water managers through research project funding and internships.

As CWI director, I am pleased to report this year that the institute continues to benefit from a committed staff, excellent support from Colorado State University upper administration, and the guidance of an outstanding advisory committee. This annual report contains only the highlights of our activities in service to Colorado this past year. More information on our activities can be found at www.cwi.colostate.edu.

Cover Photo: *Aerial view of the South Platte River east of Kersey, Colorado.* Photo by Bill Cotton

Colorado Water Research

CWI, an affiliate of Colorado State University (CSU), exists for the express purpose of focusing the water expertise of higher education on the evolving water concerns and problems being faced by Colorado citizens. CWI coordinates research efforts with local, state, and national agencies and organizations. CWI works closely with researchers, scientists, and private industry to develop sound science that assists and informs Colorado water managers and users. CWI accomplishes this by facilitating the transfer of new water knowledge and assisting in educating the next generation of Colorado water professionals by working with all Colorado institutions of higher education.

Outreach/Information Transfer

CWI collaborates with CSU Extension to house four water outreach specialists around the state. CWI operates several websites with up-to-date water information that have become a consistent source of knowledge for water professionals and community members alike. Publications available on these sites include research reports and *Colorado Water*, a bimonthly newsletter containing information on current research, water faculty, outreach program updates, climate, water history, Colorado State Forest Service updates, and water-related events and conferences, featuring a different research theme each issue.

CWI outreach activities are conducted in conjunction with CSU Extension, the Colorado Agricultural Experiment Station, the Colorado State Forest Service, and the Colorado Climate Center. Our primary partners include water managers, water providers, and water agencies.

Training

One of CWI's primary missions is to facilitate the training and education of university students. To this end, the institute works with the U.S. Geological Survey and the Colorado Water Conservation Board to place student interns in positions and also funds student research grants and manages scholarships on behalf of students. Student researchers funded by CWI work with faculty members and gain valuable water expertise as well as knowledge of the research process.

CSU students Staci Amburgey (master's student, Biology) and Jennifer Swanson (undergraduate student, Rangeland Ecology), apply a single elastomer mark to recently metamorphosed boreal toads at a reintroduction site in Rocky Mountain National Park. Photo by Larissa Bailey

CWI Websites

www.cwi.colostate.edu/southplatte/

http://cwi.colostate.edu/ThePoudreRunsThroughIt/

www.crbagwater.colostate.edu/index.shtml

www.cwi.colostate.edu/workshops/nexus2014/Default.aspx

http://agwaterconservation.colostate.edu/

Selected Current Projects

Faculty Research Projects

Application of Remotely Sensed Data for Improved Regional and National Hydrologic Simulations
Terri Hogue, Steve Regan, and Reagan Waskom, Colorado State University; DOI-USGS

Assessing the Agronomic Feasibility of Single-Season Irrigation Deficits on Hay as Part of a Western Slope Water Bank
Calvin Pearson, Abdel Berrada, Perry Cabot, and Joe Brummer, Colorado State University; CWCB and NIWR 104B

Data Collection and Analysis in Support of Improved Water Management in the Arkansas River Basin
Jeffrey Niemann and Tim Gates, Colorado State University; CWCB

Determination of Consumptive Water Use of Corn in the Arkansas Valley
Michael E. Bartolo, Lane Simmons, and Allan Andales, Colorado State University; CWCB

Developing an Unmanned Aerial Remote Sensing of ET System
Jose Chavez, Colorado State University; CWCB

Development of Visualization Tools for the South Platte
Steve Malers and Reagan Waskom, Colorado State University; CWCB

Improving Data Quality for an Enhanced Climate Data Delivery System for CoAgMet (Colorado Agricultural Meteorological) Network
Wendy Ryan and Nolan Doesken, Colorado State University; CWCB

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
Domenico Bau and Ryan Bailey, Colorado State University; CWCB

Moving Forward on Agricultural Water Conservation in the Colorado River Basin
Reagan Waskom, Colorado State University; USDA-NIFA

Poudre Basin Water Sharing Working Group Efforts Leading to Agreements, South Platte Basin
Reagan Waskom, Colorado State University; CWCB

The Poudre Runs Through It Study/Action Work Group 2014
Reagan Waskom, Colorado State University; PHAROS

Routes to Sustainability for Natural Gas Development and Water and Air Resources in the Rocky Mountain Region
Reagan Waskom, Colorado State University; NSF

Water Quality Impacts of the Mountain Pine Beetle Infestation in the Rocky Mountain West: Heavy Metals and Disinfection Byproducts
John McCray, Colorado State University; NIWR 104G

Student Research Projects

Ecological Functions of Irrigation Dependent Wetlands
David Cooper and Erick Carlson, Colorado State University; NIWR 104B

The Effect of Normative Trends on Water Conservation
Chad Mortensen and Anastasia Bacca, Metropolitan State University of Denver; NIWR 104B

Exploration of Morphometric Approaches for Estimating Snow Surface Roughness
Steven Fassnacht and David Kamin, Colorado State University; NIWR 104B

Impact of Limited Irrigation on Health of Three Ornamental Grass Species
James Klett and Sam Hagopian, Colorado State University; NIWR 104B

Nutrient Rentention and Productivity in Rocky Mountain Streams Under Alternative Stable States
Dana Winkelman and Adam Herdrich, Colorado State University; NIWR 104B

WOOD: Windows Of Opportunity for Debris Retention in Response to 2013 Front Range Flooding
Ellen Wohl and Natalie Anderson, Colorado State University; NIWR 104B

Honoring Our Past – 50 Years of Water Research and Education

In Colorado, a state of many headwaters, compact agreements, and competing water demands from the agricultural, industrial, municipal, environmental, and recreational sectors, water is a complex and pivotal topic. Since its founding in 1965, the Colorado Water Institute, known formerly as the Colorado Water Resources Research Institute (and other titles throughout its history), has placed priority on state water research, training, teaching, and outreach to meet the needs of Colorado water managers and citizens. These central goals have been exemplified by its five directors and supported by many exceptional staff members, some of whom were with the institute for as long as 30 years. Though each director has brought a different research background, from civil engineering to economics to soil and crop sciences, all the directors have incorporated an interdisciplinary approach to water research, training, and outreach. Today, more than 35 areas of expertise are represented among CWI's contacts in water research.

The institute was founded after the U.S. Congress Water Resources Research Act of 1964. Then-President of Colorado State University William E. Morgan played a key role in garnering support for this federal bill. In partnering with Colorado State University, the institute reaped the benefits of a prestigious water research tradition, and the institute continues to support and benefit from partnerships with water faculty and students throughout the state, as well as partnerships with researchers, water managers, and water leaders.

The institute has faced various challenges over its 50 years, including operating on a tight budget in years of low funding and the complexities presented by water law and management in Colorado. Institute directors and staff have faced and overcome many such challenges and today, the institute stands poised to expand upon this legacy of serving the Colorado water community.

Each director has worked to uphold the institute's central mission as Colorado's water management, research, and education needs have evolved over the 50 years since its establishment.

Stephen W. Smith
Director: 1965 – 1967

Norman A. Evans
Director: 1967 – 1988

Neil S. Grigg
Director: 1988 – 1991

Robert C. Ward
Director: 1991 – 2005

Reagan M. Waskom
Director: 2006 – Present

WOOD: Windows of Opportunity for Debris Retention in Response to 2013 Front Range Flooding

Natalie Anderson, PhD Student, Fluvial Geomorphology, Colorado State University
Ellen Wohl, Fluvial Geomorphology, Colorado State University

The September 2013 floods caused extensive erosion of river floodplains, and damage to roads and infrastructure in and near rivers on Colorado's Front Range. It also toppled many large floodplain trees and moved these into river channels or onto floodplains. Although the general public and stormwater engineers often view these downed trees as "debris" that must be removed after a flood to ensure human health and safety, other river scientists and managers know that large wood is a natural feature of streams and rivers, and it has important functions that help sustain rivers and the animals and plants that live in and along them.

Colorado State University faculty meet with river engineers and natural resources managers from the city of Fort Collins shortly after the September 2013 flood to discuss possibilities for managing large wood in the Cache la Poudre River. Photo by Kurt Fausch

The goal of this project was to assemble a rapid response interdisciplinary team of scientists to advise regional water and natural resource managers on management of instream wood entrained by recent flooding and to design guidelines and a risk assessment procedure for future management of instream wood. Our six person interdisciplinary team included Ellen Wohl, Kurt Fausch, Kevin Bestgen, Mike Gooseff, Brian Bledsoe, and Natalie Anderson (graduate student in fluvial geomorphology). This spring, we met and advised local community groups in Boulder and Larimer counties and drafted a technical report, which was disseminated to practitioners this summer for review and comments.

The guidelines as well as background information on stream ecology and wood that we provide therein assist managers in decision making for whether individual wood pieces or jams must be removed, can be stabilized and left in place, or can simply be left alone, as opposed to the default method of always removing woody debris. Feedback from managers has been enthusiastic with many thanking us for writing a much-needed document. The document is currently under revision as we incorporate comments and suggestions from practitioners. Launch of the final document as well as a peer-reviewed journal article is planned for spring 2015.

Wood piled against a train bridge pier on the Poudre River near Greeley after the Fall 2013 flooding. Photo by Natalie Anderson

Erick A Carlson, PhD Student, Ecology-Forest and Rangeland Stewardship, Colorado State University
David Cooper, Forest and Rangeland Stewardship, Colorado State University

During the 2014 field season, Carlson developed an in situ sampling methodology for measuring the denitrification potential of wetlands. The study wetlands are indirectly supported by irrigation, and the four sites were selected downslope of agricultural fields, where irrigation tailwater collects. Shallow wells for sampling nitrate levels in groundwater were installed and fitted with automatic water depth sensors. Piezometers were installed to characterize the movement of shallow groundwater in the wetland. Portable soil incubation chambers were constructed and tested in the field. The chambers were airtight so that gas samples could be taken without atmospheric contamination. This summer was a pilot study, and time was spent trouble shooting aspects of the setup, including how to get two meter long piezometers into solid clay and how to keep a hole in non-cohesive sands open long enough to insert a groundwater well. The soil incubation chambers posed a series of challenges, such as how to incorporate vegetation into a small (3 inch diameter pipe), how to best extract the 20 inch tubes from the ground, and how to keep the caps airtight.

Instrumentation of the four field sites was necessary to explore how the hydrologic dynamics of these wetlands change over the irrigation season. Water table data will be analyzed after the sensors are pulled in mid-October. Along with improving the incubation chamber design, the concentration of reagents, timing of the incubation, and other factors were varied, and the data are currently being analyzed. This pilot study year will be used to identify the most efficient and rigorous experimental design for setting up field sites and streamlining the methods for the 2015 sampling campaign.

A set of soil incubation chambers to measure denitrification potential of the upper soil layers under field conditions. Photo by Erick Carlson

Instrumentation in cattails: the large pipe is a groundwater well where samples are collected for nitrate measurements; the smaller pipes are piezometers which measure the groundwater pressure at a given depth. Photo by Erick Carlson

6 Poudre Basin Water Sharing Working Group Efforts Leading to Agreements, South Platte Basin

MaryLou Smith, Policy and Collaboration Specialist, Colorado Water Institute

All across Colorado and elsewhere in the West, water historically used in agriculture is being targeted for transfer to cities to accommodate population growth. While most of us would prefer not to tap into the water needed to grow our food, the simple truth is that people in cities need water too. The Colorado Water Conservation Board (CWCB) has funded grants for several years for entities like Colorado Water Institute (CWI) to investigate ways that urban and agricultural stakeholders could formulate plans for water transfer methods that would not take water permanently from agriculture, but would instead provide a source of water on a temporary basis, especially in times of drought. These methods have been labeled ATMs—alternative transfer methods.

CWI's ATM grant from CWCB has been underway almost a year and will be completed by April 1, 2015. CWI was funded to work with a newly formed group called the Poudre Water Sharing Working Group to perform the funded project. The Poudre Water Sharing Working Group is made up of half a dozen agricultural ditch companies and all the domestic water providers on the Poudre, committed to investigating ways they might cooperate to meet the needs of both farmers and municipalities. MaryLou Smith facilitates the meetings of the group and is project manager of the funded project. Specifics of the project include:

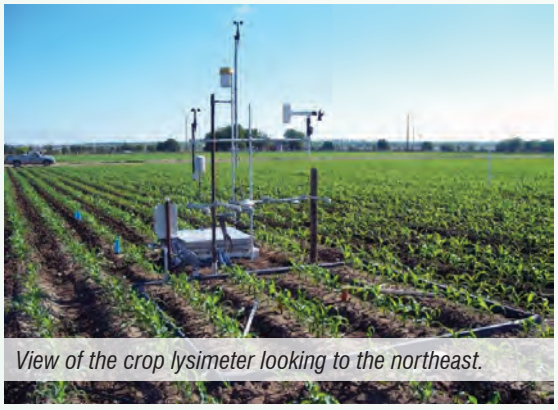
- Developing a database of information about the ditch companies and the domestic water providers to shed light on their operations and infrastructure to illuminate ways they might work together to "share water"
- Developing a number of potential "water sharing" approaches that might be employed by these groups
- Surveying Ag producers to determine which of these potential methods might be of interest to them
- Formulating prototype agreements for those types of methods that farmers favor

The Poudre Water Sharing Working Group is hopeful that out of these prototype agreements will come some actual agreements between Ag producers/ditch companies and domestic water providers—agreements that provide "win-win" solutions to both sectors. CWI's technical, policy, and collaborative process expertise has been instrumental in facilitating this multi-sector collaboration.

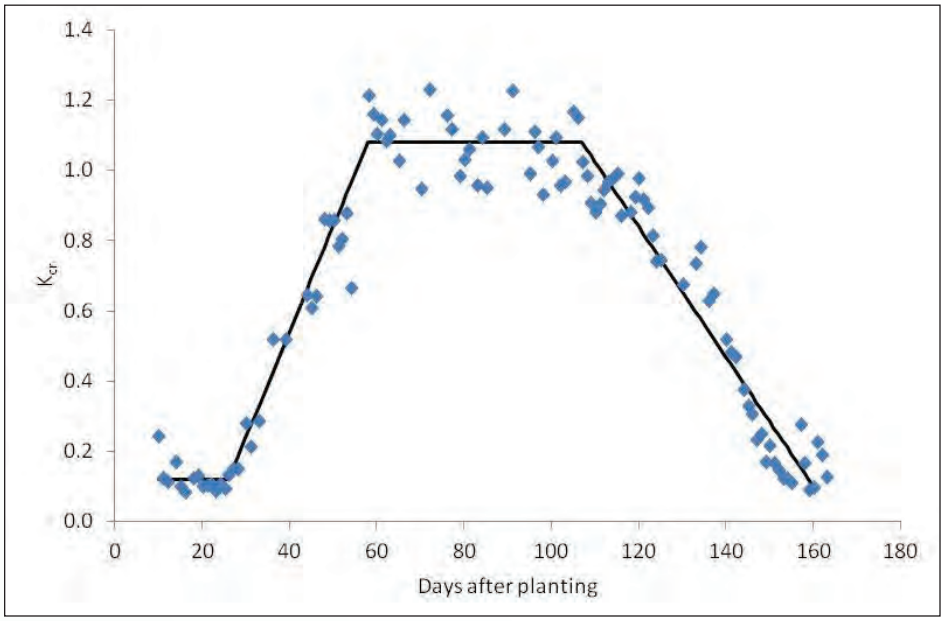
Members of the Poudre Water Sharing Working Group discuss a presentation by Steve Malers, Open Water Foundation, March 13, 2014 at City of Fort Collins Water Utility. Photos by Stephen Smith

Allan Andales, Soil and Crop Sciences, Colorado State University
Dale Straw, Engineer (Retired), Colorado Division of Water Resources
Lane H. Simmons, Research Associate, Arkansas Valley Research Center
Michael E. Bartolo, Manager/Research Scientist, Arkansas Valley Research Center

This study measured consumptive use of corn (crop evapotranspiration, ET_c) in the Lower Arkansas River Valley, Colorado, over a growing season. Accurate calculations of irrigated corn (Zea mays) are needed in the Arkansas Valley for irrigation water management and to establish Arkansas River compact compliance. A locally-derived crop coefficient (K_{cr}) curve for corn is needed to convert alfalfa reference crop ET_{rs} calculated from the ASCE standardized equation to non-stressed corn ET_c at different stages of crop development. The objective of this study was to measure the seasonal ET_c of corn and develop a preliminary K_{cr} curve using data collected in 2013. A precision weighing lysimeter at Rocky Ford, Colorado was used to measure daily ET_c of furrow-irrigated corn grown under local weather and environmental conditions. The mass of an undisturbed soil monolith with an actively-growing corn crop contained in a steel tank (3 m x 3 m area; 2.4 m deep) was continuously monitored with a calibrated load cell to determine corn ET_c. Corn (Fontanelle 8A818RBC variety) was planted on the monolith and surrounding field (4 ha) on 5/7/2013. Crop height and soil water content were monitored weekly during the growing season. Hourly measurements of solar radiation, air temperature, wind speed, and humidity were used to calculate hourly and daily ASCE standardized ET_{rs} values. Daily K_{cr} values for corn were calculated as ET_c/ET_{rs}. Total season corn ET_c (5/6/2013 – 10/17/2013) was 817.68 mm. Average daily ET_c was 5.0 mm d^{-1}. The seasonal corn K_{cr} curve in 2013 had an initial value of $K_{cr\ ini}$ = 0.12 (1 – 25 days after planting (DAP)), a mid-season value ($K_{cr\ mid}$) of 1.08 (58 – 106 DAP), and an ending value ($K_{cr\ end}$) of 0.10 (160 DAP). Corn grain water use efficiency was 1.66 kg m^{-3}, which was comparable to published values for the High Plains.



View of the crop lysimeter looking to the northeast.



Seasonal corn crop coefficient (K_{cr}) fitted curve for 2013 at Rocky Ford, CO.

Acknowledgements:

The lysimeter project is a joint effort between the Colorado Water Conservation Board, Colorado Division of Water Resources, Colorado Water Institute, and CSU. Technical support has also been provided by USDA-Agricultural Research Service engineers and scientists in Fort Collins, CO and Bushland, TX.

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

Brian Bledsoe, Civil and Environmental Engineering, Colorado State University

Whitewater parks (WWPs) consist of one or more instream structures that create a hydraulic wave for recreational purposes. As such, they provide a valuable recreational and economic resource that is rapidly growing in popularity, with Colorado being the epicenter for WWP design and construction. WWPs were originally thought to enhance aquatic habitat; however, recent studies have shown that the hydraulic conditions required to meet recreational needs can act as a partial barrier to upstream migrating trout and that WWP pools may contain lower densities of fish compared to natural pools. There is limited knowledge of the direct effects of WWPs on fish passage. Managers and policy makers have been forced to review WWP designs and make permit decisions without sound scientific evidence. It is also difficult to make design recommendations for future WWPs and possibly retrofit existing WWPs to allow for successful fish passage without improved understanding of the factors contributing to suppression of movement in WWPs.

Depiction of a large whitewater park (WWP) design. Courtesy of Tim Stephens

Depiction of a large WWP of different design type. Courtesy of Tim Stephens

In this study, we combine fish movement data and hydraulic descriptions from a three-dimensional computational fluid dynamics model to examine the physical processes that limit upstream movement of trout in WWPs. We present a novel modeling approach that provides a continuous and spatially explicit description of velocity, depth, vorticity, and turbulent kinetic energy along ~10^4 potential fish swimming paths at each WWP structure. Statistical models based on these swimming paths accurately predict greater than 87 percent of observed fish movements at a WWP in Lyons, Colorado and indicate that variables describing the magnitude and distribution of velocity and depth relative to fish swimming ability are robust predictors of passage success among WWP structures and size classes of trout.

The methods developed in this study provide a powerful approach to evaluating the effects of hydraulic structures on fish passage for management and design guidance. This work also underscores the need for further investigation of WWP effects on passage of native fishes with lesser swimming abilities across WWPs of various sizes.

Depiction of shallow depth and high velocities over a grouted chute on Clear Creek in Golden. Courtesy of Tim Stephens

Trial run for using a raft to sample additional WWPs too deep and swift to wade (Poudre River). Courtesy of Tim Stephens

HB1278: *Concerning The Authorization of a Study of the South Platte River Alluvial Aquifer*

In 2012 the Colorado Legislature passed HB12-1278, entitled *Concerning The Authorization of a Study of the South Platte River Alluvial Aquifer*. The Act directed the Colorado Water Institute (CWI) to conduct a study of the South Platte alluvial aquifer with funding provided by the Colorado Water Conservation Board (CWCB). CWI was required under the Act to prepare and present a report to the General Assembly by December 31, 2013. HB1278 directed CWI to:

- Evaluate whether current laws and rules that guide water administration in the South Platte River basin achieve the dual goals of protecting senior water rights and maximizing the beneficial use of both surface water and groundwater within the basin
- Identify and delineate areas within the basin adversely impacted by high groundwater levels and conduct a feasibility-level evaluation of the causes of high groundwater levels in the affected area
- Provide information to use as a base for implementation of measures to mitigate adverse impacts in areas experiencing high groundwater levels
- Provide information to the General Assembly, CWCB, and the State Engineer to facilitate the long-term sustainable use of South Platte water supplies.

In addition, CWI was directed to evaluate and report its findings and conclusions regarding:

- To what extent augmentation plans are preventing injury to other water rights holders or potentially causing over-augmentation of well depletions
- Whether additional usage of the alluvial aquifer could be permitted in a manner consistent with protecting senior surface water rights
- Whether, and to what extent, the use of water in the basin could be improved or maximized by affording the State Engineer additional authority to administer water rights while ensuring protection of senior surface water rights

The HB1278 study required the Colorado Water Institute to ramp up an intensive effort in a short period of time. A great deal of credit goes to Panagiotis (Takis) Oikonomou, Roy Cook, Pia Gerstle, Beth Plombon, Lindsey Middleton, and MaryLou Smith of CWI for their dedication and hard work on this project. Takis Oikonomou was responsible for much of the data organization and analysis. Steve Malers of the Open Water Foundation (formerly of Riverside Technologies) was invaluable throughout the project in helping the CWI team utilize the SPDSS TSTools and crafting fixes as we navigated the data. Dr. Tristan Wellman of the U.S. Geological Survey conducted an analysis of groundwater level data and developed the proposed monitoring network. Wendy Ryan of the Colorado Climate Center provided climate data and analysis for the study. We were fortunate to have expert technical help in developing the pumping, augmentation, and gain/loss data from Erin Wilson and Kara Sobieski of the Wilson Water Group, and Mark Matisek of Leonard Rice Engineering. Steve Malers developed the point flow tool for the TSTools for the HB1278 study, with help from Mark Matisek. Dr. Ahmed Eldeiry of Colorado State University conducted the analysis of phreatophyte evapotranspiration in the basin. Much of the background material for the HB1278 report was extracted from the South Platte Decision Support System (SPDSS) Technical Memos and associated reports previously prepared by contractors for the CWCB.

HB1278 did not authorize or contemplate the development of new models to study the system, but rather an evaluation of the available

data to address the objectives of the Act. High groundwater was not explicitly defined in HB1278 and thus we choose to define it as a depth to water below land surface of 10 feet or less, based on discussions with research colleagues and the Colorado Division of Water Resources. Our general plan of work for the study was to use the existing data tools in the SPDSS developed for CWCB as part of the Colorado DSS (CDSS) but not the SPDSS groundwater model, which was released during the HB1278 study.

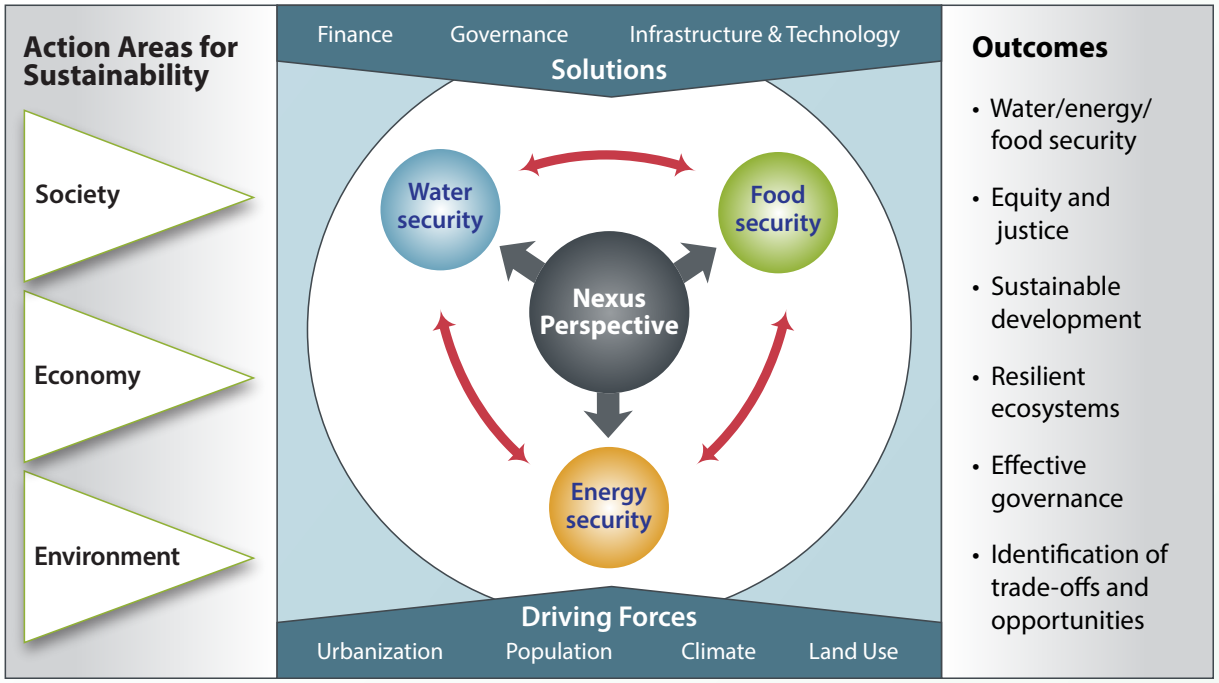
Our evaluation of the data led us to the conclusion that current administration of groundwater in the basin is working well for the majority of water users, and that senior surface water users are for the most part protected from injury due to well pumping by current administration. Groundwater users in Water District 2 and parts of District 1 have been adversely impacted by the shortage of affordable augmentation supplies to offset pumped depletions. Changes in water administration in the past decade have led to increasing groundwater levels that in some cases impact land and homes. Presently, high groundwater conditions impacting landowners appear to be localized and thus, local solutions are recommended. HB1278 asked whether management of the system could be improved while still respecting augmentation decrees and the work accomplished to bring wells into compliance. In that context, the recommendations offered in the HB1278 report fell into four broad categories: 1. Mitigation of localized high water table conditions, 2. Increasing augmentation plan efficiency, 3. Implementation of basin-wide management, and 4. Recommendations for the State of Colorado, DWR, and CWCB. The final report to the Legislature, background data, and recommendations can be found online at www.cwi.colostate.edu/southplatte/.

Background Photo: *The Platte River Basin between Platteville and Sterling, Colorado.*
Photo by Bill Cotton

Water, Energy, and Food: *Mutual Security through a Nexus Approach*

Report from the U.S. Nexus Workshop, June 23-24, 2014; Golden, Colorado

Given the many pressures on water, energy, and food systems, it is essential that national and regional strategies for development and sustainability recognize the interdependencies among them and not plan for isolated sectors. To address this need, the U.S. Army Corps of Engineers Institute for Water Resources and the U.S. Department of State asked the Colorado Water Institute to convene a Nexus Workshop. The workshop was held in Golden, Colorado on June 23-24, 2014. The goal of the workshop was to draw from U.S. experiences to identify useful lessons about the nexus approach to management of water-energy-food systems. Twenty-three experienced practitioners and scholars met in Golden to share case studies and their perspectives on food, energy, and water management and security. The workshop outcomes are designed to contribute to the ongoing dialogues about the water-energy-food nexus with sets of U.S. examples, assessment of current practices and challenges, proposed methodologies to improve management and governance, and identification of best practices and selected case studies to present in international forums such as World Water Week, the Nexus Dialogue, and the World Water Forum.



Adapted from: Hoff, H., Understanding the Nexus. Background Paper for the Bonn2011 Conference: The Water, Energy and Food Security Nexus. *2011, Stockholm Environment Institute: Stockholm.*

The main question to workshop participants was how to plan and manage jointly and effectively across the nexus for the range of contextual situations of resources and institutional capacities found in the U.S. The workshop built on outcomes of previous forums to contribute to the international dialog by studying lessons drawn from U.S. experiences during decades of development, discovery, and challenges. The cases showed most potential for success through actions where stakeholders can forge cooperation directly, but scaling the lessons to higher policy levels is critical to provide a supportive enabling environment for them.

Given the extensive funding requirements of infrastructure, finance is a main driver of the nexus. Single-sector projects with limited partners may seem more accountable, but partnerships to build and operate infrastructure systems are needed to pool resources. New organizational structures to take advantage of the public and private sector approaches are needed. Again, local projects and partnerships will normally work better than large-scale programs.

The Nexus Workshop participants, case studies, background report, and Workshop report are available online at www.cwi.colostate.edu/workshops/nexus2014.

John Fetcher Scholarship Award

The Upper Yampa Water Conservancy District John Fetcher Scholarship provides financial assistance to a committed and talented student who is pursuing a water-related career in any major at a public university within the state of Colorado. Congratulations to this year's scholarship recipient, Taylor M. Baird.

- University: Colorado School of Mines
- Anticipated Graduation: May 2015
- Major: Environmental Engineering
- Minor: Humanitarian Engineering
- Interests: Water and wastewater treatment, Water reclamation and distribution, International development, Environmental health and safety

Baird is currently a senior studying Environmental Engineering with a minor in Humanitarian Engineering at the Colorado School of Mines. She intends to pursue a master's degree in hydrological engineering from the Colorado School of Mines, then would like to be selected to become a Peace Corp volunteer, with a focus on community development in supplying resources and fostering citizen ownership for community developments. She hopes to lead a career in providing clean water to developing nations, then to work in municipal water or wastewater treatment. She enjoys running and being outdoors when she has free time.

Brad Udall

CSU's Colorado Water Institute hired Brad Udall as its first senior water and climate research scientist/scholar to provide additional expertise in the field of water resources and climate change.

Udall has extensive experience in water and climate policy issues, most recently as the director of the Getches-Wilkinson Center for Natural Resources, Energy and the Environment and the Western Water Assessment at the University of Colorado, Boulder. He previously held a research faculty position for 10 years at the University of Colorado's Cooperative Institute for Research in the Environmental Sciences and has served on NGO boards, including the Colorado Coalition of Land Trusts, as well as serving as an executive director with the Eagle Valley Land Trust. He has authored numerous peer-reviewed publications on water management and climate change, which have been published by several major journals and the federal government. Udall's hire will extend the reach of CSU's water research and outreach programs by linking climate mitigation and adaptation research with water quality/quantity and other sustainability issues in the western United States. He has an engineering degree from Stanford and an MBA from CSU.

In his new role, Udall will build on CSU's nationally recognized water expertise by adding additional focus in the Rio Grande and Colorado River basins and in the area of water and climate policy needs for the 21st century.

Working the "People Side": *Collaborative Water Solutions Throughout Colorado*

MaryLou Smith, Policy and Collaboration Specialist, Colorado Water Institute

Since its beginning, the Colorado Water Institute (CWI) has been involved in water research and education related technology, economics, and sociological aspects of water. Increasingly, CWI has been seeking out and taking advantage of opportunities for direct engagement with stakeholders who are struggling with water policy conflicts. The work is slow and doesn't always show immediate results. Almost always, what we accomplish in one project provides opportunities to move further in the next one. Helping stakeholders open their eyes to beliefs and values different than their own is at the root of all of this work. It's one thing to give lip service to the idea that those with different values must come together to solve water problems in Colorado and the West. It's another thing to actually spend meaningful time listening to those whose values are different and finding that you can begin to see their point without necessarily giving up your own ideas. CWI is currently involved in a number of such stakeholder engagements, including:

Water Preservation Partnership

- Assisting farmers and ranchers from eight groundwater management districts in the Northern High Plains of Colorado to work through different opinions on how best to carve out grassroots policies to make themselves accountable for pumping less water from the Ogallala Aquifer—to make their livelihoods and their rural communities more sustainable.

Moving Forward on Agricultural Water Conservation in the Colorado River Basin

- Facilitating dialogue of agricultural producers on the West Slope who have conflicting views of how agriculture can best respond to the intense pressure from urban growth and drought to use less water in agriculture.
- Raising the awareness of Ag producers in the Colorado River Basin to water conserving strategies that are technologically available in both the Upper and Lower Basin, and helping them consider how they might look out for their best interests by tackling legal, economic, and social obstacles to more widespread adoption of such strategies.

Poudre Runs Through It Study/Action Work Group

- Bringing together environmental, agricultural, urban, and recreational interests on the Poudre River for study and action on issues they can agree on—"to make the Poudre River the world's best example of a river that is a hard working river for cities and farms, but also ecologically healthy." Ditch company managers, fisheries biologists, and urban water managers, after a year of relationship building, agreed on an initiative to look at ways diversions and exchanges might be managed differently to keep more water in the river at critical times for fish.

Poudre Water Sharing Working Group

- Facilitating dialogue of Ag water managers and Ag producers with domestic water providers to see how they might be proactive to counter the increasing "buy and dry" of Ag lands. (See page 6 for details.)

CWI is often asked, "Well, are you resolving conflict? Is it working?" Perhaps the best answer is that the complex conundrums we face in western water will not be solved overnight, and in fact, perhaps they cannot be solved, only managed. We do know that we see the stakeholders we work with learning how to listen to one another and cooperatively craft new creative options that meet multiple needs. Actually putting those options into action may be a long way off—or some may happen relatively quickly. But we know that without building relationships and tackling the problems together instead of at odds with one another, those options would not have even come to light.

Current Colorado Water Institute Staff

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Water Resources Specialist

MaryLou Smith
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Brad Udall
Water and Climate Research Scientist/Scholar

Dr. Reagan Waskom
Director

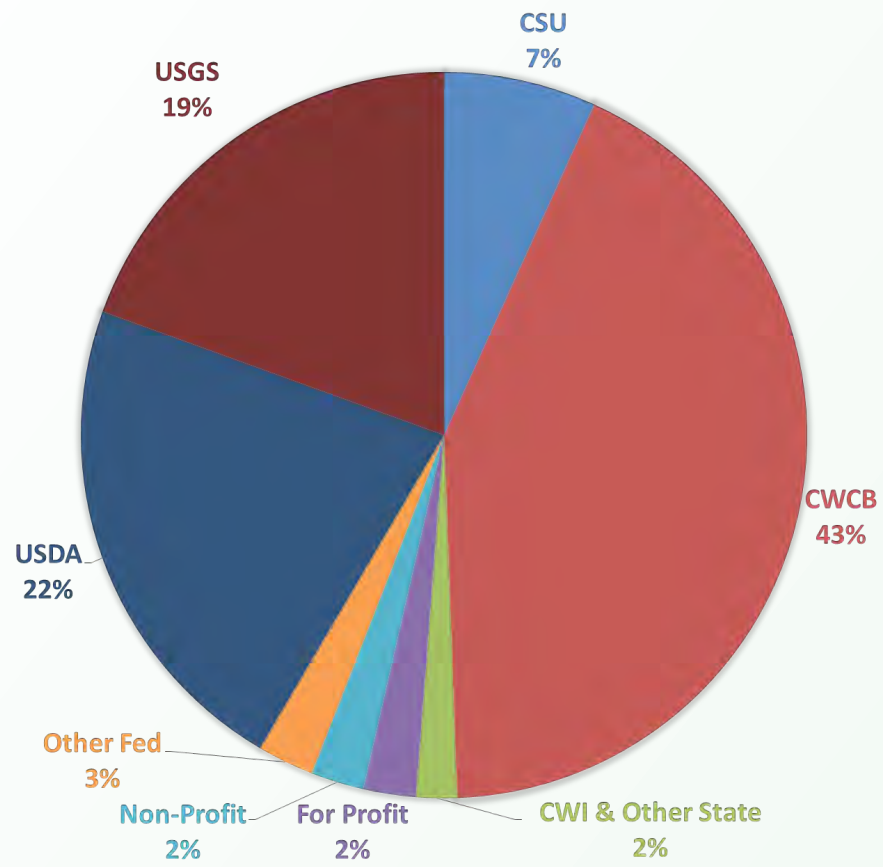
Active Project Funding Sources
(November 1, 2013 - October 31, 2014)

CSU	$ 268,537.00
CWCB	$ 1,808,263.00
CWI	$ 18,000.00
For Profit	$ 106,603.00
Non-Profit	$ 93,471.00
Other FED	$ 249,308.00
Other State	$ 141,930.00
USDA	$ 873,000.00
USGS	$ 742,134.00
Total	$ 4,301,246.00

Active Project Type

Research	34
Education	19
Outreach	10
Internships	5
Training	4
Total	72

Funding Sources



Student Degree Level on Projects

Undergraduates	15
Master's Students	12
PhD Students	13
Total	40

Name	Organization	Telephone	Email
Jim Broderick	Southeastern Colorado Water Conservancy District	(719) 948-2400	jwb@secwcd.com
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Colorado Water Institute

Colorado State University

North Clear Creek Falls, Rio Grande National Forest, Colorado. Photo by Scott Ingram

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