Colorado Water

Colorado State University

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Highlights

In Every Issue

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Front Cover: Noah Newman, education coordinator for CoCoRaHS, teaches a group of 4th-5th graders about measuring rainfall and prepares to play the "Make it Rain" game at the Greeley Water Festival (April 25th, 2012). Courtesy of the Colorado Foundation for Water Education

This Page: As part of Project WET: Water Education for Teachers, participants learn about tamarisk removal and riparian restoration as they float in the Colorado River Basin. Courtesy of the Water Center at Colorado Mesa University

Editorial

by Reagan Waskom, Director, Colorado Water Institute

Water education in Colorado probably began just a few days after the first European settlers arrived and realized what they were in for. Maps and journals from the 1806 Pike expedition and the 1820 Long expedition spread information about the lack of water and vegetation that those daring enough to settle here would face. The education continued as early colonists from back East learned how to build ditches and farm in an unfamiliar landscape. With each wave of newcomers, the need for water information and education bore out repeatedly as the rain failed to follow the plow.

As easterners settled on Cherry Creek, the Arkansas, the Poudre, and other rivers where water was more easily available, they soon became educated about flash floods. The need to learn about water quality emerged in the early mining towns and settlements, when water borne illness became problematic. And then there was drought, and the need to capture, store, and divert water to where humans needed it.

Efforts in water education in Colorado have been variable over the years, gaining in intensity as various groups undertook efforts to get water projects financed and built. Universities have been a bit more consistent. Colorado Agricultural College had three faculty and five students when classes began in Fort Collins on September 1, 1879. Almost immediately, the college began efforts to transfer research-based knowledge about irrigation to the farmers and ranchers of Colorado. In 1883, math Professor Elwood Mead joined the faculty, where he initiated the irrigation engineering curriculum, one of the first in the nation. Ralph Parshall, who joined the Colorado State University irrigation engineering faculty in 1907, designed and directed construction of the U.S. Department of Agriculture Hydraulics Lab, which was located where the Lory Student Center is sited today. This facility was used by the Bureau of Reclamation in designing the Boulder Canyon Project (today's Hoover Dam and Lake Mead). Much of the early hydraulics research that permitted construction of large western reservoirs was conducted on the CSU campus in the 1930s. In 1914, CSU President Charles Lory initiated Cooperative Extension, and the first County Agents were located in Logan and El Paso counties, dispensing knowledge on water management.

Today, water education continues at CSU with some 120 faculty and 40 research scientists across all eight colleges in 22 departments, applying their disciplines to water and water-related topics. These faculty teach approximately 150

courses at the junior, senior, and graduate levels on water-related subjects. CSU Extension and the Colorado Water Institute work in tandem to bring water information and education to stakeholders across Colorado.

The need for robust water education and information programs remains critically important. Witness the current information flow about fracking, rainwater harvesting, conservation, and new storage projects. What's changed in recent decades is the surprising number of organizations in Colorado that have either incorporated water education into their missions or specifically focused their organizations on water education, as a number of new organizations have. Additionally, the State of Colorado has made significant investments in recent years in water education, recognizing the need to help 5.2 million citizens understand and appreciate the variability and value of this limited resource. The Colorado Foundation for Water Education (CFWE) has just turned ten years old and celebrates great success in reaching the water interested public. CFWE has been able to foster collaboration among water education professionals and organizations across the state, and there are refreshingly few turf battles in the water education scene in Colorado.

We need to work together to find new and better ways to engage the public in understanding the value of water for our economy, our way of life, and the ecosystems we rely on in Colorado. As the next generation and the next million Coloradans arrive from other places, water education is key. The easy and inexpensive water projects and infrastructure have all been built; from here on it is about collaboration, tradeoffs, and conservation, and a new water ethic and understanding are going to be needed. An educated citizenry armed with sound information and community spirit are what will get us there.

Water Education in the Warner College of Natural Resources

Fostering Learning of Our Watershed

Sara Rathburn and Michael Ronayne, Department of Geosciences, Colorado State University
Stephanie Kampf and Melinda Laituri, Department of Ecosystem Science and Sustainability, Colorado State University

In a Nutshell

- Purpose: CSU professors along with collaborators from UNC and FRCC received grants to address water literacy in their institutions
- Methods: Hydrologic stations were set up within the Cache la Poudre Basin to collect data to educate students at CSU, FRCC, and UNC, and students' water knowledge is currently being assessed using questionnaires
- Hypothesis: Student learning will show positive gains due to hands-on, contextual association with the local watershed

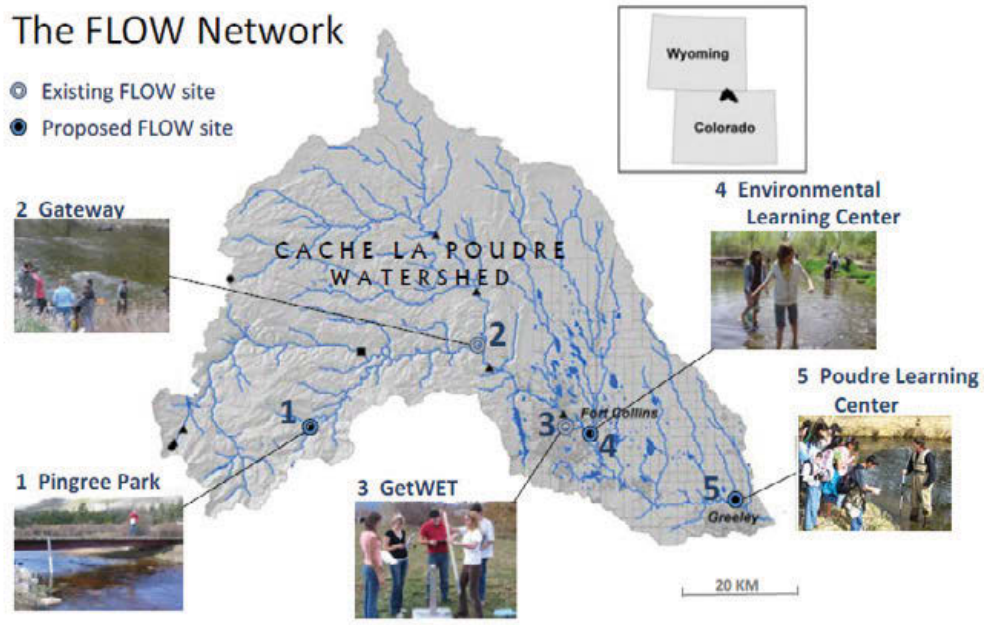


Figure 1. *Existing and proposed hydrologic field stations within the FLOW network Cache la Poudre Basin.*

Introduction

Faculty members in the Warner College of Natural Resources (WCNR) are utilizing the local Cache la Poudre watershed to underpin and enhance water education in our college. We approach undergraduate water education as a scholarly activity through collaboration; grant writing; development of relevant, high-impact learning materials and reliable and validated assessment instruments; and dissemination of our findings online, at professional meetings, and through publications. We teamed with colleagues from Front Range Community College (FRCC) and the University of Northern Colorado (UNC) to address water literacy across the spectrum of course offerings at three institutions of higher education located in the watershed. Grants from WCNR and the City of Fort Collins are helping support instrumentation for a network of hydrologic field stations to provide sound, reliable water quantity and quality data from the Cache la Poudre headwaters to the plains. The objective of the hydrologic stations is to provide continuous water data for educational and research purposes. These data provide the basis for field-based learning opportunities for students in WCNR, and eventually FRCC and UNC. Finally, innovative metrics are being developed to assess student knowledge of fundamental water concepts. Fostering greater student understanding of key water concepts is well aligned with WCNR's Strategic Plan and mission of educating our students and the larger community to ensure the responsible use and protection of renewable and non-renewable resources.

Study Sites

Five hydrologic field stations are planned for the Cache la Poudre watershed as part of the Fostering Learning of Our Watershed (FLOW) network (Figure 1) to span the diverse physical, chemical, biological, and land use practices within the basin. Currently, three are fully or partially instrumented, including Pingree Park at CSU's mountain campus along the South Fork Cache la Poudre River (partially instrumented), Gateway Natural Area along the main stem Poudre River in Poudre Canyon (fully), and the Groundwater

Teaching and Education Observatory (GetWET; Rathburn and Weinberg, 2011) along Spring Creek on campus property (fully). Additional stations at the Environmental Learning Center in Fort Collins and the Poudre Learning Center in Greeley will complete the hydrologic network. Full instrumentation at these stations includes surface water gauges and ground water wells along a reach of river that spans approximately 10-15 channel widths. Eventually all wells and gauges will contain pressure transducers to continuously measure stage/water depth and shallow piezometer nests to assess groundwater-surface water exchange. All but one of the sites offer infrastructure that safely accommodates class field trips with up to 50 students at one time, including parking, shelters, and restrooms.

Educational Relevance

The Cache la Poudre River in northern Colorado is a vital natural resource for over 700,000 residents in three counties and myriad ecological communities within its 5,000 square kilometer watershed. A network of flow modification structures export and import water in the Poudre watershed, with over 70 structures within the Poudre Canyon alone (Richer, 2009). These flow modifications exacerbate the complexities on the only river in Colorado that is jointly designated as Wild and Scenic and a Natural Heritage Area. Several major water supply infrastructure projects have been proposed for the watershed, and the feasibility and environmental effects of these projects are a source of active public debate. In addition, fires during summer 2012 have heightened public awareness of our local watershed and brought many scientists together to work collectively on post-fire research. While the fire tragically destroyed over 250 homes and displaced many families in our community, it has sharpened the community's focus on the future health of our watershed and the long-term potential impacts of climate change, including drought, pathogen outbreaks, and overall reductions in annual flow within the Poudre River. Now is an opportune time to develop relevant, authentic Cache la Poudre watershed-based learning tools for CSU students in WCNR to cultivate an informed and water-literate public.

WCNR Course Offerings Utilizing the FLOW Network

Fourteen courses in WCNR are utilizing, or plan to utilize, the learning opportunities of the FLOW network (Table 1). Our students gain skills to quantify surface water and groundwater flow, develop water balances that account for basin inflows and outflows, assess surface-subsurface water interactions, evaluate downstream changes in channel form/function and physical-biotic interactions along streams and riparian corridors, conduct basic chemical analysis, and assess alluvial aquifer properties through field measurements and computer modeling. In the 100-level geology courses, new class exercises using FLOW network data reinforce introductory water concepts. At the advanced undergraduate level, our goal is for students to master the broad scientific skills necessary to enter the environmental science workforce or pursue graduate research.

Learning objectives for introductory courses include the use of established scientific methods to: 1) describe watershed attributes, 2) collect watershed data, and 3) develop simple water balances. Advanced courses emphasize more rigorous learning objectives where students

Table 1. *Undergraduate courses in WCNR that utilize data or the field setting of the hydrologic stations within the Cache la Poudre Basin.*

Course (Lecture/Laboratory)	WCNR Department[1]
GEOL120 Exploring Earth: Physical Geology (Lec)	GEO
GEOL121 Introductory Geology Laboratory (Lab)	GEO
GEOL122 The Blue Planet: Geology of our Environment (Lec)	GEO
GEOL150 Physical Geology for Scientists and Engineers (Lec+Lab)	GEO
GEOL376 Field Methods (Lec+Lab)	GEO
GEOL446 Environmental Geology (Lec)	GEO
GEOL452 Hydrogeology (Lec+Lab)	GEO
GEOL454 Geomorphology (Lec+Lab)	GEO
GEOL551 Groundwater Modeling (Lec)	GEO
NR220 Natural Resources Ecology and Measurement (Lec+Lab)	ESS, FRS, FWCB, HDNR
NR420 Integrated Ecosystem Management (Lec+Lab)	FRS
WR304 Sustainable Watersheds (Lec)	ESS
WR416 Land Use Hydrology (Lec)	ESS
WR417 Watershed Measurements (Lec+Lab)	ESS

[1] ESS - Ecosystem Science and Sustainability; FWCB – Fish, Wildlife, and Conservation Biology; FRS – Forest and Rangeland Stewardship; GEO – Geosciences; HDNR – Human Dimensions of Natural Resources

Figure 2. *Students in GEOL376 and 446 assisted with on-site well logging during drilling (left), well development, measuring initial groundwater levels, and gauging discharge (right) in the Poudre River at Gateway Natural Area.*
Courtesy of Sara Rathburn

assess watershed function, water data analysis, and water balance modeling. The remainder of this article will describe introductory courses where learning materials and assessments have already been completed, and one advanced course that is using the basin as a learning platform.

Introductory Courses

Undergraduate students in GEOL150 Introductory Geology for Scientists and Engineers recently completed a laboratory exercise assessing surface and groundwater along the Poudre River at Gateway Natural Area. During a three hour field outing students evaluated the geologic substrate within the valley and along the river in cutbanks, gauged the flow in the river at upstream and downstream cross sections, conducted pebble counts of the bed material, measured water levels in the wells, and constructed a geomorphic map of channel morphology and riparian vegetation. Well logs and measurements completed by upper division students during well installation in spring 2012 (Figure 2) were provided as additional information. Subsequently, a three hour laboratory in-class session on data analysis and scientific report writing allowed GEOL150 students to share, compare, and discuss data. Each student then completed a short, scientific report summarizing the results of the field study. Pre- and post-tests were administered to assess student knowledge changes of fundamental water-related concepts.

Watershed Attributes

Introducing watershed attributes to students includes describing the soils, geology, topography, vegetation, and climate of the site. In GEOL150, students noted bedrock control on one bank of the river, and reworked alluvium and riprap on the other bank associated with infrastructure of the City of Fort Collins former water treatment plant. Using the concepts of process domains of Montgomery (1999), they learned that the valley is unglaciated and confined, with the disturbance regime at this elevation primarily fire, wind, debris flows, and floods. Students observed that riparian vegetation is relatively sparse, composed of several willow species, river birch, alder, with conifers and grasses on hillslopes.

Water Data

Introducing water data to students includes presenting them with different types of data, how data are measured, and how the data are plotted and interpreted. Students in GEOL150 used a one-dimensional Marsh-McBirney flow meter to measure water velocity in the Poudre River, and recorded flow stage on the staff plate at the surface water gauges. They calculated discharge for the upstream and downstream gauges and compared their results to student-collected data from spring 2012 (Figure 2). Interestingly, a consistent loss of discharge of approximately eight to nine percent between the upstream and downstream cross sections on the Poudre River has been measured. Water level measurements in the groundwater wells support an overall losing stream at this site. While the data are limited, it appears that the Cache la Poudre River is the local water table high along this reach on the upgradient portion of the meander bend, with a gradient from the river to the aquifer (Figure 3).

Water Balance

For introductory students, the concept of a water balance is simplified to focus on the river only, with the upstream and downstream cross sections and channel banks serving as boundaries. Students then identify and describe the inputs and outputs of the river reach only, as

$$Q_i + P \pm Q_{gw} = Q_o + ET$$

where Q_i = river inflow, P = direct precipitation (and hillslope runoff), Q_{gw} = gain or loss to groundwater, Q_o = river outflow, and ET = evapotranspiration. Further discussion introduces the influence of natural and anthropogenic storage, and how that relates to temporal and spatial variability of water movement, and hence availability, within the basin.

Assessment

Our assessment strategy is to evaluate changes in student's watershed-based conceptual knowledge. Currently, there are no available hydrology-specific assessment instruments to use in college classrooms, and existing concept inventories in the geosciences (e.g. Libarkin and Anderson, 2005) do not include enough water-related questions from which to create new assessment materials. Therefore, we developed new watershed concept questions to assess student learning. Prior to any lecture presentations on water, 21 questions were given

to GEOL150 students. The same assessment was given at the end of the semester to evaluate learning that resulted from the laboratory exercise. The hypothesis is that student learning will show positive gains due to the hands-on, contextual association with the local watershed. Research on student knowledge of fundamental geosciences concepts (Libarkin and Anderson, 2005) found no significant gains in student learning over the course of a semester in introductory geology courses for non-majors. Our approach, centering student learning within the familiar context of their local watershed, tests whether enhanced student mastery of watershed understanding occurs (Rathburn et al., 2012).

Students in a large enrollment (>250 students) GEOL120 course were also given the same 21 hydrology-specific questions in fall 2012 prior to any instruction on surface or ground water. This lecture class does not have an associated laboratory nor emphasize the Poudre basin in units on rivers and groundwater. Post-tests were then completed at the end of the semester. One confounding factor is that a large percentage of GEOL120 students visit the on-campus GetWET well field during a separate GEOL121 laboratory course. While it will be difficult to tease out the field versus no-field aspect of undergraduate learning of water concepts from this first round of assessments, enhanced learning through contextual associations to the Poudre River is expected to emerge through pre- and post-test scores.

Advanced Course

WR304 (Sustainable Watersheds) is designed to introduce students to key watershed science and management concepts, and they apply these concepts to analyses of the Cache la Poudre Basin. Students conduct an integrated set of assignments throughout the semester building upon a set of skills that involve downloading water data, creating graphs, conducting field assessments, and presenting results through oral presentations. Students write a watershed description in which they characterize the elevation range, river gradient, basin area, land cover, and other attributes of the basin. They analyze discharge data from the upper and lower basin to examine the effects of snow accumulation, flow diversions, and reservoirs on river flow. As a semester project, students are assigned a publically accessible reach approximately 400 meters in length along the Cache la Poudre River from Overland Trail to Interstate-25. They conduct a field assessment of a surveyed river reach to determine impacts and river health through observational data collection and photography. The students then collate their data to determine overall reach condition, prioritization of impacts along that reach, and suggested solutions and restoration projects. Their results are presented in class where students evaluate their peers.

Dissemination

All information from the hydrologic field sites, including location coordinates, GIS layers, and water quantity and quality data are planned for dissemination on WCNR's Geospatial Centroid http://ibis-live.nrel.colostate.edu/DH.php?WC=/WS/Centroid/index.html. The existing GetWET website http://getwet.colostate.edu/index.html will be folded into an overall FLOW website to consolidate Web resources. CSU's Information Science and Technology Center (ISTeC) is hosting a Cache la Poudre Water Data Retreat in February 2013 to discuss water data needs and uses across the basin and how best to meet the needs of students, researchers, and stakeholders utilizing an integrated dataset.

Another tool at our disposal for dissemination and visualization is Morgan Library's projected Google Liquid Galaxy. Google Earth is projected on a wall to allow a three-dimensional "fly through" of the Cache la Poudre from the headwaters to

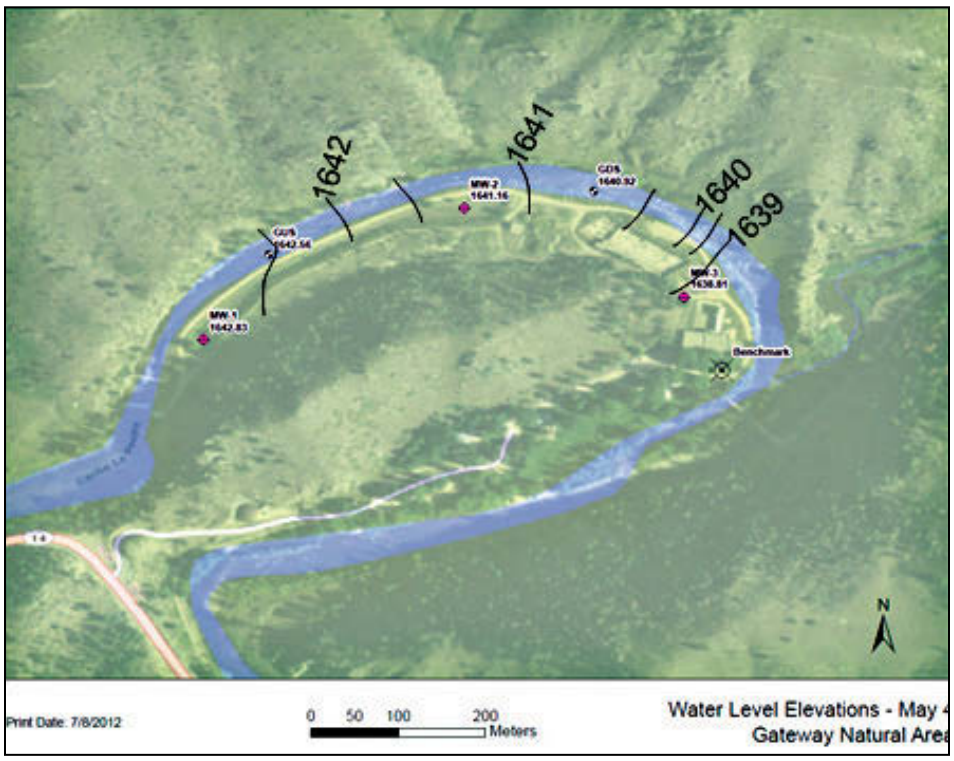


Figure 3. *Water table surface map at Gateway Natural Area. Contours of the water table are in meters above mean sea level. Flow in the Cache la Poudre River is from left to right.*

the confluence with the South Platte. Multiple digital data layers can be overlaid that include historical maps, the complex of irrigation ditches, boundaries of the High Park fire, and sites of critical instrumentation throughout the basin among other numerous data layers. Our goal is to create an easily accessible, user-friendly website to host data on the Poudre watershed, in addition to course materials for use by students, faculty, and community members in the basin.

Conclusions

Researchers and educators at CSU are undertaking science education as a scholarly activity through use of the Cache la Poudre watershed. The efforts to develop FLOW hydrologic field stations will support state-of-the-art research on a watershed that embodies pertinent water issues in the West, and facilitates effective use of the basin as a launch point for teaching. Results from the innovative educational materials will inform us of student-held water concepts within courses, and elucidate the importance of field versus no-field experiences and contextual versus standard learning. We look forward to expanding learning materials into other undergraduate courses at CSU and continuing to collaborate with FRCC and UNC colleagues to create educational opportunities through the FLOW network. The numerous, relevant scientific and societal issues related to our local watershed offer unique and unprecedented learning opportunities for our students, for they are our most important stakeholders as the next generation of water users and resource managers. Fostering student water literacy and watershed stewardship is therefore a critical investment.

> "Our goal is for students to master the broad scientific skills necessary to enter the environmental science workforce or pursue graduate research."

Please contact the authors for information on references used in this article.

Aurora Students Experience "H2O Outdoors" – Program Goes Global

Natalie Brower-Kirton, Senior Education Program Specialist, Aurora Water

Each spring and fall, high school students get the opportunity to attend the Keystone Science School's H20 Outdoors program thanks to scholarship funding provided by Aurora Water, Denver Water, and The Colorado River District. In the past it was exciting to get students from across Colorado together, but in 2012, H2O Outdoors went global. Students from Denver's African Community Center who attend Aurora Central High School and South High School joined students from across Colorado to learn about water in the arid West. Students mostly hailed from the Democratic Republic of Congo, and many had never been in the mountains before standing on top of the Continental Divide during the camp.

The three-day program, pioneered by the Colorado River District, is designed for students who want to learn in-depth information about water in the West. "Talking about rivers and streams, water rights, and water policy east of the Continental Divide doesn't necessarily connect students with their source of water," Aurora Water's Mary Dawson said. "It's about getting kids up here, and experiencing the relationship between snowfall and streamflow." Students completed stream surveys and water quality monitoring, hiked the continental divide while teaching each other about water law, did snow-water equivalency tests, and learned about water management strategies in Colorado.

The mission of H2O Outdoors is to foster awareness about issues surrounding water in Colorado, inspire critical thinking, and teach the process of citizen action. Students also see collaboration at work—how personalities interact and the way difficult compromises are made. In order to understand the perspectives of real-life stakeholders in water management, students interviewed an expert panel of current water managers, county commissioners and non-profit watershed groups. Then, students each took on a stakeholder role and discussed their positions in a town hall meeting. "Learning about other people's point of view really broadens you knowledge about water in Colorado," said Natalie Brower-Kirton at the event, "but learning beside students from different cultures impacts your life."

Aurora also has an All About Aurora Water Activity Book, available at http://www.npscolorado.com/Aurorabook.pdf.

Civil Engineering at CSU

A Close Look at a Distance Program

Sarah Youssef, Distance Learning Coordinator, Civil and Environmental Engineering, Colorado State University

In a Nutshell

- The Colorado State University Department of Civil and Environmental Engineering offers a distance education Master of Engineering degree online ("OnlinePlus")
- The OnlinePlus will soon be expanded to include a Master of Science non-thesis degree (Fall 2013)
- The program intends to offer prerequisite classes so students without an M.S. Engineering degree can participate

Distance education, or the expansion of the pedagogical institution beyond its campus, came about in order to overcome limitations in people's opportunities to study. In keeping with the ideals of Colorado State University's (CSU) land grant mission, part of the Department of Civil and Environmental Engineering's (CEE) vision is a "commitment to the citizenry of Colorado, the nation, and the international community." The CEE department, as part of the College of Engineering at CSU, has been bringing that vision to fruition by providing educational opportunities to students beyond Fort Collins for more than 40 years.

History of CEE Distance Education

It was in 1967 that the State University Resources for Graduate Education (SURGE) program was founded in order to provide continuing education to engineering professionals employed in Colorado-based industries. This was accomplished by recording and distributing lecture videos to companies where they could be viewed at employees' convenience, thereby overcoming limitations of inopportune lecture times and students' distance from campus. SURGE flourished over the next 20 years, and by the 1980s more than 1,000 part-time students in more than 35 companies had obtained degrees in engineering from CSU via the distance education program. Students were not the only ones to benefit from the program—SURGE also made it possible for the College of Engineering to develop valuable relationships with Colorado's developing industrial community. The National Technological University would eventually stem from the SURGE program and would serve not just CSU, but several other universities as well. By the early 2000s, technologies had developed to a point at which it was feasible for CEE faculty members to record and deliver lecture content to distance students via the Internet, thereby greatly improving upon the efficiency of the delivery of content. During this time, the Division of Continuing Education worked closely with the CEE department to handle marketing and administrative responsibilities. The Division of Continuing Education, currently known as "OnlinePlus," continues to work with the CEE department, not only with marketing and administration, but also with modern media technologies to deliver lecture videos in ways that offer even more conveniences for distance students.

The Distance Program Today

Today, the CEE department offers a Master of Engineering with a formal specialization in Civil Engineering. Students may pursue either a Water Resources Engineering focus or Geospatial Engineering focus. We believe that students are attracted to our degree program because of the flexibility of fully online learning. There is no obligation on the students' part to come to campus at any time. All lectures are recorded and students

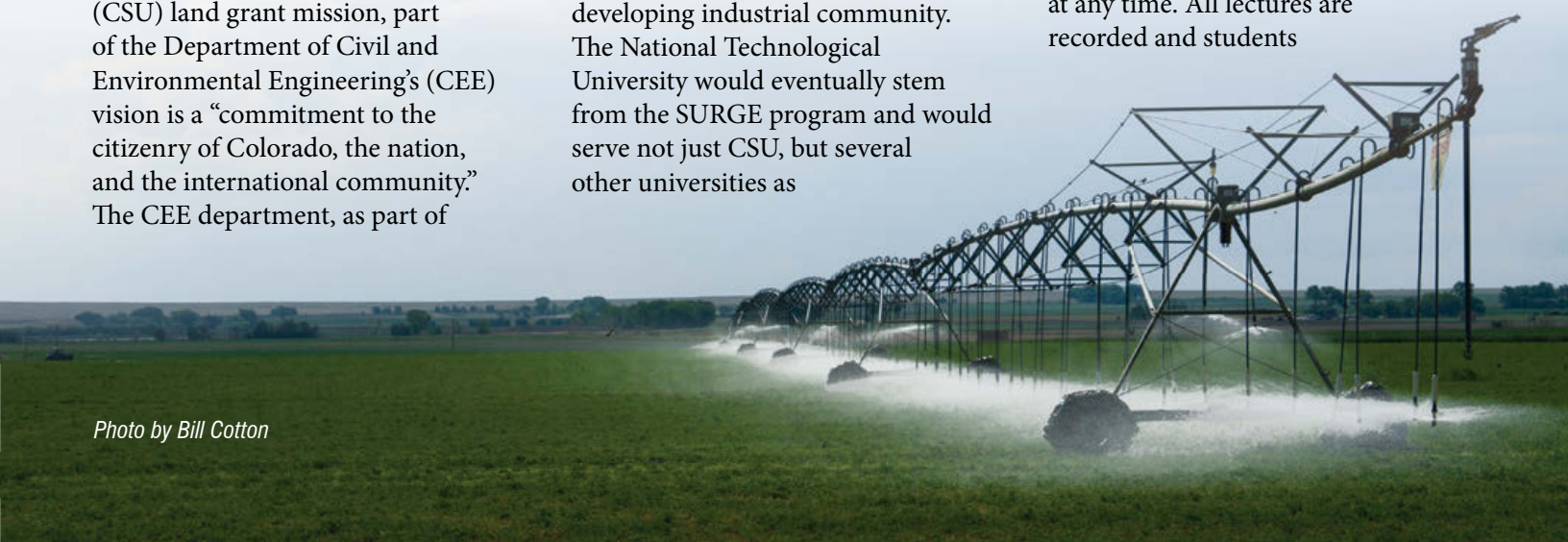


Photo by Bill Cotton

are given online access to stream or download the recordings onto a variety of internet capable devices, very soon after the recording is completed. Upon completing the 30 credits required for graduation, students who have taken the courses at a distance receive the same, regionally accredited (from the North Central Association of School and Colleges) degree awarded to on-campus students. We can offer students a competitively ranked graduate program, as well as access to faculty who are world renowned in their respective fields and course content that is relevant to practical applications. In terms of time, because of the flexibility of when students can view and work on the material for a course, they are able to maintain their current work and personal commitments while pursing the degree. Because of the advantages listed above, we believe that the nature and content of our online degree program is especially beneficial to engineers who are serving in the military, who are located at remote sites, or who have schedules that do not allow them to participate on a campus-based program. We believe that our program is also appealing to those looking to further their careers while continuing their professional work. Private industry, government organizations, the military, or other institutions may be interested in establishing continuing education programs for their employees through our distance learning program.

Students enrolled in our courses and degree program will find a supportive environment within the CEE department and through OnlinePlus. While OnlinePlus takes students through the administrative steps necessary (i.e., application, enrollment, drop/add, etc.), the CEE faculty and their instructional assistants are committed to the academic success of the students. Faculty members are committed to responding to students' emails and phone calls in a timely manner. Thanks to OnlinePlus's technology team, we have recently made the switch to recording lectures in a way that is very user friendly for students—depending on the internet speed and type of device a student is using, they have access to 1) a prominent display of what is projected onto the smartboard in the classroom, 2) a screenshot of the instructor as he or she is lecturing, and/or 3) a audio of the lecturer. The CEE department has committed to providing at least one instructional assistant for each course. The instructional assistants are responsible for serving as an additional resource for students by also answering emails, holding virtual/phone-in office hours, holding recorded review sessions, etc. The department has also hired a distance education coordinator to work with faculty, OnlinePlus, and students to bring consistency to our distance courses and to offer administrative support within the department.

Faculty member Dr. José Chávez teaching in one of the CEE Department's distance-equipped classrooms.
Courtesy of Sarah Youssef

The Future of CEE Distance Education

The CEE department has a vision for expanding and improving the distance education program in the near future in order to meet present day and anticipated demands. Starting in Fall of 2013, the department will add Structural Engineering to the list of foci that can students can pursue. As do the Water Resources and Geospatial Engineering foci, that of Structural Engineering will initially start off as a Master of Engineering degree that requires students to complete 30 credit hours, with no thesis requirement. However, we also intend on expanding our distance program to include a Master of Science degree (Plan B), with the same foci as those offered through the Master of Engineering degree starting in the Fall of 2013. The M.S. degree, Plan B (non-thesis) requires a minimum of 32 semester credits of approved graduate work, at least half of which must be in regular graduate-level civil engineering courses. For the M.S., Plan B, an engineering report is required, which could be done at a distance. Our future plans include offering the M.S. degree, Plan A (thesis required), which requires 30 credits of approved graduate work, 12 credit hours of which must be regular graduate-level civil engineering courses. Students pursuing this degree may be required to spend some time

Distance faculty members in the Civil and Environmental Engineering Department (from left to right): Professors John Labadie, Neil Grigg, and Darrell Fontane by the Poudre River.

Courtesy of Sarah Youssef

on-campus (although this yet to be determined) in order to fulfill the research requirements.

Currently, one of the admission requirements for the M.Eng. degree program is that students have a Bachelor of Science in engineering. However, as is done for on-campus students, we would like to give potential distance students with non-engineering backgrounds the opportunity to pursue an M.Eng. or M.S. by giving them a way to take the prerequisite courses. Our aim is to begin offering the CEE prerequisite courses through our distance program in the near future.

Our vision for expansion of our distance program also includes a certificate program offered through distance. Certificates will be awarded to students who complete three specified courses in one of the following areas: Geospatial, Hydrology, Soil and Water, Infrastructure, Structures – Analysis, and Structures – Design.

We take pride in our history of accommodating students who wished to further their education and careers, even though obstacles such as distance, time, and other obligations might have prevented them from reaching their goals. The faculty and administration of the CEE department continue to honor that commitment to serving people everywhere through education.

We are equally passionate and are working diligently toward developing our program in a way that meets modern students' needs and that takes advantage of current technologies in a way that provides additional conveniences for our students.

The Basin Education Movement

Judy Lopez, Conservation Education Specialist, Rio Grande Watershed Conservation and Education Initiative

In a Nutshell

- The Rio Grande Watershed Conservation & Education Initiative has grown into a far-reaching group with projects like a kids camp, a teacher workshop, Project Wet and local curriculums

The Upper Rio Grande River Valley. Photo by Amy Jackson

The upper Rio Grande Basin is an amazing place, the confluence of the San Juan and Sangre de Cristo mountain ranges opening up to the highest and largest mountain valley in the world. The fact that all of this sits atop a unique aquifer system enclosed by these behemoths still is not what makes this place amazing. The basin is amazing because of the people who are here and their passion for water.

The Rio Grande Watershed Conservation & Education Initiative is a small part of that passion. It has been 20 years since the conservation districts began a conservation education position. Little did they realize that their commitment to conservation land use practices would grow into a movement. The education position has grown from a conservation poster contest, a handful of school visits, and community outreach events to over 10,000 student visits a year, a variety of field trips for students and community members, a two-week teachers workshop, a kids camp, and grazing and farming workshops The initiative serves as an education voice on many boards, committees, and educational programs and provides Project Wet, Project Learning Tree, Food Land and People, and local curriculums.

This change is due to partnership building, program planning, and community buy in. When the education position became a 501c3 in 2009, the mission was the same as always—to provide quality, informative education about conservation and the use of natural resources to San Luis Valley farmers, ranchers, landowners, community members, and students.

As our population continues to increase, it becomes increasingly important that we continue to support sustainability through the actions of sound resource management. It is essential that we begin to think differently as we look toward the future—we must ensure that we provide everyone with the experience to make informed decisions based on sound information, not misaligned propaganda.

The valley is home to many leaders and organizations. What took place as part of the state wide "Water 2012" movement was just another part of how this collaboration works together. The partnership took minimal funding from the basin roundtable and shared the word in every way we could. Weekly articles were run in the local newspaper about water issues from here and across the state, monthly radio shows were done, water projects were toured, field hikes were presented by a multitude of folks, the Rio Grande Reservoir held their 100th anniversary celebration, and folks from across the state came up to the headwaters of the Rio Grande. There was a traveling library display, a blog, a website, a water fest, and school events. Yet more important than all of this, there has been a lot of conversation.

It is exciting to watch the pendulum swing. There are more people seeing that resources are limited, and with technology advancing, we sit on a threshold of being able to effect true change. As more and more of our youth get outside, our educational community is more willing to take part. Our community and business alliances are strengthening. I believe that this is not just a rural movement, but it can be an urban movement, too.

There are, after all, seven billion of us here on the planet and five million in Colorado, with both of those numbers expected to double by the year 2050. Our water footprint is far out growing the supply that we have readily available. When we consider that those fresh water supplies are in jeopardy of becoming contaminated, that compounds our water supply problems.

There are many things that contribute to water pollution and surprisingly, these issues do not just focus on our population centers. Rural areas have water contamination issues, too. Any urban center regardless of the size may have to treat their water supply for biological contamination. Most all effluent (waste) water, even septic tanks, can reach the groundwater or local stream. Though most contaminants filter harmlessly away, during years of drought there is less water in the system, so possibilities for contamination increase.

> "The mission is to provide quality, informative education about conservation and the use of natural resources to San Luis Valley farmers, ranchers, landowners, community members, and students."

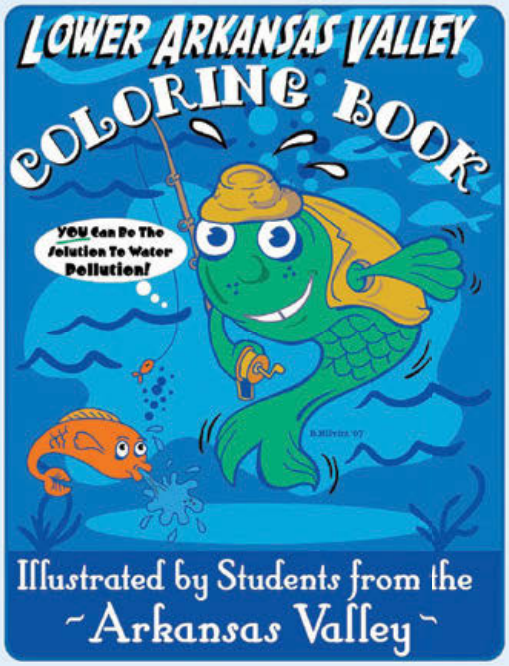
The same holds true for our rural mountain watersheds, since they provide run-off to our streams and rivers and are also a vital supply system to our aquifers. During drought years as systems dry out, they dry from the top down, making it more difficult for water to reach the lower valley systems. This increases the dilution levels in streams and rivers, allowing them to have higher pH levels, and depending on the surrounding rocks, higher minerals and metals content. This could also increase the total dissolved solved solids (TDS) and total suspended solids (TSS) in any given body of water, changing the habitat.

This means that now more than ever there is greater need for environmental/conservation education for our populace as a whole. By truly educating ourselves, it is possible for us to make great decisions about our future. Author Richard Louv, in his book *Last Child in the Woods: Saving Our Children from Nature-Deficit Disorder*, said, "It's a good thing to learn more about nature in order to share this knowledge with children; it's even better if the adult and child learn about nature together. And it's a lot more fun." I couldn't agree more.

Water Education in the Lower Arkansas River Basin

Carla Quezada, Office Manager, Lower Arkansas Valley Water Conservancy District

The main educational goal for the Lower Arkansas Water Conservancy District (LAVWCD) is to reach children, because they are the future. For Water 2012 the LAVWCD did several presentations at libraries and one presentation at the Children's Museum in Pueblo. The LAVWCD tries to get to all the schools in Pueblo, Otero, Bent, Crowley, and Prowers Counties. Our goal is to make sure that the kids understand that water doesn't come from the faucet, but that we have to have snow in the mountains and rain on the plains. We show the H20 Jo Takes a Ride Through the Storm Drain DVD (available at http://npscolorado.com/h2oJomovie.htm), and now the Water 2012 DVD (http://vimeo.com/38999360). After the short films, we break out into groups and help the students brainstorm how we can conserve water. We give handouts to the students and some items like pencils. A presentation to some first graders at the earlier this year in Rocky Ford was a lot of fun and generated many thank you cards. Some years back we had children in the district design a coloring book that can be found at www.npscolorado.com/Arkcoloringbook.pdf.



Operation Water Festival

Curry Rosato, Watershed Outreach Coordinator, City of Boulder Water Quality

In a Nutshell

- Operation Water Festival engages fourth and fifth grade Boulder Valley and St. Vrain Valley school districts and independent education students via classroom lessons and a day-long event in each district with hands-on experiments and interactive learning
- Nearly 2,000 students participate in Operation Water Festival each year
- Students receive a take-home Water Agent book with family-inclusive assignments

Students learn about the types of insects and animals that live in local water bodies at the water festival.

Courtesy of Curry Rosato

Although water is a precious natural resource that students and their families use every day, learning about local water resources is often left out of classroom curricula. Enter Operation Water Festival, a model, standards- based, water education program featuring a pre-festival learning program and day-long water education event that engages fourth and fifth grade Boulder Valley and St. Vrain Valley school districts and independent school students in hands-on activities designed to teach them where drinking water comes from and how to protect and conserve local water resources. The Keep it Clean Partnership (KICP) is the leading sponsor and organizer of two Operation Water Festivals hosted in Boulder and Longmont. Operation Water Festival includes two key components to maximize water learning over a six week period, in a fun, engaging way.

Participating classes attend four 25-minute long water education classes. Science educators and scientists from over 30 leading state, regional, and local science and environmental education organizations and agencies volunteer to teach water festival classes. In addition, over 50 volunteers (mainly city and sponsor organization staff) help with logistics at each of the two day events.

Nearly 19,000 Boulder Valley School District and local independent school students have attended the Boulder Water Festival since its inception in 1992. Held in May each year at the University of Colorado at Boulder, this successful event engages an average of 1,000 students from 40 classrooms and 16 schools annually.

Over 10,000 St. Vrain Valley School District students have attended the Longmont Water Festival since its inception in 1998. Held in May each year at the Plaza Hotel in Longmont, this festival hosts an average of 800 students from 36 classrooms and 11 schools annually.

The year 2006 marked the inception of a new and improved pre-festival program. Thanks to a donation from the city of Boulder Stormwater Program, city of Boulder and Keep it Clean Partnership staff worked with Environmental Communications Associates and local teachers to create Water Festival preparation materials for fourth and fifth graders on fundamental water awareness, conservation, pollution, and flooding. The resulting program, Operation Water Festival, includes

an orientation meeting for two Water Agents from each class; a complete teacher's packet featuring teacher's guides, student worksheets, and flash cards on each water topic; and free T-shirts for all Water Agents (students) and teachers. Colorful, water themed stickers and certificates were given to student Water Agents as study and performance measures. All of these elements were presented in a contemporary secret agent undercover theme.

A key benefit of the Operation Water Festival materials is the take-home Water Agent book. This book features homework assignments that encourage students to work with family members to complete the water awareness assignments. As a result, parents and siblings alike also learn about water protection and conservation.

Teacher, student, and parent program evaluations indicate the detective theme proved a critical piece in generating student interest in water and the festival. Recognizing the added learning benefits of pre-festival lessons, both school district science curriculum and sustainability administrators support full participation in the Operation Water Festival Pre-Festival Water Agent Program.

The program now facilitates six weeks of water learning in elementary classrooms. Although the Boulder festival has been in existence since 1991, the pre-festival component was developed as a supplemental water education program featuring local water resource information designed to enrich water curriculum in the classroom through locally relevant water lessons.

The classroom lessons and homework activities play a key role in providing background information about local water resources and help prepare students for deeper water learning at the festival. Festival teachers report students are quick to respond to content questions presented during classes at the Festival. Finally, since the program is teacher led and implemented in the classroom with little KICP staff time requirement, it is an efficient way to leverage water learning in elementary classrooms and empowers teachers and Water Agents to engage in water learning at their own pace and in their school community environments.

Operation Water Festival goals are to (1) engage students and teachers in learning about local water, (2) increase student knowledge of local water resources and issues (quality, conservation, etc.), (3) encourage family participation in learning about local water resources and issues, and (4) fill a curricular gap by offering a local water education tool/resource for teachers and the school districts.

> Teachers and Water Agents (students) engage in water learning at their own pace and in their school community environments.

Program evaluations, video interviews, and testimonials from teachers, students, parents, district staff and administers indicate these goals are being met.

The cities of Aurora and Greeley have adopted the Operation Water Festival pre-festival program in their communities. Colorado Springs is planning to adopt the program in the near future and other municipalities and water agencies have requested to use the lessons as part of their festival programs. Keep it Clean watershed outreach coordinator, Curry Rosato, has presented Operation Water Festival at state and national conferences and has realized program adoption by water festival organizers nationwide.

Operation Water Festival is a model government, school district, private, non-profit educational partnership. Festival success is dependent on school district support, teacher adoption, and volunteer presenters from leading science education organizations and institutions including: City of Boulder and City of Longmont Public Works and Utilities, CU Science Discovery, Museum of Natural History, Fiske Planetarium, Colorado Water Conservation Board, Center for Resource Conservation, CLACE, Colorado Trout Unlimited, Colorado Division of Wildlife, NCAR, USGS, Growing Gardens, Wild Bear Center for Nature Discovery and more. Parent chaperones, government, and community volunteers are also key to festival success.

This is a model, scalable, and replicable water education program that facilitates opportunities for students, teachers, family members, and volunteers to enhance their knowledge of local water resources issues and to gain an understanding of ways they can protect and conserve water for public and environmental health.

The Operation Water Festival website includes information, lessons, video and images: http://www.keepitcleanpartnership.org/pollution-prevention/teachers/operation-water-festival

The same information is available at http://www.npscolorado.com/festival.htm. A video including documentation of the Water Agent Pre-Festival Program at Boulder Valley School District's Crestview elementary is also available.

Water Education Efforts Serve Diverse Purposes Across the Western Slope

Hannah Holm, Coordinator, Water Center at Colorado Mesa University

In a Nutshell

- Water education activities along the Western Slope of Colorado include the Water Information Program, Riverfest, Waterwise Wednesdays, university curriculums, K-12 programs, and others

Diverse entities across the Western Slope organize water education activities for a variety of purposes, from promoting general awareness and stewardship to developing tomorrow's water leaders. Below you will find a sampling of water education and outreach activities across Colorado's Western Slope and comments on how the Water Center at Colorado Mesa University (CMU) is tied into this landscape.

Regional information and advocacy on water supply

The Southwestern Water Conservation District, based in Durango, and the Colorado River District, based in Glenwood Springs, both support water education programming that furthers their missions to develop and safeguard water supplies for their service areas, which together comprise the entire western slope of Colorado.

The Southwestern Water Conservation District has partnered with other water entities in its territory to form the Water Information Program (WIP). WIP maintains a website with extensive regional water information and organizes a variety of educational seminars and events throughout the year. From the WIP website (www.waterinfo.org), the public can subscribe to WIP's quarterly newsletter and news feed.

The Colorado River District manages its website (www.crwcd.org) and educational activities in-house, although it also supports conferences and seminars organized by other organizations, including the Water Center at CMU. Signature initiatives include an annual fall seminar and a spring series of "State of the River" meetings at locations across its territory. Materials on the website include links to snowpack information, resources for teachers, and videos on the state's water challenges. The River District also put billboards up on both sides of the Continental Divide to send the message that, "It's the same water" that Coloradans use for skiing, fishing, drinking, and irrigation.

In the case of the Colorado River District, whose jurisdiction includes areas affected by existing and potential transmountain diversions, eastern slope–western slope tensions are often addressed in seminars and talks. According to Jim Pokrandt, Communication and Education Specialist, "the best defense of West Slope water is an educated public."

Watershed health information and advocacy

Watershed organizations typically seek to promote public understanding of watershed health in order to foster stewardship. Two examples of Western Slope watershed groups with very active water education programs are the Eagle River Watershed Council and the Roaring Fork Conservancy.

The Eagle River Watershed Council (www.erwc.org), based in Avon, organizes a "Waterwise Wednesdays" seminar series, which features a wide variety of speakers. The Council also organizes a RiverFest that does double-duty as an educational event and fundraiser, as well as providing educational volunteer opportunities such as a fish sampling program. The Roaring Fork Conservancy (www.roaringfork.org), based in Basalt, carries out a dizzying array of water education activities, from standard seminars to river floats, snowshoe hikes, and dam tours. The Roaring Fork Conservancy also does a number of K-12 educational activities. The Colorado Watershed Assembly (www.coloradowater.org) networks together watershed organizations around the state and has a statewide directory, so you can find a watershed organization near you.

Citizen Science

Two major statewide citizen science initiatives are active on the Western Slope: Colorado River Watch, which engages citizens in monitoring water quality in local rivers and streams, and the Community Collaborative Rain, Hail and Snow network (CoCoRaHS), which engages citizen in precipitation monitoring. Both Projects engage K-12 schools in their programs, which gives students a chance to learn about the how and why of the monitoring programs while providing data to increase scientific understanding of our water quality and climate. The River Watch Program (https://wildlife.state.co.us/

LANDWATER/RIVERWATCH/Pages/Riverwatch.aspx), based at Colorado Parks and Wildlife, often partners with watershed organizations as well. CoCoRaHS (www.cocorahs.org), led by the Colorado Climate Center, works with diverse partners throughout the water community, as well as schools and interested individuals.

K-12 Education

Children's water festivals are popular across the Western Slope, as they are elsewhere in the state. The largest children's water festival in the state is organized by the Ute Water Conservancy District (www.utewater.org). This is a two-day festival held at Colorado Mesa University that brings in virtually every fifth grader in Mesa County (that's about 2,000 kids) in a two-day, volunteer-intensive event that is supported by many local water providers and management agencies. The other major avenue for promoting K-12 water education is to educate teachers. Various organizations on the Western Slope, including the Water Center at CMU, have hosted Project WET (Water Education for Teachers) trainings.

Higher Education Programs

Western Slope colleges and universities offer several programs of study for students seeking skills for water-related careers. CMU (www.coloradomesa.edu), with campuses in Grand Junction and Montrose, offers a minor in Watershed Science and Associates Degrees in Water Quality Management and Sustainable Agriculture. Western State Colorado University (www.western.edu), in Gunnison, has a Water Studies program within its Environmental Studies program. These schools, Durango-based Fort Lewis College (http://www.fortlewis.edu/) and Colorado Mountain College (www.coloradomtn.edu), with 11 campuses across Colorado's mountain country also offer courses on water resource issues through broader disciplinary programs, such as Environmental Science and Geosciences.

Advocacy and Education

Since watershed organizations are focused on protecting and restoring particular landscapes and stream segments, they sometimes engage in policy advocacy in relation to those landscapes and resources, and public seminars and media campaigns may be part of that. Some Western Slope watershed organizations have advocated for federal "Wild and Scenic" designations for particular stream segments and against mineral or petroleum extraction near sensitive water resources.

Likewise, both domestic and irrigation water providers have policy concerns that they educate the public about. This past year, when a pair of "public trust" initiatives appeared close to reaching the ballot, the Colorado Water Congress coordinated educational activities on the potential impacts of these initiatives for water users and providers.

These issues are often quite controversial. Whether or not individuals agree with the advocates' stands on these issues, public forums and media articles related to such campaigns to provide the public the opportunity to learn about and engage with policy-making processes that affect water quality and access.

Uncompahgre Valley Water Tour visits Randy Meaker's farm near Delta, where he's explaining his center-pivot irrigation system.
Courtesy of the CMU Water Center

Water Center at CMU: Promoting education and dialogue

The Water Center at CMU (www.coloradomesa.edu/WaterCenter) has collaborated with water providers, the Colorado River District, and watershed groups to organize numerous seminars and tours that further its mission of promoting education, research, and dialogue to address the water challenges facing the Upper Colorado River Basin. The Water Center at CMU is also seeking to enlarge the community of water insiders by increasing water education opportunities for university students.

The Water Center at CMU tends to blur the lines between education and dialogue with its programs, because dialogue is a potent educational tool as well as a means for people with differing priorities to find common ground and solve problems. While the Water Center at CMU does not advocate for specific policies, it does advocate for citizen engagement on water policy issues. To that end, it is partnering with the Colorado and Gunnison Basin Roundtables to increase public awareness of the statewide water planning process and the roles of the roundtables in that process. Key tools are presentations to local civic organizations and media articles.

Conclusion

The 2012 drought and the possibility of its extension into 2013 has underscored the fact that we live in a dry region that cannot afford to have its citizens be thoughtless about water use. The rich array of water education venues on the Western Slope is a valuable infrastructure for helping our communities better understand the magnitude of the water challenges we face and our options for addressing them.

Spring 2013
Interdisciplinary Water Resources Seminar

Sponsored by CSU Water Center, USDA-ARS, Civil and Enviormental Engineering, Forest and Rangeland Stewardship, and the School for Global Enviormental Sustainability

Theme: Advances in Water Research
Wednesdays From 12:00 to 1:00 PM

February 6 LSC Room 208	Joe Ryan & Mark Williams - University of Colorado Economic and Environmental Trade-Offs of Unconventional Oil and Gas Extraction
February 13 LSC Room 226	Holly Barnard - University of Colorado Ecohydrology of Forested Catchments: Investigations of Transpiration and Subsurface Hydrology
February 20 LSC Room 208	Suzanne Pashke - U.S. Geological Survey Simulation of Groundwater Movement in the Denver Basin Aquifer System
February 27 LSC Room 208	Thijs Kelleners - University of Wyoming Measurement and Modeling of Soil-Plant-Atmosphere Water, Heat, and Carbon Fluxes in Cold Regions
March 6 LSC Room 208	Dave Williams & Scott Miller - University of Wyoming Hydrological Consequences of Woody Plant Encroachment into Floodplain Grasslands
March 13 LSC Room 208	Levi Brekke - U.S. Bureau of Reclamation Evaluating the Relevance, Reliability, and Applicability of CMIP5 Climate Projections for Water Resources and Environmental Planning
March 20	No Seminar Spring Break
March 27	No Seminar Hydrology Days Mar. 25-27; www.hydrologydays.colostate.edu
April 3 LSC Room 208	Stephen Burges - University of Washington Hydrological Variability, Reservoir Storage, and Water Supply Reliability
April 10 LSC Room 208	Michael Ronayne - Colorado State University Modeling Coupled Conduit and Matrix Flow in Karst Aquifers
April 17 LSC Room 211E	Mark Eiswerth - University of Northern Colorado The Joint Impact of Drought Conditions and Media Coverage on the Colorado Rafting Industry
April 24 LSC Room 228	Lee Sommers - CSU Agriculture Experiment Station Reflections on Water Research
May 1 LSC Room 208	Reed Maxwell - Colorado School of Mines Towards a Complete Description of the Hydrologic Cycle: Large Scale Simulations with Parallel Integrated Models

* Room may be changed if needed. Check weekly announcements.

All interested faculty, students, and guests are encouraged to attend.
For more information, contact Reagan Waskom at reagan.waskom@colostate.edu or visit the CWI web site at www.cwi.colostate.edu.

Colorado WaterWise Conservation Outreach

Ruth Quade, Water Conservation Coordinator, City of Greeley & Colorado WaterWise Board

In a Nutshell

- Major educational outputs from WaterWise include the *Guidebook of Best Practices for Municipal Water Conservation in Colorado*, the Annual Water Conservation Summit, and the Colorado WaterWise Newsletter

Colorado WaterWise was formed by joining two organizations: Metro Water Conservation Inc. and Xeriscape Colorado. The goal of the merger was to create an organization that would serve all of Colorado and promote the efficient use of Colorado Water. Metro Water Conservation Inc. was primarily for the water providers in the Denver Metro area, and Xeriscape Colorado was education for both water providers and customers.

Colorado WaterWise then known as Colorado WaterWise Council was developed to provide resources for stakeholders and to serve as a collaborative leader in projects that utilities could not accomplish alone. For many years, conservation staff were alone in their utilities and networking with other conservation people was the best way to develop new projects or programs. Several smaller groups had simultaneously formed to join forces on projects. Many of the same people were traveling all over the Front Range to attend meetings with the same people, so it made sense to join forces. Meanwhile the larger utilities were forging ahead with conservation programs, it became apparent that the medium and smaller utilities could benefit by learning from programs already implemented. Colorado WaterWise became a way to share these successes and failures.

In 2010, Colorado WaterWise with Colorado Water Conservation Board (CWCB) funding hired Aquacraft Inc., to develop and write the *Guidebook of Best Practices for Municipal Water Conservation in Colorado (Guidebook)*. A Project Advisory Committee (PAC) and a Stakeholder Advisory Committee(SAC) were formed to provide insight and expertise. The PAC were instrumental in selecting the best practices for inclusion in the Best Practices Guidebook and in editing the final document. The SAC, a larger group provided useful edits to the final document and provided important input to the Best Practices Guidebook. Collaborating with the Green Industries of Colorado (GreenCO), a long-term partner, Colorado WaterWise leveraged GreenCO's BMPs for its *Guidebook* as the state's standard for outdoor water use efficiency. Both the SAC and PAC were comprised of individuals from utilities of all sizes and all over the state, consultants, environmental groups, Colorado State University, green Industry, plumbing industry, state and federal government. The final product is a 227 page guide book of 14 Best Practices. A Summary Guide was also developed for the non-technical reader and for marketing purposes by Colorado WaterWise.

The Best Practices were divided into four target categories:

1. Water System and Utility Best Practices
2. Outdoor Landscape and Irrigation Best Practices
3. Indoor Residential (single-family and multi-family) Best Practices
4. Indoor Non Residential (commercial, industrial and institutional) Best Practices

Then the best practices are organized by using category labels:

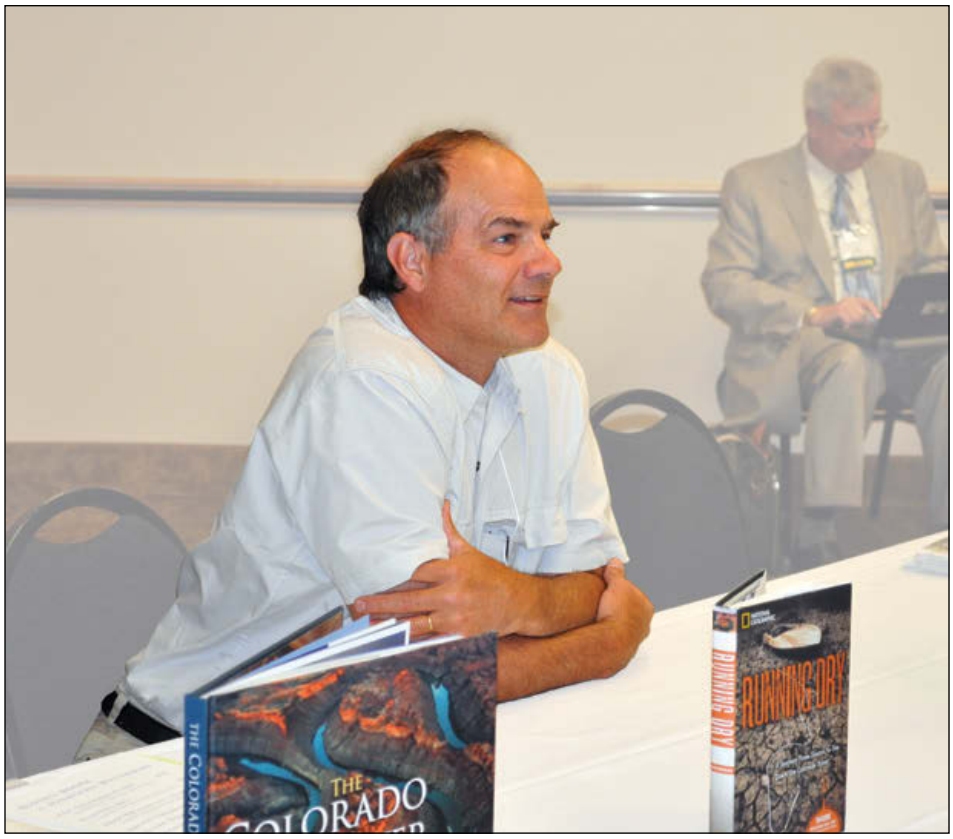
- Foundational – best practices for water efficiency that are considered essential for all utilities to implement
- Informational – best practices that offer useful information on water efficiency to utility customers to foster conservation actions and behavior
- Support – best practices that provided technical information, data, and assistance on water efficiency to customers (closely related to informational best practices)
- Management – best practices that offer improved utility management procedures and actions to promote water conservation
- Understanding – best practices that aim to improve knowledge and awareness of water use and efficiency
- Operational – best practices that seek to improve water conservation in everyday utility functions

The *Guidebook* serves as a resource for utilities when developing programs and projects. Case studies for each of the best practices are also outlined for utilities to emulate. Half day workshops were held around the state to introduce the *Guidebook* and CWCB mailed a copy to all the water utilities. It is also available online.

Using the *Guidebook*, members of Colorado WaterWise can post a case study on the website. Expanding on the case studies in the *Guidebook*, utility members can use the case studies as a template and not reinvent the wheel. This is an invaluable tool for anyone just starting out with a conservation plan or for smaller utilities who don't have a staff person dedicated to conservation. Many times conservation staff wear several hats at the utility and don't have time to research programs from scratch. This is also helpful for consultants who may be hired to write a plan for water utilities.

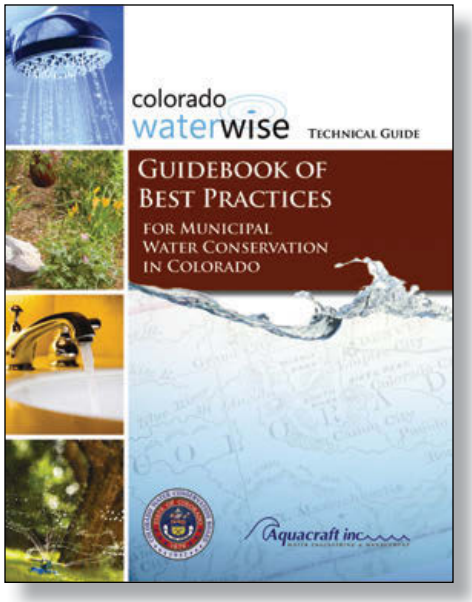
Water Conservation Conference

Colorado WaterWise just held is 4th Annual Water Conservation Summit in October. Each conference is built upon a consistent theme that informs the direction of the annual summit. This summit is attended by more than 100 conservation and water resource staff, from around the state and Wyoming attend this event. The Colorado WaterWise Board and summit committee listens to what the attendees say and have speakers addressing their needs and makes an effort to incorporate feedback and ideas into the next event. Over time this event has become essential for networking and collaborating with other conservation staff, consultants and vendors and for offering a forum for dialogue on policy discussions with the rest of the water community.



Jonathan Waterman getting ready to sign books.

Photo by Esther Vincent



Water 2012

Colorado WaterWise partnered with Colorado Foundation for Water Education on the Water 2012 Campaign this year. Water 2012 was a statewide initiative to celebrate several organizations milestone anniversaries. Water related events and activities were held to celebrate water around the state. To capitalize on the momentum generated from Water 2012, Colorado WaterWise is working with CWCB to plan a Value of Water Campaign in 2013 that utilities can use to connect customers with where their water comes from and all of the uses. Although it is in its early stage and branding has not been developed yet, the goal will be to have Coloradoans value their water and recognize its importance in their everyday lives.

Information and Outreach

Sharing intelligence is one of the awesome dynamics in Colorado WaterWise. The one great thing about the water conservation community is we plagiarize, steal and borrow from each other and that has become the norm. Everyone is willing to share what they know. Everyone has something to offer and learn. Colorado WaterWise was organized

to facilitate this collaboration both within the membership and with sister organizations like GreenCO, Rocky Mountain American Water Works Association (RMSAWWA) and Colorado Foundation for Water Education and many more.

To reach members and others interested in water conservation, Colorado WaterWise utilizes electronic media. This is accomplished through a quarterly newsletter, regular e-mail updates, and social media.

For more than 10 years, Colorado WaterWise has produced a quarterly newsletter to inform its members on successful programs, current issues, interviews with conservation innovators, and more. This newsletter provides an in-depth look into many aspects of Colorado water conservation and efficiency issues. It is an online publication that only members have access.

Members find out about a new issue of the Colorado WaterWise Newsletter through and e-mail message. E-mail is also used to send important information to members on meetings and events. Social media sites such as Twitter, Facebook, and LinkedIn is another way that the organization interacts with members and other people interested in water in a statewide or national level. Please follow Colorado WaterWise at www.twitter.com/ColoWaterWise or www.facebook.com/ColoWaterWise. There is also a Colorado WaterWise group in LinkedIn.

Colorado WaterWise membership and social media interaction are just a few ways to get into the statewide conversation on water efficiency. To learn more about Colorado WaterWise, visit www.coloradowaterwise.org.

Hydrology Days

33rd Annual Hydrology Days
American Geophysical Union

March 25-27, 2013

Cherokee Park Room
Lory Student Center
Colorado State University

hydrologydays.colostate.edu

For questions or comments reguarding Hydrology Days, contact:

Professor Jorge A. Ramirez
hydrologydays@engr.colostate.edu

Colorado State University

Program:

Hydrology Days Award Lecturer

Vijay P. Singh
Caroline and William N. Lehrer
Distinguished Chair in Water Engineering and Professor
Department of Biological and Agricultural Engineering
Texas A & M University

Borland Lecturer in Hydrology

Richard M. Vogel
Professor
Department of Civil and Environmental Engineering
Tufts University

Borland Lecturer in Hydraulics

Peter R. Wilcock
Professor
Department of Geography and Environmental Engineering
Johns Hopkins University

Celebrating 10 Years of Statewide Water Education with the CFWE

Caitlin Coleman, Program Associate, Colorado Foundation for Water Education

In a Nutshell

- CFWE celebrates a successful decade, and looks ahead to expanding its reach toward the business community and elected officials

Everyone makes choices about water, whether it's at home or on a larger scale. When people understand the complexities of water issues, they make better decisions—that's the philosophy of the Colorado Foundation for Water Education (CFWE), Colorado's only statewide nonpartisan nonprofit water educator. CFWE just celebrated its 10th anniversary.

"In Colorado, water is a scarce resource and the competition for that resource is going to get more and more difficult in the future," says CFWE executive director, Nicole Seltzer. "Everybody needs to understand the implications of their water use on a personal and a policy level."

For the past decade, CFWE has been advancing its mission to promote better understanding of Colorado's water resources and issues by providing balanced and accurate information and education, helping Coloradans "Speak Fluent Water." Over the last 10 years, things have changed in Colorado and at the Foundation— priorities have shifted, staff and board members have transitioned in and out, and new programs have started. As CFWE's next decade begins, the landscape of water education continues to shift.

"[The CFWE] has really grown and developed; it's become a lot richer than I ever saw," says vice president of the CFWE board and Colorado Supreme Court Justice Gregory Hobbs.

Today CFWE boasts a solid backbone of basic water information and educational programming but also enhances leadership among water professionals, creates networking opportunities, helps advance the water planning dialogue in the state, and reaches out to those who aren't already involved in the world of Colorado water.

That basic, digestible water information is what CFWE was founded upon and continues to be an essential part of the organization. "The bedrock of [CFWE] is having a reliable source, the publications are a perfect example," says Greg Johnson, a representative of the Colorado Water Conservation Board and CFWE board member. "Really being able to rely on what you know is a good go-to source whether it's publications or your website or your upcoming tour—it's critical," Johnson says.

When CFWE started in 2002, it came on the heels of many failed attempts to create a water education foundation funded solely through grants. The 2002 success of launching

Nicole Seltzer and Justice Hobbs honoring CFWE's legislative founder, Diane Hoppe during the 10th Anniversary Celebration. Courtesy of CFWE

"We provide an important professional networking opportunity for water educators."
–Nicole Seltzer, CFWE Executive Director

the nonprofit was due to legislation and strong financial support from the Colorado Water Conservation Board (CWCB). "It was a real long-term investment by the state of Colorado," Seltzer says. Hobbs echoes the importance of that support—water professionals came together with the shared sentiment that Colorado needed an organization focused on nonbiased statewide water education. "We can point to a law that the legislature passed that is unlike anything else that I know about in the water field," Hobbs says. "The fact that the state of Colorado has decided to support a non-advocacy, nonpolitical water foundation to communicate with people is extraordinary."

In addition to legal support of the Foundation came the sustained financial support from the Colorado Water Conservation Board. "It was solely because of that support from the State that we've been able to do what we've done for the last ten years," Seltzer says.

That work has also been important to the state. "CFWE is a fair and balanced third party that can convey a lot of the messages that [the CWCB] may not even have the proper position to convey, let alone the resources to do it," Johnson says. "[CFWE] can stand outside the fray of political issues and is not the official state entity—I think there is a lot of power in that unbiased position that the Foundation holds."

That strong support created a CFWE determined to quickly prove its worth. "There was a real pressure to deliver tangible product very quickly, right out of the gates to show the State that we were capable of producing useful educational products," Seltzer says.

At the very beginning, Hobbs remembers working on a map illustrating the beneficial uses of water; he then volunteered to write the Citizen's Guide to Colorado Water Law— so began CFWE's Citizen's Guide Series, which now covers nine different Colorado water topics. To replicate some of the work done by a water education foundation in California, CFWE began leading river basin tours. An early executive director, Karla Brown, came up with the concept of creating Headwaters magazine. All of these programs have remained and grown as the "meat and potatoes of water education," says CFWE board assistant secretary and director of the Colorado Water Institute at Colorado State University, Reagan Waskom.

The Colorado Foundation for Water Education (CFWE) celebrated its 10th anniversary in April 2012 with a reception at the Governor's Mansion in Denver.

Courtesy of CFWE

The Foundation's work has started to extend beyond those basic products. "We provide an important professional networking opportunity for water educators," Seltzer says. "Before CFWE was created, there was nobody that a water educator could go to for help, advice, networking, or ideas. We provide a strong network and we can get best practices out there." That network and the Foundation's constant work with water issues brings more visibility to water in Colorado and raises awareness about water on a consistent basis, Seltzer says. "We're bringing everybody together in service to good effective water education in Colorado."

The Foundation has helped the CWCB convene stakeholders across the state to spread the message and interest of the Statewide Water Supply Initiative and planning for Colorado's water future. "I think that's helped a lot with the engagement that we have with the roundtable process," Johnson says. Basin roundtables bring together local stakeholders and meet in river basins across the state to discuss the local water use priorities and use that dialogue to plan for future pressures on water supply. "The roundtables have helped change the game locally and CFWE has been a partner in that conversation," Waskom says. "CFWE has helped take the findings and understandings of the Statewide Water Supply Initiative out to the public as well."

Colorado Water 2012, the statewide celebration of water, was spearheaded by CFWE as another mode of bringing people together around water. "2012 happened because of a decade of good solid work," Waskom says. For Water 2012, CFWE convened partners and volunteers across the state, profiled and shared

the work of water educators across the state, started a blog that speaks to the general public, and helped bring water festivals and other public events together under a common theme—making the small events part of something bigger, Seltzer says. "In Water 2012, working with the media, doing regular news articles, I think all of that work has greatly expanded the reach of water education in Colorado," Seltzer says.

Launching from 2012 and into the next decade, the Foundation will continue to expand that reach. "That's who we're looking at as our next audience, people interested in water issues. Then we can work with them to cross the spectrum from increasing water awareness to understanding to participation," Seltzer says.

Some board members think that role could expand beyond the borders of Colorado. "Our impact and base could be much larger," Waskom says. "Colorado is an amazing place to study water. I think that people around the world could learn from us."

As water becomes increasingly scarce, competition for water will gain more national importance, Johnson says. "Having your materials, there may be room for an increased voice for the Foundation," Johnson says. "To have that good solid background educational material available so we can inform any policy discussions at the national level too."

The organization is celebrating the fact that it has existed for ten years, but is at a turning point. "It's been very successful," Johnson says. "I also think absolutely, it's just the beginning."

Over the last 18 months, CFWE has expanded its reach, budget, and staff capacity. "I'm really looking forward to the next ten years, continued growth and reaching more and more people with the basics of water in Colorado," Seltzer says. In the coming years look forward to the Foundation's role expanding as a professional development resource for water educators and branching out to reach new audiences such as the business community and elected officials.

"There's a lot of potential moving forward," Johnson says. "[The Foundation] is something you feel a part of, you have a sense of pride in—it's one of those local institutions you support. It's nice to have a group like the Foundation that includes a broad base of various water folks. It's not just water conservation or Water Congress, it's all of the above, it's everything."

Colorado Water 2012

Celebrating a Year of Anniversaries, Education, and Bringing Awareness to Water in the West

Nona Shipman, Assistant Project Coordinator, Colorado Water 2012

In a Nutshell

- The 2012 Year of Water ("Water 2012") celebrated water in Colorado, including the anniversaries of several fundamental water organizations in the state
- Water 2012 faced challenges, such as reaching certain parts of the state and sectors of the public
- Successes included reaching Water 2012's goal of exposing 500,000 people to its message and creating partnerships to provide education materials to educators

"2012 is a notable year in Colorado's history around water. 75 years ago many of the organizations and laws that govern how we use, manage, and administer Colorado's water were born. In 2012 Coloradans will come together to honor the hard work of those who came before us, participate in solving the tough challenges that lie ahead, and celebrate our most important natural resource," said Governor John Hickenlooper after he officially declared 2012 the Year of Water in January 2012. And he was exactly right. 2012 served as the year for recognizing water as a necessary and vital resource in Colorado and celebrating everything that it is today, has been, and will be. To honor the organizations celebrating major anniversaries and to show equal respect to the natural resource that allows us all to live in a dry arid state, a statewide water awareness campaign was created named Colorado Water 2012.

It is important to mention the organizations and legislation celebrating anniversaries that got the idea of Colorado Water 2012 off the ground:

- 75th anniversary of the Colorado Water Conservation Board
- 75th anniversary of the Colorado River Water Conservation District
- 75th anniversary of the Northern Colorado Water Conservancy District
- 50th anniversary of the Fryingpan-Arkansas Project
- 10th anniversary of the Colorado Foundation for Water Education

In addition to these anniversaries, more and more significant anniversaries came out of the woodwork, such as the 40th anniversary of the Clean Water Act, the 100th anniversary of the Rio Grande Reservoir, and the 50th anniversary of the Bear Creek Water and Sanitation District that were recognized. The Colorado Foundation for Water Education was not only celebrating ten years but also took on the responsibility to spearhead the entire campaign.

Water 2012, as it was known, aimed to bring awareness to water as a precious resource through activities and events held across the state. In order to do this, six committees were assembled. Each committee brought different qualities to the table with different focuses, but with one common goal: to celebrate water in Colorado through fun educational activities. Each committee focused on a task such as assembling a Water 2012 Book Club and conducting author presentations, circulating informational displays to Colorado libraries and museums, and installing rain gauges in Colorado schools. In addition to the committees, Water 2012 had hundreds of partners located all over the state conducting their own events with a Water 2012 presence. In total there were over 400 Water 2012 related events in the Year of Water.

1. Some Water 2012 swag created by different partners throughout the year. Photo by Nona Shipmen

2. Volunteers and committee leader, Marcee Camenson, pose while wearing their Fort Collins Water Festival/Water 2012 t-shirts. Courtesy of Marcee Camenson

3. Featured Water 2012 Book Club authors Jon Waterman, Justice Greg Hobbs, and Craig Childs discuss their book club selections at Colorado Water Congress. Photo by Alyssa Quinn

4. To celebrate their 10th anniversary, the Colorado Foundation for Water Education hosted two bike tours along the South Platte River with Water 2012. Courtesy of the Colorado Foundation for Water Education

Now you may ask, "What does 'Water 2012 related event' mean?" With the help of the Art Institute of Colorado, Water 2012 created an overall look including signature icons, a logo, and marketing materials. These elements were made available to all Water 2012 partners to use as they wished in accordance with Water 2012's list of goals. "Plagiarism" was literally the name of the game. So a Water 2012 related event was an event or activity that wasn't specifically executed by a committee but by a partner organization that included

the Water 2012 logo on a t shirt, flier, or water bottle for example. And there were hundreds of these events. You may even have some Water 2012 paraphernalia that the Water 2012 key players have never seen!

One of Water 2012's major goals was to expose 500,000 people to its message. This was recorded through feedback surveys, face to face discussions, pictures, and event materials. By September 2012, the campaign was on the verge of exceeding that goal, and a major contributor to that success was media exposure. Through the tireless work of partners and volunteers, Water 2012 spawned a 52 week series of articles in the Pueblo Chieftain and the Valley Courier, a weekly series that began in June in the Grand Junction Free Press, and dozens of other mentions in news articles, blogs, and social media. In addition to the news articles, Water 2012 was given the opportunity to create a radio PSA for the West Slope in June. Although 2012 had been declared the Year of Water by Governor Hickenlooper, the Senate, and communities all over Colorado, Mother Nature had a different plan for water, and the state was dealing with a drought. In order to recognize the drought and use it as a learning opportunity, the PSA was focused on the drought and how the average Coloradan could understand what was happening. The PSA played 6-10 times a day on four different radio stations for the month of June. A full list of article and blog mentions is available on the Water 2012 website (Water2012.org).

Though Water 2012 surpassed many of its goals throughout the year, every project has struggles. There were parts of the state with little to no involvement, finding funding for a grassroots campaign was sometimes difficult, and not all media channels were interested in featuring a water campaign when they could feature a "sexier" topic. One major struggle Water 2012 faced was reaching the general public. The campaign first aimed all its tools on reaching the average Coloradan but several months into 2012, it was clear that the campaign was far more successful reaching people already involved in the water community and with an initial interest in water. So the campaign re-focused. It became less about throwing messages to the public and more about providing educators, water conservancy districts, and the like with materials to give to their communities. The Water

2012 began like no other year before, destined to be a year of unprecedented collaboration, volunteerism, and educational efforts.

2012 Speakers Bureau presented to leaders of communities such as at Rotary Club meetings, Chambers of Commerce, and Progessive 15 gatherings; the K-12 Committee, in collaboration with CoCoRaHS, taught teachers how to use rain gauges and provided a lesson plan; one of the six traveling educational displays was made available to requesting organizations for events such as water festivals. With a campaign on a limited schedule and with limited resources, it was hard to make an impact on people who knew little or cared little about water. But hopefully, through re-focusing campaign efforts on providing the providers, an impression was made on the general public and will continue through the developing Value of Water campaign (coloradowaterwise.org/campaign).

In October 2012 an end of year survey was distributed to more than 500 people to gauge overall impressions. The responses collected were diverse from long time members of the water community to average Coloradans who had attended an event and taken an interest in Water 2012. Generally the opinions and impressions were positive and appreciative. One improvement suggested by several survey takers was to reach outside the water community but that was, clearly, a struggle the campaign faced. Others were concerned the campaign was too focused on educators and did not have a big enough reach or deep enough connection. But with the struggles came unexpected benefits from the campaign. Through the survey results it came to light that many people felt that the campaign allowed them to develop professional relationships with people and organizations they otherwise would not have started. Water 2012 can only hope that those people continue to utilize those connections to create more educational activities and ongoing water stewardship.

2012 began like no other year before; destined to be a year of unprecedented collaboration, volunteerism, and educational efforts. On December 31, 2012 Colorado Water 2012 will have come to an end, but the good times don't have to end there. To keep the momentum going and to celebrate a successful Year of Water, Water 2012 will be hosting a celebratory luncheon on January 30, 2013 at the Marriott Denver Tech Center. Lunch will be $25 but the laughs and memories are priceless! You can reserve your spot at cowatercongress.org/annualconvention. In conclusion, Colorado Water 2012 would like to send a huge thank you to every person who volunteered their time and efforts, those who financially sponsored the campaign, and those who attended an event. Without their endless contributions and support of Water 2012, none of it would have been possible.

The Past Enhances the Future

Preserving the Records of the Montezuma Valley Irrigation Company

Patricia J. Rettig, Head Archivist, Water Resources Archive, Colorado State University Libraries

Spending summer vacation in a remote location working with water documents is not the sort of opportunity most college students embrace. For one Colorado State University (CSU) senior, however, such an opportunity has provided a path to the future while helping preserve the past.

Recognizing the importance of their documents, management at the Montezuma Valley Irrigation Company (MVIC), including board president Randy Carver and general manager Don Magnuson, developed an internship with a goal of making the materials more useful to staff. They wanted to see the documents organized, with unimportant materials tossed and important materials digitally scanned for office use. MVIC hired CSU senior Katie Wilkins-Wells for the summer 2012 internship and provided a great deal of support for her as she dived in to the project.

While Katie wasn't quite sure what she was getting into when accepting the internship, her interest in small community agriculture led her to Cortez, in the southwest corner of Colorado, where MVIC is based. Her appreciation for Colorado agriculture and irrigation practices arose in part from family trips during her childhood, with her father, CSU sociology professor John Wilkins-Wells, studying the subjects for more than two decades.

At MVIC, Katie worked her way through the document vault, and then found out about the storage trailer, holding materials that most of the staff, board members, and shareholders had never seen. As she delved into the trailer, she brought historical treasures to light. From financial ledgers to system maps, Katie and others who saw them were fascinated. "The bond books are my favorite," Katie says, about oversize volumes from 1907. They were created when the Montezuma Valley Irrigation District, a predecessor organization formed in 1902, proposed purchasing the water rights and ditch system existing at the time. The bond purchases were meticulously recorded, and the books can now be used not only to examine early financing attempts, but also local family history.

Unfortunately, some of the bond books and other ledgers had gotten wet at some point in the storage trailer. The water damage caused stains and cockling, but worse, ink had run and some pages had become moldy. While Katie brushed off mold, dust, and cobwebs as she sorted through materials, some of it was clearly in a very bad state.

The board decided professional attention was needed for long-term preservation of their materials. In addition to the mold issues on the bound volumes, many deeds and other legal agreements had been folded for decades and were too fragile to scan on site. Hundreds of rolled maps were too large for standard office scanning equipment. The original vision of materials organized for more efficient office use morphed into wanting materials to be safe and useful to the community and the state as a whole. Don Magnuson and the board under Randy Carver's leadership agreed that the materials should be made accessible for research and education.

Katie began making phone calls, including one to CSU's Water Resources Archive. After phone discussions and a visit to Cortez by the archivist to see the materials and share information about archival services, the board decided CSU was the right place for their documents. In November, the archivist drove a mini-van to Cortez to transport the historical materials to Fort Collins.

Now being preserved at the Water Resources Archive are seventeen boxes of files, field books, rolled charts, and ledgers; approximately 700 oversize rolled maps, plats, and plans of reservoirs, ditches, land, and equipment; and more than twenty oversize financial ledgers and bond books. Documents cover more than a century of history, from at least 1902 until 2003. The collection is not comprehensive, though, as the company retained most of the minute books and shareholder

information and all of their most recent records.

At the Archive, staff will clean the materials, using special equipment required for the moldy items. They will also flatten the rolled sheets and carefully unfold the folded papers. After organizing everything, an inventory will be posted on the Archive's website. The collection will be stored in environmentally controlled, secure space and made available for public use in the Archive's reading room in Morgan Library on CSU's main campus. Digitization for uploading to the Internet will take place as funding is available.

Though requiring a higher level of care than the standard historical collection, MVIC's records deserve the special treatment the Water Resources Archive will provide. The company and its predecessors have a fascinating history in a part of Colorado that is too often ignored. MVIC, incorporated in 1920, made a success out of forty previous years of failed attempts by other organizers. The company's main water source, a transbasin diversion from the Dolores River into the San Juan Basin, was one of the earliest tunnels constructed for moving water, completed in 1889. Today, the system includes two reservoirs and over 124 miles of constructed waterways, irrigating more than 30,000 acres and making life possible in the Montezuma Valley.

MVIC's historical documents provide a valuable resource for many types of research and education. Most directly, the documents provide the best source of publicly accessible, first-hand information on MVIC and its system and operations, the development and changes it has gone through, and its finances. Beyond the company itself, the records can be used for comparative studies with other irrigati companies, especially one on the eastern plains. As students, historians, and the interested public beg to spend some time with this collection, addition research areas will be brought to light, and their dissertations, books, and articles wil be further sources of education.

For both the Montezuma Valley Irrigation Company and the Water Resources Archive, the right intern with a passion for small community agriculture made a significant positive impact on preserving the past. For Katie Wilkins-Wells, a bright, eager college student open to new experiences, the opportunity has broadened her education and likely that of the whole state as well.

Photos from top:

A pile of ledgers pulled out of MVIC's storage trailer. Courtesy of CSU Water Resources Archive

MVIC headquarters in Cortez. Courtesy of CSU Water Resources Archive

Water causes ink to run and mold to grow, literally erasing history. Courtesy of CSU Water Resources Archive

Katie Wilkins-Wells, happy to be immersed in a great learning experience with MVIC. Courtesy of K. Wilkins-Wells

A Brief History of Water Education Activities in Colorado

Tom Cech, Director, One World One Water Center for Urban Water Education and Stewardship, Metropolitan State University of Denver

Introduction

Water education efforts in Colorado are quite extensive today, due in large part to a cadre of innovative, dedicated, and far-sighted individuals and water groups. Although it was slow starting back in the 1970s and '80s, water education in Colorado is now at the forefront of efforts in the U.S. This article will provide a brief background of how we expanded from cartoon characters and occasional newsletters to cutting-edge water education programs for a wide range of learning groups.

The Early Years

Dick Bratton, a well-known water attorney from Gunnison, was an early proponent of water education in Colorado, and in 1976 was instrumental in creating the Colorado Water Workshop at Western State College (now Western State Colorado University). It was an early effort to bring together interested parties from both sides of the continental divide to discuss and learn about water issues. The 37th annual workshop was held this past summer in Gunnison.

Comic Books and Other Characters

Also in 1976, Denver Water learned of a water conservation comic book/workbook developed by East Bay Municipal Utility District in Oakland, California. Denver Water education staff purchased the workbooks and distributed them to elementary classrooms in its service area. In 1977, the Colorado Water Congress (CWC) contracted with the developer of the workbook to design a Colorado-specific teacher's guide for each watershed in our state. The program used "Captain Hydro" as their comic book ambassador and started a brief statewide effort of water education information for the general public. A portion of this work was funded by a $5,000 grant from the Adolph Coors Company to help develop a water education and information program. A communications major from the University of Colorado (CU)-Denver was hired as Education Director for the CWC, and was directed to work with environmental science teachers in the region. Dick Bratton, mentioned above, was CWC President at the time.

Bus Tours, Annual Newsletters, and Speakers

During the 1980s, several water agencies across the state developed day-long water facility tours, such as Northern Water's bus tours along the Colorado-Big Thompson (C-BT) facilities, Denver Water bus journeys within its extensive system, Ute Water Conservancy District visits to its water treatment facilities, Central Colorado Water Conservancy District (CCWCD) and Groundwater Appropriator of the South Platte (GASP) tours of the South Platte and Arkansas River basins, and many other organizational tours across the state.

Newsletters were also prevalent with water groups, and provided reports of ongoing activities. Speakers were at the ready to visit with Kiwanis and Optimist groups, the T-Bone Club in Greeley, Club 20 on the West Slope, public libraries, and any other group with an interest in water.

Colorado Division of Wildlife

In 1989, the Colorado Division of Wildlife (DOW) River Watch program began with six schools along the Yampa River. Carol Bylsma, the Project Wild Coordinator at the time, and Barb Horn, Colorado Project Wild Water Quality Specialist, developed and implemented the program to collect water data for high levels of decision-making. The program began with two primary goals, which remain today. The first is to provide a hands-on experience to understand the value and function of river ecosystems. The second is to collect quality aquatic ecosystem data over space and time to be used for

The Colorado River Watch program.

Courtesy of Colorado Parks & Wildlife

the Clean Water Act and other water quality decision-making processes.

Since 1989, more than 60,000 individuals in Colorado have provided data from 3,000 stations located at over 300 rivers.

Colorado Water Institute

Neil Grigg, and later Robert Ward, directors of the Colorado Water Institute (formerly CWRRI) in Fort Collins, provided strong leadership in water research and outreach for a wide range of water groups. Quite often, they helped organize water conferences, speaker events, and other water-related education activities, generally focused on water-related research.

CCWCD and SPLATTE Water Curriculums

During the late 1980s, water curriculum development expanded with U.S. Environmental Protection Agency Region 8 Section 319 grants funding K-12 curriculum for the CCWCD. In addition, the SPLATTE (South Platte) water curriculum was developed by Wendy Hanophy, former teacher and then Colorado Division of Wildlife program coordinator, and others in the Denver metro area.

South Platte River Environmental Education

During 1982–2003, Carl Crookham developed and operated the South Platte River Environmental Education (SPREE) Program in Denver. Nicknamed "Old Montana," Crookham worked with thousands of Denver students and teachers, and then turned over the program to Jolin Clark at the Greenway Foundation in 2003. The program continues to receive positive reviews from students and teachers in the region.

Metro Water Conservation Inc.

Around 1987, Denver Water, Aurora Water, and others joined together to start Metro Water Conservation Inc. That organization did a number of educational efforts, including the first xeriscape outreach, which evolved into Xeriscape Colorado and Colorado WaterWise.

The 1990s

Colorado State Fair Exhibit

In 1990, water groups from across the state came together for the first time to present a "Colorado Water: Liquid Gold" Exhibit in the Industry/Technology Building of the Colorado State Fair in Pueblo. For eleven days, presenters from Denver Water, the Colorado River Water Conservation District, Northern Water, CCWCD, and many others visited with the public in front of their exhibits—some included flowing water, low-tech presentations (this was before the day of wide spread computer use, PowerPoint, and electronic graphics programs), and scores of brochures. Approximately 140,000 people (19 percent of all fairgoers) viewed the exhibit, and an important part of their visit was answering a survey with a handheld clicker survey instrument. Visitors were asked approximately 25 water-related questions, and the results were tabulated based on age, education, occupation, and region of the state where they lived. Questions included:

"What is the percent of water consumed in Colorado by Denver metro area?"

"What is the percent of water consumed in Colorado by agriculture?"

"What is the annual amount of water used by an average urban household?"

"How would you describe the importance of water for recreation?"

"Should water resource education be placed into school curriculum?"

"Would you support a water use tax?"

The 7,387 valid survey responses were intriguing—most respondents estimated that the Denver metro area used between 20 to 55 percent of Colorado's water, while more than half thought that agriculture annually used less than 40 percent of the state's water. Most felt that water for recreation was important, 65 percent agreed that water resource education should be placed in school curriculums, and remarkably, 46 percent responded that they would support a water use tax.

John Kalizewski, the Exhibit Coordinator for the Colorado Division of Water Resources, provided the observation that fairgoers attended the Colorado State Fair to be entertained, and secondly, to be educated. He noted that the exhibits had *"…too much to read, too much technical data, and a lack of dynamic and hands-on components in displays."* His words of advice ring true today, but the effort was still considered a success.

Colorado Foundation for Agriculture

Bette Blinde, Executive Director of the Colorado Foundation for Agriculture, has been a strong proponent of agricultural and natural resources education since the group was formed in 1991. An integral part of the program has been the Colorado Reader series, which is distributed to tens of thousands of students across the state.

Children's Water Festivals

In 1991, the CCWCD in Greeley hosted the first-ever Children's Water Festival in Colorado. The Greeley event had over 1,500 fourth and fifth graders, teachers, and parents for the one-day event at Aims Community College in Greeley. The festival was filled with indoor and outdoor water education activities and an exhibition hall of activities, and Ed Greene, KUSA Channel 4 weatherman, was the first "Water Wizards" host in the state. Since that first event in Greeley, hundreds of thousands of Colorado

students have attended a Children's Water Festival.

Legislative Water Festivals

The Colorado Legislature was next, and Representative Bill Jerke of LaSalle suggested a water festival at the State Capitol. The Chief Clerk of the House of Representatives, Judith Rodrigue, was contacted by Tom Cech, and asked if the basement level of the Capitol Rotunda could be used for a first-ever Legislative Water Festival. The event was a fabulous success as Bette Blinde of the Colorado Foundation for Agriculture organized an all-Colorado buffet lunch where legislators, staffers, capitol workers, and even a few homeless individuals shared food. The event was highlighted when fifth graders from Scott Elementary School in Greeley competed against members of the House and Senate Agricultural Committees in the Water Wizards (water knowledge) contest. Legislators were given a list of questions (and answers), such as "What is the largest reservoir in Colorado?" (Blue Mesa). The fifth graders won 15-7. The event carried on for several years, hosted by different water groups, and later became the brown bag lunch water seminars, which continues.

The event continued with a series of water-related brown bag lunches in Committee Hearing Rooms of the capitol building. The first were held during the 1990s and sponsored by the CWC. Later, the education series was organized and sponsored by the Colorado Foundation for Water Education, which continues the program today.

Southwest Colorado Water Conservation District Public Information Network

In 1994, the Southwest Colorado Water Conservation District's Water Information Program, in cooperation with several water agencies and entities in southwestern Colorado,

Students take part in the Children's Water Festival 2012 in Greeley.

Photo by Natalie Stevens

combined resources and created the Water Information Program (WIP). A Steering Committee generally meets three times per year to provide program guidance. WIP continues to provide a common forum for communicating shared information, and was one of the first water education groups in Colorado to utilize the Internet.

CWC Education Committee

From 1980-2005, Richard D. "Dick" MacRavey, Director of the CWC, watched the water education effort grow in Colorado from Captain Hydro and the Colorado State Fair Water Exhibits to the suite of children's water festivals, legislative water festivals, bus tours, and heightened interest in water education by the general public. The CWC formed a Water Education Committee, co-chaired by Chris Treese of the Colorado River Water Conservation District, and Tom Cech of the CCWCD, to further promote water education in the state and to lay the groundwork, with Rita Crumpton, Ute Water Conservancy District; Reagan Waskom of CSU; Brian Werner of Northern Water; John Porter, Delores Water Conservancy District; and many others for a statewide water education foundation.

In 1999, Dan McAullife of the Colorado Water Conservation Board; Rita Crumpton, Reagan Waskom, David Nickum with Trout Unlimited, and Tom Cech traveled to Sacramento, California, to meet with Rita Schmidt Sudman, Executive Director of the Water Education Foundation of California, and her staff. The purpose of the trip was to learn from their efforts in California to create a statewide water education foundation in Colorado.

The 2000s Through the Present

Colorado Foundation for Water Education

In 2000, the Colorado General Assembly appropriated $150,000 from the Colorado Water Conservation Board (CWCB) construction fund for a water education program for K-12 students and citizens throughout Colorado. The purposes of the program are to

"…develop and integrate a Colorado water education curriculum into existing education programs; identify mechanisms to distribute a water education curriculum to effectively supplement or coordinate with other private and public water education programs; and convert the curriculum to compact disc format for statewide distribution."

This was the first time the CWCB was directed by the General Assembly to become involved in the kindergarten through twelfth grade student and citizen water education activities. The legislation was sponsored by Representative Diane Hoppe of Sterling.

In 2002, the General Assembly provided $250,000 from the CWCB Construction Fund for

"... a water education foundation and continued support of water education programs by means of a grant to the Colorado Water Congress. The purpose of the board's funding is to promote a better understanding of water issues through educational opportunities and resources so Colorado citizens will understand water as a limited resource and will make informed decisions."

Also in 2002, the General Assembly authorized an annual appropriation of $150,000 from the CWCB Construction Fund to the water education foundation. That same year, the Colorado Foundation for Water Education (CFWE) was established. CFWE is "the only statewide non-profit, non-advocacy organization providing water resource information and education."

Karla Brown was hired as the organization's first Executive Director, and now Nicole Seltzer ably leads the CFWE.

The CFWE continues it stellar work by hosting bus and bike tours, promoting Water 2012 activities, publishing *Headwaters* magazine, co-hosting water education conferences, and a wide range of other important activities.

In 2008, the Colorado Water Conservation Board published a "Colorado Water Education Taskforce" report, a cooperative project of the Colorado Alliance for Environmental Education, the Colorado Watershed Network, and the CWCB. The conclusions and recommendations were the result of a multi-year effort of water education providers across the state, and came up with numerous recommendations, including:

- Supporting a statewide water education initiative
- Establishing long-term and adequate funding
- Coordinating water education efforts across state government agencies

Colorado Water for the 21st Century Act

The Colorado Water for the 21st Century Act created the Public Education, Participation, and Outreach, or PEPO, workgroup to advance the understanding of future water needs through educational programs and processes. CFWE has provided strong support for the PEPO workgroup.

Higher Education Efforts

Reagan Waskom, CWI Director, has been a leader in water education activities across Colorado for over a decade, and has served on the board of directors of CFWE since its inception. He has been instrumental in linking the following universities to elevate their water education efforts. CSU's *Colorado Water* publication is part of that effort. In addition, Brad Udall and others at CU–Boulder have worked for many years on water education activities throughout the region.

In 2009, Colorado Mesa University (CMU) began work on a Water Center to connect CMU faculty with Mesa County Water Association activities. The university currently has a watershed science minor and an associate of applied science in water quality management. The group also hosts an annual Upper Colorado River Basin Water Forum, and seeks to coordinate research and education on Colorado River issues. Hannah Holm is the coordinator and Gigi Richard is the faculty director.

Metropolitan State University of Denver (MSU Denver) raised the bar in water education when Valarie Gates donated the One World, One Water sculpture, created by artist Rik Sargent, in May 2012. An anonymous donor then provided $1 million over five years to develop a water studies minor for all schools and departments on campus, including art, environmental studies, industrial design, theater, English, history, and others. It is believed to be the only higher education water program of its type in the country.

CSU-Pueblo and the University of Northern Colorado are working to develop water centers of their own to build upon their academic strengths, and the water education needs of their communities.

The American Water Resources Association (AWRA) has been active in career outreach activities across Colorado, and has hosted a series of events for students in recent years. The American Water Works Association is also active in working with university students and faculty.

Future Activities

Colorado has developed a rich and extensive program of water education activities over the past 20 years, and the effects have been significant. Water awareness in Colorado has improved, but significant work remains to be done. However, profound thanks goes out to all of the agencies, groups, boards of directors and individuals who have created and continue rich legacies of water education work across the state.

Headwaters magazine is in its ninth year, and is the CFWE's flagship educational publication. The magazine highlights the history, people, and current challenges of water management in Colorado.

The WRECking Crew

Anne Casey, Youth Development Education Specialist,
Colorado State University Extension

Colorado State University (CSU) Extension and The Colorado Water Institute are partnering with the Colorado Water Conservation Board to offer a unique new water education program to high schools students called the WRECking Crew, short for Water Resource Education Curriculum Crew.

This program is designed to accomplish two goals:

1. Reduce water usage at participating schools through the streamlining of their landscape irrigation system with the use of LISA (Landscape Irrigation Self Audit) Kits, a tool developed by CSUE Water Resource Specialists and to promote best practices for water conservation for common activities
2. Provide a hands-on student-led STEM (science, technology, engineering, and math) enrichment project that incorporates opportunity for skills development, campus improvement, and community service

Decreasing scores on international tests of science and math competencies (TIMSS and PISA) since the 1980s have spurred a number of efforts to improve education in the STEM areas. Studies indicate that students learn more and retain it longer when they are engaged in real world experiential activities. In addition, concerns about increasing water consumption by a growing population require fostering new consumption habits in our communities. The WRECking Crew provides a vehicle to accomplish both objectives.

Designed as a weekly one hour, year-long project, this program has been adopted by three high schools in the Fountain Creek/Arkansas River basins under the leadership of: Nate Chisholm, Environmental Science teacher at the Air Academy High School in Colorado Springs, Fran Weber, Honors Biology teacher at Pueblo West High School in Pueblo West, and Alec Walter, Biology teacher at County High School/SEBS in Pueblo. As an inter-curricular program, it supports Colorado Academic Standards in Science, Math, English, and History. The program also has the additional bonus of reducing the school's water bill, the savings on which the participating students will be given partial authority on how to re-allocate for other school purposes.

During the course of the three years, the program progresses from local water issues to global ones. First-year participants entering the program will concentrate their attention on their own campuses first. Using tools developed by CSU Extension Water Resource Specialists and climatologists, (LISA Kits, Colorado Agricultural Meteorological Network (CoAgMet), and Community Collaborative Rain Hail and Snow Network (CoCoRaHS)), students will design experiments, collect and analyze data, and finally implement a more efficient water usage plan for their schools. To date these students have conducted a survey of student water awareness, preformed a campus water audit, and created a map of their school grounds within their watersheds using ArcGIS Online mapping software. They will be encouraged to use these tools and skills to audit their own homes, as well, and bring awareness of water issues to their neighborhoods.

In the second year of the program these students continue their water education by learning about the historical issues concerning water in Colorado and the Western Region of the U.S., including water diversion projects, dams and reservoirs, and irrigation systems. They will study the natural history of native plants and grasses and the ecosystems that depend on them. Applying this knowledge to the campus landscaping will allow

Lake Pueblo
Photo by Les Barstow

them to make good recommendations for water-wise plantings and turf grasses. The WRECking Crew teams have visited demonstration xeriscape gardens at the Colorado Springs Utilities Conservation and Environmental Center, 2855 Mesa Road in Colorado Springs, and the Southeastern Colorado Water Conservancy District Xeriscape Garden, 31717 United Avenue in Pueblo, guided by Perry Cabot, CSU Extension Water Specialist. Field trips that are planned for the future include a visit to the Arkansas Valley Research Center to familiarize students with agricultural water issues and a camping trip to Lake Pueblo State Park to learn about water diversion projects and dams.

Third year participants will continue to expand their research to include global solutions to water problems. They will study how other countries use water and meet their water needs. Their studies will focus on water technologies, how they have changed and what is in store for the future. At this point they will be very familiar with their own campus and be able to consider the possibility of incorporating new technologies to enhance their school's environment. While there is no formal program for graduates of the program, they will be expected to become teachers and record keepers. In this way the program becomes self-sustaining.

This program supports both water conservation goals and educational goals in STEM. Through experiential, inquiry-based projects students will gain valuable analytical skills and develop an understanding of resource stewardship. This program is sustainable, replicable, and community-based. The desired outcome of the program is to generate greater interest in STEM careers with links to water conservation, natural and water resources management, watershed studies, and climatology.

Throughout the program, teachers and CSU Extension collaborators, Anne Casey, CSU Extension Education Specialist, Perry Cabot, CSU Extension Water Specialist, and Shelby Will, CSU-Pueblo Biology student intern, are using feedback from teachers and students to create a Colorado-specific water education curriculum for use by high schools throughout Colorado. Teachers in the program attend two professional development sessions each year, in addition to participating in optional curriculum writing sessions. This group is combing the available literature for best practices in water education to build a curriculum that presents the best in water conservation principles delivered in the context of the research-based 4-H extension Essential Elements of youth development. The Essential Elements of youth development form the basis of all 4-H programs and include providing opportunities that allow students to see themselves as active participants in the future as well as opportunities for self-determination, mastery of a skill, engagement in learning, and to value and practice service to others.

One important benefit of the program for schools is the increased awareness among students of campus facilities issues. It is hoped that through this exposure, students will become more invested in their campus buildings and grounds, having developed a sense of ownership and pride in their school's appearance and workings. Another hope is an increased interest in STEM careers, especially in the field of hydrology. According to the Bureau of Labor Statistics, job growth in that area is expected to grow by 18 percent with many of those jobs being located in Colorado, which has the highest average annual wage in that profession at $94,670.

CSU Extension is excited to be partnering with these outstanding students and teachers on the WRECking Crew through the generous support from the Colorado Water Conservation Board. We look forward to seeing how these students "wreck" old out-dated water systems on their campuses and bring in their own fresh water-saving ideas.

Counting (on) Precipitation

CoCoRaHS in the Classroom

Noah Newman and Nolan Doesken, Colorado Climate Center, Department of Atmospheric Science, Colorado State University

The Colorado Climate Center at Colorado State University is responsible for closely monitoring climatic conditions in Colorado, providing a historic context for recent climate variations, and sharing climate information widely (http://ccc.atmos.colostate.edu).

The "Water 2012" water education campaign coincided with a year of extreme drought for most of Colorado. This water and climate challenge provided a water education opportunity. As a part of "Water 2012" the Colorado Climate Center reached out to schools, students, and educators across Colorado encouraging schools to join with us in monitoring and tracking climate, drought, and water resources as we marched through 2012.

The platform we used for this collaboration was the Community Collaborative Rain, Hail and Snow Network (CoCoRaHS). "Every Drop Counts" is the slogan behind CoCoRaHS (www.cocorahs.org), a program where volunteers of all ages collect precipitation data from as many locations as possible. When data from many locations are combined, mapped, and shared, we are able to track in great detail the rain and snow that become our water supply. By participating in the process of monitoring water as it arrives from the sky, volunteers gain a fuller appreciation and personal experience with our limited and variable water resources.

CoCoRaHS has become a highly respected source of hydrometeorological data. Data from CoCoRaHS volunteers are used routinely by the National Weather Service including River Forecast Centers, the Hydrological Prediction Center, and the National Operational Hydrological Remote Sensing Center.

CoCoRaHS originated here in Colorado in 1998, one year after the devastating Spring Creek Flood of 1997. This "citizen science" network has now expanded to all 50 states

CoCoRaHS education coordinator Noah Newman introduces the water cycle to second graders at SkyView Elementary School in Windsor, Colorado.

Courtesy of CoCoRaHS

(and Manitoba, Canada) with over 16,000 volunteers recording precise daily precipitation. Besides providing high quality data, CoCoRaHS also promotes education and climate literacy to the community with the use of daily messages, newsletters, topical webinars, educational animations, outreach events and many forms of training resources to help volunteers gain skill in weather observations.

Through a grant funded by the National Science Foundation, CoCoRaHS has expanded to engage K-12 audiences with a standards-aligned education outreach component. The partnership with the year-long "Water 2012" statewide water celebration (water2012.org) proved to be ideal. Through additional fundraising efforts, CoCoRaHS was able to offer a free rain gauge to every school in Colorado. Teachers immediately saw a win-win situation where they can participate in a scientific project that meets State and National Standards for not only science but also math, geography, and computer skills. CoCoRaHS also sees a win-win situation where educational outreach combines with receiving more data, especially in rural areas.

A Great Classroom Project for All Grade Levels!

Kindergarten to Second Grade

At the lowest grade levels, the entire class participates together while the teacher is responsible for entering data. Practicing basic observation skills is the primary goal at this age, leading the children outside to make basic observations about the weather. Younger students are not yet ready to collect and record measurements online, but as a group activity, they can be a part of observing the rain gauge and helping to count the marks on the side of the measuring tube.

Students at a water festival in Denver compete to fill up their rain gauges. Reading the gauge to the nearest hundredth of an inch is required to see who wins.

Courtesy of CoCoRaHS

Teachers enter their data and add their weather observations to the "notes" section of the data entry page. In the classroom, an introduction to the water cycle (and the "Water Cycle song") is a great activity.

Third to Fifth Grade

Students at this grade level are perfect for participating with CoCoRaHS. By this age, many students have at least some experience on a computer and using the Internet, but logging in and entering/viewing data are critical "21st century skills" that will be needed by middle school and CoCoRaHS provides a safe and easy venue for learning and practicing these basic tasks. Furthermore, mathematics and fractions are now part of the curriculum at this age, and using one's own data is a huge asset to answer the age old question, "Where in the real world will I ever need to know this stuff?" Besides computer literacy and math, students at this age usually have a weather component in their curriculum where the water cycle is taught. They are now able to grasp the concept of variability and can relate to the fact that it can rain different amounts at different locations.

Sixth to Eighth Grade

At this point, schools with CoCoRaHS gauges installed are able to send out assigned groups of students, taking turns, with reading and reporting the data. This is where the bulk of data entry errors are experienced. All over the country, we experience errors made by our volunteers on a daily basis. Decimal errors, mixing up precipitation with the time of observation, and general typos happen to almost everyone in the network at least once. Students at this age are given more flexibility by their teachers and have been found to be more error prone than more experienced volunteers. Is that really 7.00 inches of rain or was it merely 7:00 a.m. when you took the observation? Most of the errors stick out and are easily corrected. This always provides a teachable moment, where we can write to the school and make sure they are aware of their error. This not only allows us to teach someone what went wrong, but it also lets them know that people are actually looking at their data. Wow! At this age level, students are beginning to understand the larger

world around them. The idea of submitting data that helps out the community starts to take hold.

Ninth to Twelfth and Beyond

High School participation with CoCoRaHS has some tremendous opportunities. Already, groups of students participating in environmental clubs have taken advantage of the free rain gauge to use for their project—tracking local rainfall and comparing to long term averages. Math and science teachers are finding CoCoRaHS a useful tool, incorporating it into lessons that involve learning how to view and graph data using spreadsheets.

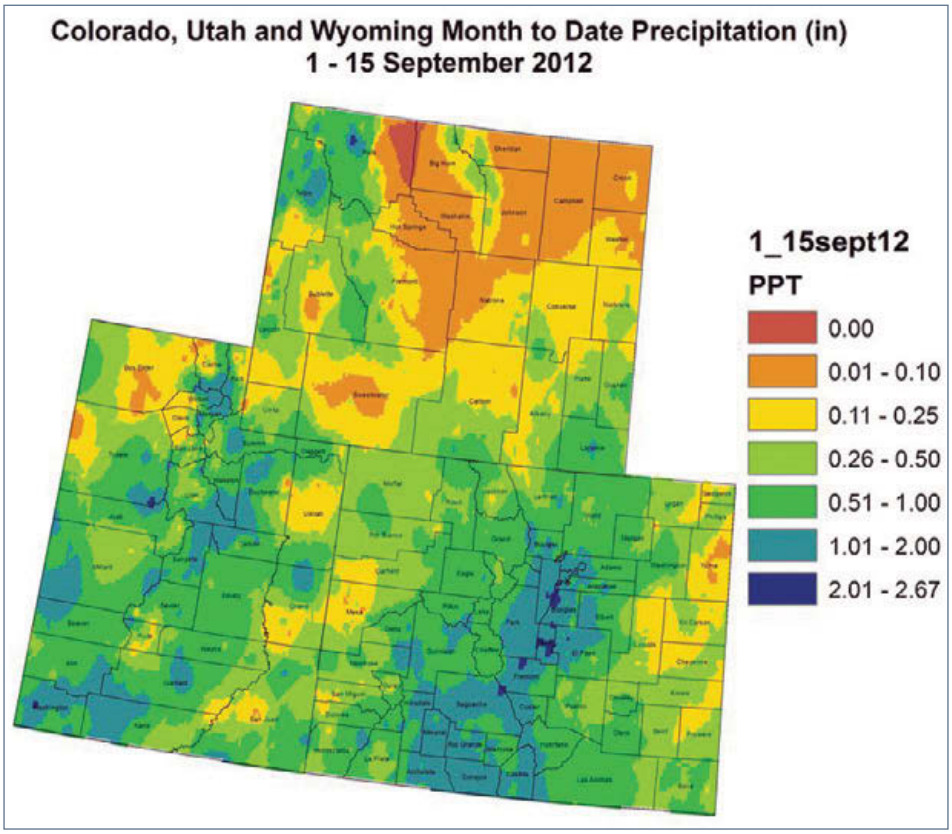
Locally, CoCoRaHS has partnered with the Poudre School District and their television station Channel 10. Here, a monthly "Water Report" is filmed with students from participating schools hosting an episode where they report their monthly precipitation totals and compare them to long-term averages. Episodes can be viewed on the CoCoRaHS YouTube channel: www.youtube.com/cocorahs.

Outside of Colorado, researchers at universities with their own outreach components have connected with CoCoRaHS schools, partnering together to ship rainfall samples back to their labs for isotope analysis. The future holds more exciting opportunities where CoCoRaHS will be partnering with NASA's upcoming Global Precipitation Measurement satellite mission scheduled for launch in 2014, providing data that will help calibrate the satellite.

The Make it Rain Game and Rain Gauge Week

As Water2012 began, CoCoRaHS had a goal of offering a rain gauge to every school in Colorado. By attending nearly every water festival around the state, the CoCoRaHS "Make it Rain" game was very popular and we managed to engage over 4,000 students—each one getting a chance to compete with a classmate by filling up a rain gauge with a squirt gun and then reading their measurement.

In an effort to encourage all participating schools to submit data during the same time, CoCoRaHS promoted "Rain Gauge Week" from Sept. 5-11. CoCoRaHS was featured on several Denver TV news shows and in the Denver Post. Nearly 150 schools participated from all over the state; from Grand Junction to Sterling, Fort Collins to Pueblo, Colorado Springs, Durango, Alamosa, Greeley, Denver, and the list goes on. Their data helped paint the picture of precipitation across Colorado, helping meteorologists and climatologists who study rainfall patterns and more importantly this year, drought. Even after Rain Gauge Week ended, the momentum continued with a number of new schools joining since! Another Rain Gauge Week in the spring will be coming, so look for announcements if you missed the first one.



This precipitation map was used to assess the drought situation in Colorado, Utah and Wyoming. For Colorado, this includes data that was submitted from schools all over the state during Rain Gauge Week.

Courtesy of Colorado Climate Center

Colorado Water Conservation Board 2012 Drought Conference

Taryn Finnessey, Drought and Climate Change Specialist, State of Colorado

The 2012 Colorado Water Conservation Board (CWCB) State Drought Conference: Building a Drought Resilient Economy Through Innovation was held September 19 and 20 in Denver. This two-day conference highlighted the most innovative approaches to drought preparedness and brought attention to how those innovations contribute to an economy more resilient to the devastating effects of this natural disaster. Although drought has a much slower onset than other natural disasters, it still brings economic consequences that can devastate a community. In 2012, nearly every county in Colorado was designated as a primary disaster area for drought, and the wildfire season proved to be the most costly in history. The agricultural as well as the tourism and recreation industries, the first and second largest contributors to Colorado's economy, respectively, are impacted deeply by drought as are natural environments, municipalities, and local businesses. A goal of the conference was to put forth an agenda that would help communities address drought concerns in new and efficient ways. Representatives from a multitude of industries presented, including finance, recreation, development, energy, agriculture, and emergency management; all offered different views of how they are impacted by drought and how they are able to address those concerns.

While it was a Colorado drought conference, presenters from other western states also talked about their recent experiences with the impacts of drought as well. Representatives from ski areas and the energy sector discussed their approaches to drought response, while environmental representatives presented mechanisms to adapt to drought and climate change yet still protect our natural resources. Innovations on the business side were also examined from Colorado's unique beer brewing industry to agricultural range management in the San Luis Valley.

In addition to more than forty presenters, the conference attendees also heard from three keynote speakers. Entrepreneur and philanthropist John Paul DeJoria spoke about his investments in sustainability through his companies Paul Mitchell Hair Systems and Patrón Spirits, as well as his involvement domestically and abroad in advancements to help less developed regions gain improved access to clean water and nutrition. Author and Colorado resident Steve Maxwell spoke about his recent book The Future of Water, in which he looks at major challenges facing our water resources in the decades to come and empowers us to change the future of water. Last, but certainly not least, Governor John Hickenlooper spoke about how his administration is trying to address challenges to ensure that generations of future Coloradoans can both enjoy the natural beauty of Colorado and maintain a high quality of life with adequate water availability.

United States Secretary of Agriculture Tom Vilsack and Colorado Commissioner of Agriculture John Salazar were on hand the second day of the conference to announce the creation of a new Colorado conservation project. The project will enhance water quality, reduce erosion, improve wildlife habitat, and conserve energy in portions of the Rio Grande watershed within Colorado. Secretary Vilsack said the "USDA is proud to work with the state of Colorado to enroll up to 40,000 acres of eligible irrigated cropland in an effort to address critical water conservation and other natural resource issues within portions of the Rio Grande watershed." The program is part of the Conservation Reserve Enhancement Program (CREP), in which participants will receive compensation and incentives for voluntarily enrolling irrigated cropland into contracts and installing the approved conservation practices.

Feedback on the conference has been extremely positive and CWCB feels that the event was successful in raising awareness about the importance of taking an innovative, proactive approach to drought preparedness as a means to build a more drought resilient economy. Conference evaluations show that attendees overall were very satisfied. Average overall satisfaction ranked 4.43 out of five; the conference also met advertised objectives (4.26). Drought Connections to our Larger Economies, Vulnerability and Economic Impacts: Urban Environments, and Role of Water & Technology in Agricultural Production were among the highest rated presentations. More than half of the evaluation respondents said that they would like to see a state drought conference convened every two to three years. Local and regional topics were the most recommended additions for future events.

If you were unable to attend the conference but are interested in learning more, presentations as well as audio are available on the CWCB website at:

http://cwcb.state.co.us/water-management/drought/Pages/2012CWCBStatewideDroughtConference.aspx

Recent Publications

Water quality, streamflow conditions, and annual flow-duration curves for streams of the San Juan–Chama Project, southern Colorado and northern New Mexico, 1935-2010; Falk, Sarah E.; Anderholm, Scott K.; Hafich, Katya A.; USGS Scientific Investigations Report: 2013-5005

A regional classification of the effectiveness of depressional wetlands at mitigating nitrogen transport to surface waters in the Northern Atlantic Coastal Plain; Ator, Scott W.; Denver, Judith M.; LaMotte, Andrew E.; Sekellick, Andrew J.; USGS Scientific Investigations Report: 2012-5266

Preliminary hydrogeologic assessment near Tassi and Pakoon Springs, western part of Grand Canyon-Parashant National Monument, Arizona; Truini, Margot; USGS Scientific Investigations Report: 2012-5276

Introduction and summary of findings: Chapter 1 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Turner, Kent; Rosen, Michael R.; Goodbred, Steven L.; Miller, Jennell M.; USGS Circular: 1381-1

A synthesis of aquatic science for management of Lakes Mead and Mohave; Rosen, Michael R.; Turner, Kent; Goodbred, Steven L.; Miller, Jennell M.; USGS Circular: 1381

Environmental setting of Lake Mead National Recreation Area: Chapter 2 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Turner, Kent; Rosen, Michael R.; Holdren, G. Chris; Goodbred, Steven L.; Twichell, David C.; USGS Circular: 1381-2

Hydrology and management of Lakes Mead and Mohave within the Colorado River Basin: Chapter 3 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Holdren, G. Chris; Tietjen, Todd; Turner, Kent; Miller, Jennell M.; USGS Circular: 1381-3

Lake water quality: Chapter 4 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Tietjen, Todd; Holdren, G. Chris; Rosen, Michael R.; Veley, Ronald J.; Moran, Michael J.; Vanderford, Brett; Wong, Wai Hing; Drury, Douglas D.; USGS Circular: 1381-4

Wildlife and biological resources: Chapter 5 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Chandra, Sudeep; Abella, Scott R.; Albrecht, Brandon A.; Barnes, Joseph G.; Engel, E. Cayenne; Goodbred, Steven L.; Holden, Paul B.; Kegerries, Ron B.; Jaeger, Jef R.; Orsak, Erik; Rosen, Michael R.; Sjöberg, Jon; Wong, Wai Hing; USGS Circular: 1381-5

Threats and stressors to the health of the ecosystems of Lakes Mead and Mohave: Chapter 6 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Rosen, Michael R.; Goodbred, Steven L.; Wong, Wai Hing; Patiño, Reynaldo; Turner, Kent; Palmer, Craig J.; Roefer, Peggy; USGS Circular: 1381-6

Management implications of the science: Chapter 7 in A synthesis of aquatic science for management of Lakes Mead and Mohave; Turner, Kent; Goodbred, Steven L.; Rosen, Michael R.; Miller, Jennell M.; USGS Circular: 1381-7

Understanding and managing the effects of groundwater pumping on streamflow; Leake, Stanley A.; Barlow, Paul M.; USGS Fact Sheet: 2013-3001

Standardized methods for Grand Canyon fisheries research 2012; Persons, William R.; Ward, David L.; Avery, Luke A.; USGS Techniques and Methods: 2-A12

Prediction, time variance, and classification of hydraulic response to recharge in two karst aquifers; Long, Andrew J.; Mahler, Barbara J.; Hydrology and Earth System Sciences, 17: 281 - 294

Hydrogeomorphology influences soil nitrogen and phosphorus mineralization in floodplain wetlands; Noe, Gregory B.; Hupp, Cliff R.; Rybicki, Nancy B.; Ecosystems, 16: 75 - 94

Description of input and examples for PHREEQC version 3: a computer program for speciation, batch-reaction, one-dimensional transport, and inverse geochemical calculations; Parkhurst, David L.; Appelo, C. A. J.; USGS Techniques and Methods: 6-A43

Estimates of gains and losses from unmeasured sources and sinks for streamflow and dissolved-solids load in selected reaches of the Arkansas River, southeastern Colorado, 2009-2010; Ortiz, Roderick F.; USGS Scientific Investigations Report: 2012-5252

Brian Fugate

Lindsey A. Middleton, Editor, Colorado Water Institute

Brian Fugate, Associate Professor in the Department of Management, attained tenure at CSU in 2012. Fugate worked as an industrial engineer in private industry before choosing academia, and worked for two years at Lehigh University before moving to CSU in 2008. Fugate holds a Ph.D. in Logistics and a Master of Business Administration in Marketing and Logistics from the University of Tennessee.

While at CSU, Fugate explains that a large portion of his work focuses on supply chain management, which involves the systemic, strategic coordination and collaboration of the traditional business functions within an organization and across organizations.

Fugate has been working with companies to help them understand this systems thinking approach as applied to their own projects. In 2012, Fugate visited East Africa with marketing professor Joe Cannon to perform qualitative research studies on sustainable supply chains. The professors are studying the practices of large and small businesses and non-governmental organizations (NGOs). They spent more than two weeks in Kenya, Tanzania, and Rwanda where they talked to more than 20 managers at a dozen organizations. The overall goal of this research is to identify best management practices for the benefit of future economic development in Africa and bring new insights to CSU students. Fugate has also visited China in an effort to understand the same principles, and to help compare their management practices with those in Africa and other developing and developed countries.

Fugate explains the importance of a "shared interpretation"—even though one group may have well-meaning goals, their efforts might fall short on a system-wide scale that includes groups

approaching the same problem from a different perspective. He believes the focus on the scientific model has resulted in an output of "siloed" discipline-based research that lacks relevance or ability to tackle contemporary problems faced by business and society. Contemporary challenges such as global value creation, health care services delivery, sustainability initiatives, economic improvements, or capturing market opportunities in emerging markets are increasingly more complex, cross-functional, and multi-disciplinary.

"Sustainability is very interdisciplinary," says Fugate of his research thus far. "That's one of the main reasons I am interested in the area."

Fugate is also part of a project to collect and disseminate advice on how researchers and practitioners can work together at a system-wide scale. His research team interviewed 70 business and academic thought-leaders, including leading faculty from some of the most prestigious business schools and industry senior executives, and has summarized their advice into articles. The consensus among the thought leaders is the identification of *interdisciplinary research* as necessary for business schools to be relevant and capable of addressing numerous current and emerging challenges facing business and society as a whole. In the future, Fugate hopes to broaden this type of project to other colleges and disciplines as well as to universities throughout the U.S.

Fugate currently teaches the introductory Supply Chain Management class within the Management department as well as a few certificate training courses in graduate programs. He says he enjoys both teaching and research, and that they build on one another— "I learn from my students, and research helps me in my classes," he says.

In addition to his current research and teaching roles, Fugate is taking part in a School of Global Environmental Sustainability working group for water issues and is involved in the CSU committee tasked to re-vitalized Colorado State University Water Center. "I'm learning a lot about water," he says—"It's a big issue." He believes that addressing current water challenges requires the creation and integration of knowledge across disciplines to help us better understand water resource systems, their interaction with human societies, and the policy needs to create solutions. Fugate also believes that CSU has a unique opportunity to build on its history as a leader in solving these water challenges.

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Water Research Awards

Colorado State University (November 16, 2012 to January 15, 2012)

Carlson, Kenneth H, Civil & Environmental Engineering, Halliburton Company, Characterization and Optimization of Electrocoagulation Treatment of Produced Water in the Denver-Julesburg, $53,488

Cotrufo, Maria Francesca, Soil & Crop Sciences, NSF - National Science Foundation, Full Accounting of Pyrogenic-C Dynamics at the Watershed Scale: A Unique Opportunity Offered by the High Park Fire, $197,363

Cottrell, Stuart P, Human Dimensions Of Natural Resources, NSF - National Science Foundation, Collaborative Research: Water Quality & Supply Impacts from Climate-Induced Insect Tree Mortality & Resource Management in the Rocky Mountain West, $174,355

Gates, Timothy K, Civil & Environmental Engineering, DOI-Bureau of Reclamation, Toward Optimal Water Management in Colorado's Lower Arkansas River Valley: Monitoring and Modeling for Agroecological remediation, $50,001

Johnson, Brett, Fish, Wildlife & Conservation Biology, Northern Colorado Water Conservancy District, Characterizing Bioaccumulation of Mercury in Sport Fish: Informing TMDL Development & Modeling Mitigation Strategies, $10,000

Johnson, James, Biology, Colorado State Land Board, Developing Stream Mitigation Banking Protocols, $50,000

Knapp, Alan Keith, Biology, NSF - National Science Foundation, Grassland Sensitivity to Severe Drought: Disentangling the Role of Precipitation Amount vs. Pattern Across Regional-Scale Biotic and Climatic Gradient, $204,564

Roesner, Larry A, Civil & Environmental Engineering, Urban Drainage & Flood Control District, Develop the Colorado Center for Stormwater Management, $42,500

Sanford, William E, Geosciences, Regenesis Management Group, Task 3: Quantifying Changes in Irrigation Return Flow Due to Limited Irrigation & Other Crop Optimizing Techniques, $30,905

Sundstrom, Gregory D, Colorado State Forest Service Colorado Department of Transportation, Living Snow Fences Research Study, $70,000

Thornton, Christopher I, Civil & Environmental Engineering, Various "For Profit" Sponsors, Full Scale Product Evaluation During Wave Overtopping, $39,870

Venayagamoorthy, Subhas K, Civil & Environmental Engineering, DOD-NAVY-ONR-Office of Naval Research, Flow Dynamics and Turbulent Mixing around Obstacles in Oceanic Flows, $74,869

Waskom, Reagan M, Colorado Water Institute, Colorado Water Conservation Board, CWCB/CWI Cooperative Intern Program, $16,269

Calendar

March

2 **Water Tables 2013; Fort Collins, CO**
This year's theme, "Water in the West: Coping with Extremes," promises to be livelier than ever. The event starts at 5 p.m. with a reception and tours of the Archive at Morgan Library before moving to the Lory Student Center main ballroom for dinner.
lib.colostate.edu/archives/water/water-tables/2013/

11-15 **River Crossings: Linking River Communities; Grand Junction, CO**
An interagency river management workshop and research conference presented by the Bureau of Land Management, River Management Society, Tamarisk Coalition, The Water Center at Colorado Mesa University, and International Submerged Lands Management Conference
www.sc.colostate.edu/james-campus-salon.aspx

25-27 **33rd Annual American Geophysical Union Hydrology Days; Fort Collins, CO**
The 33rd Annual Hydrology Days held at Colorado State University with award lecturer Vijay P. Singh
hydrologydays.colostate.edu/

April

7-10 **2013 Sustainable Water Management Conference; Nashville, TN**
Presents solutions for balancing the benefits of conservation with the costs, managing infrastructure, developing robust supply models and watershed management plans, water reuse, resource management, green infrastructure, and more
www.awwa.org/conferences-education/conferences/sustainable-water-management.aspx

15-17 **NWRA Annual Conference; Washington, D.C.**
Theme: Federal Water Issues
www.nwra.org

16-19 **U.S. Committee on Irrigation and Drainage (USCID) 7th International Conference on Irrigation and Drainage; Phoenix, AZ**
Using 21st Century Technology to Better Manage Irrigation Water Supplies
www.uscid.org/13azconf.html

28-2 **2013 NGWA Summit—The National and International Conference on Groundwater; San Antonio, TX**
Groundwater is a resource to be protected. It ignores political boundaries, transports contaminants, floods mine and construction sites, spins communities into an uproar, and can't be found when you need it. Model, explore, characterize, bank, inject, extract, treat, and predict all your subsurface needs with everything groundwater at the 2013 NGWA Summit.
groundwatersummit.org/

August

21-23 **Colorado Water Congress Annual Summer Conference; Steamboat Springs, CO**
Summer Conference and Membership Meeting
www.cowatercongress.org

September

15-18 **28th Annual WateReuse Symposium; Denver, CO**
The world's premier conference devoted to sustaining supplies through water reuse and desalination
www.watereuse.org/symposium28

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Colorado Water Institute
www.cwi.colostate.edu

CSU Water Center
www.watercenter.colostate.edu

Dick Proctor of the Grand Valley Water Users Association speaks at the "Roller Dam" to a group of 100 water professionals, educators, and policy makers on the 2011 Colorado Basin Tour hosted by the Colorado Foundation for Water Education.

Photo by Kristin Maharg