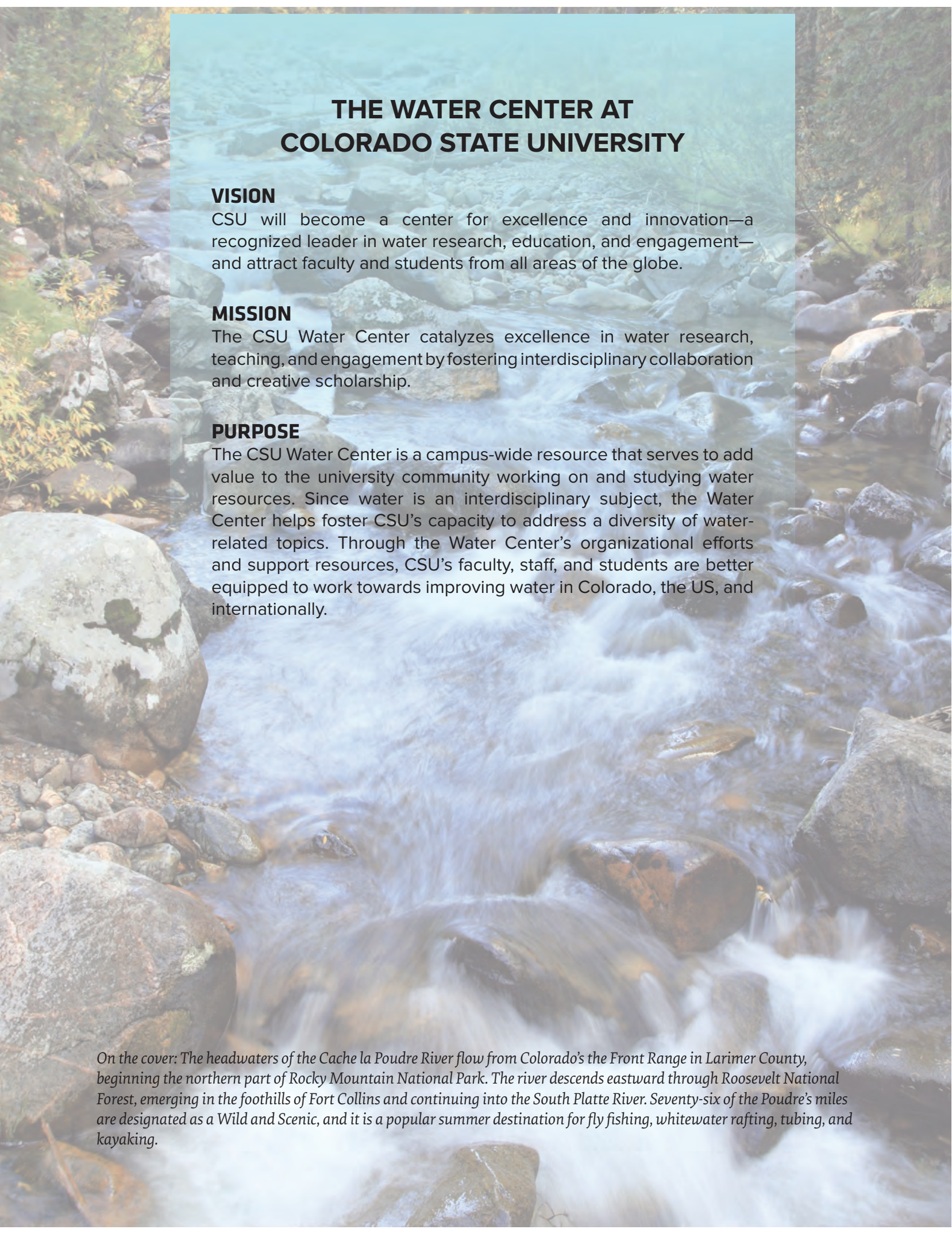




WATER CENTER
COLORADO STATE UNIVERSITY

Annual Report

2016-2017 Fiscal Year



THE WATER CENTER AT COLORADO STATE UNIVERSITY

VISION

CSU will become a center for excellence and innovation—a recognized leader in water research, education, and engagement—and attract faculty and students from all areas of the globe.

MISSION

The CSU Water Center catalyzes excellence in water research, teaching, and engagement by fostering interdisciplinary collaboration and creative scholarship.

PURPOSE

The CSU Water Center is a campus-wide resource that serves to add value to the university community working on and studying water resources. Since water is an interdisciplinary subject, the Water Center helps foster CSU’s capacity to address a diversity of water-related topics. Through the Water Center’s organizational efforts and support resources, CSU’s faculty, staff, and students are better equipped to work towards improving water in Colorado, the US, and internationally.

On the cover: The headwaters of the Cache la Poudre River flow from Colorado’s the Front Range in Larimer County, beginning the northern part of Rocky Mountain National Park. The river descends eastward through Roosevelt National Forest, emerging in the foothills of Fort Collins and continuing into the South Platte River. Seventy-six of the Poudre’s miles are designated as a Wild and Scenic, and it is a popular summer destination for fly fishing, whitewater rafting, tubing, and kayaking.

TABLE OF CONTENTS

A Message from the Executive Committee Chair	2
Executive Committee of the Water Center	3
About the Water Center	4
The Water Center: Then & Now	5
Research	6
Visiting Scholars	11
Education	12
Engagement & Service	14
Collaboration	15
Water Center Staff	16
Financial Summary	17

FROM OUR CHAIR



January 1, 2018

The CSU Water Center was reconfigured in 2013 by Provost Rick Miranda to enhance faculty and student work on global challenges of water sustainability. We are pleased to report that since that time, the Center has awarded over \$675,000 in seed funding for innovative water scholarship, resulting in approximately \$11 million awarded in external funding.

The Center has a mission to catalyze excellence in water research, education, and engagement by fostering interdisciplinary collaboration and creative scholarship. To accomplish this goal, the Center brings together a network of over 200 water experts across campus and seeks to engage the campus community in interdisciplinary approaches to water challenges. Fiscal year 2017 was a successful year for our water faculty and students. In the following pages you will learn about how they are addressing water challenges through applied research projects, read about water events that bring forward topics for debate and discussion, see how CSU's educational programs are preparing the next generations of water stewards and leaders, and learn how to become informed and involved in water matters.



In the year ahead, our hope is that CSU will continue to advance as a center of excellence and a leader in water scholarship. One of the challenges of interdisciplinary research, education, and engagement is the need for practitioners who can work across disciplines to solve complex water problems. To serve this need, the Center will continue to foster collaborations among water faculty, staff, students, and community partners to address the water challenges of today and tomorrow.

Sincerely,

Reagan Waskom

Reagan Waskom
Executive Committee Chair, CSU Water Center

EXECUTIVE COMMITTEE



The Water Center Executive Committee represents seven of CSU's eight colleges and a variety of disciplines. Pictured (from left): A. Andales, K. Bestgen, C. Goemans, H. Ramsdell, R. Waskom, K. Jones, S. Malin, S. Kampf, L. Poff, N. Grigg. Not pictured: P. Backlund, G. Kelly, J. Pritchett, J. Ramirez, B. Shuster, P. Taylor

Allan Andales	College of Agricultural Sciences
Peter Backlund	School of Global Environmental Sustainability
Kevin Bestgen	Warner College of Natural Resources
Chris Goemans	College of Agricultural Science
Neil Grigg	College of Engineering
Kelly Jones	Warner College of Natural Resources
Stephanie Kampf	Warner College of Natural Resources
Gene Kelly	Extension College of Agricultural Sciences
Stephanie Malin	College of Liberal Arts
LeRoy Poff	College of Natural Sciences
James Pritchett	College of Agricultural Sciences
Jorge Ramirez	College of Engineering
Howard Ramsdell	College of Veterinary Medicine & Biomedical Sciences
Bill Shuster	College of Business
Pete Taylor	College of Liberal Arts
Reagan Waskom	Colorado Water Institute

ABOUT US

Research, Education, and Engagement

Colorado State University's (CSU) water experts engage in nearly 100 countries and on every continent, and they have improved the lives of millions through their work in water. Special areas of focus include: water engineering, hydrology, water quality, ecology, urban water, irrigation, policy, human dimensions, and water sustainability. As one of the world's leading centers of water expertise, CSU offers:

Comprehensive water-research assets spanning all eight academic colleges

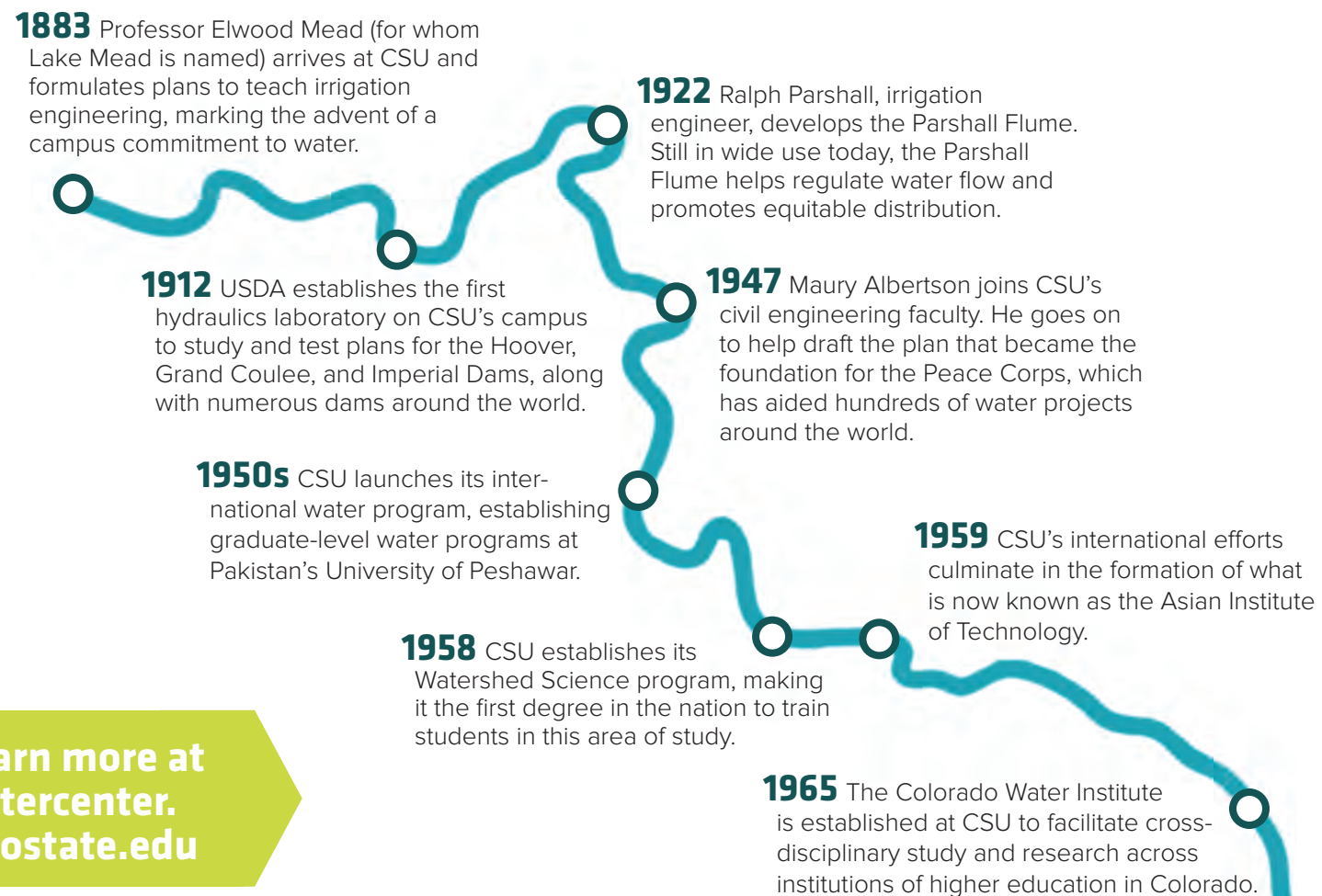
Experiences with complex water projects throughout the world

Innovative and entrepreneurial culture, designed to put research to work for the benefit of society

Commitment to international partnerships and preparing the next generation of water leaders

A Rich History at CSU

For more than 125 years, CSU has been a world leader in the water arena, sharing its knowledge with the world and educating students and influential water leaders around the planet.



Learn more at
watercenter.colostate.edu

THEN & NOW

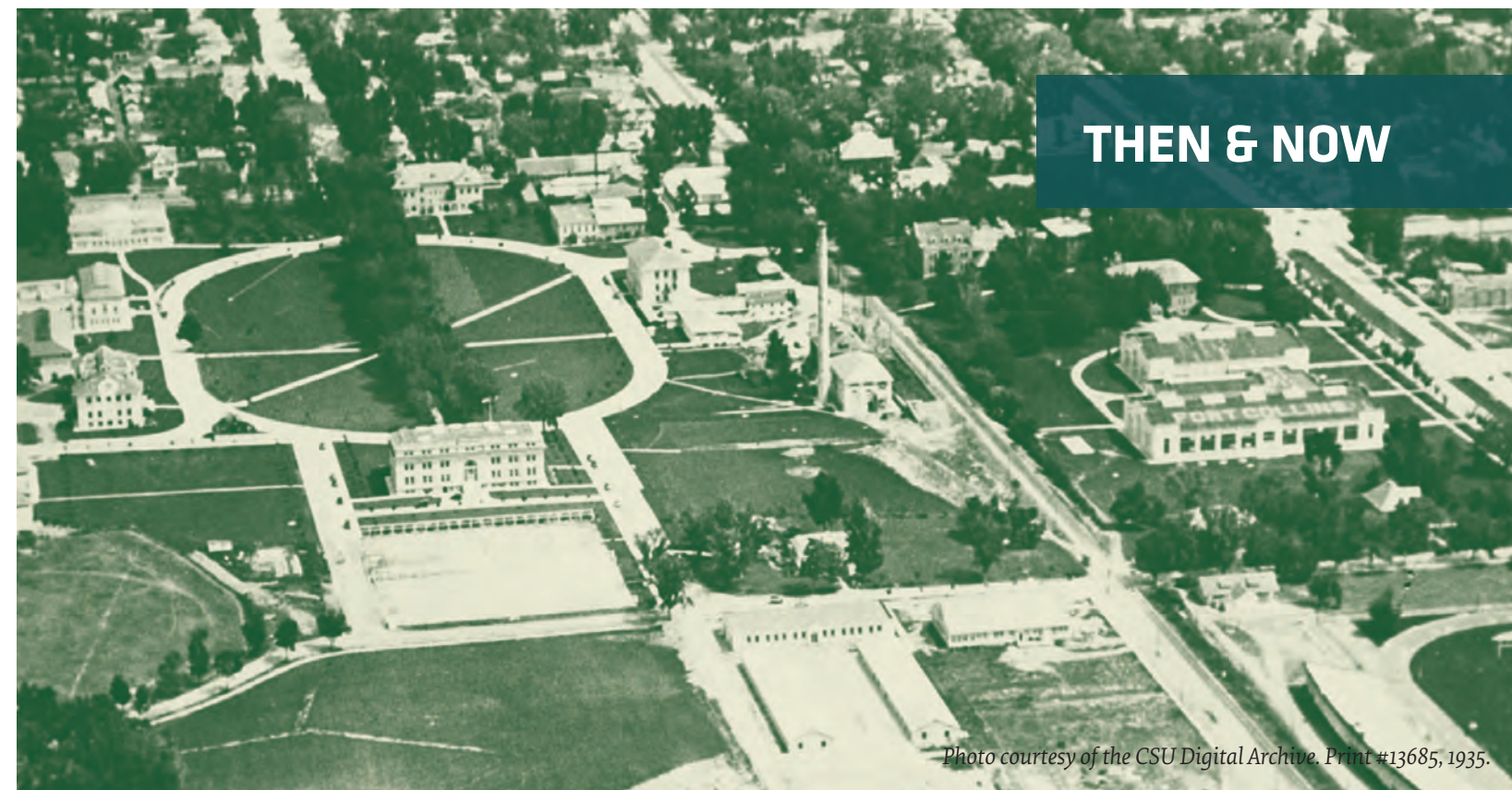


Photo courtesy of the CSU Digital Archive. Print #13685, 1935.

The CSU Water Center's roots grew out of a collaborative and interdisciplinary endeavor between the Vice President of Research and the Colleges of Engineering and Natural Resources in 1994. The Center brings together a rich history in water-related education and research with diverse talent from educators and researchers interested in water resources. During 2012, a faculty group was charged with developing a new vision for the Center with the aim to further engage the CSU community in water resources research, education, and outreach. The revitalized Center brings together a network of more than 200 faculty members from various departments across the CSU campus and seeks to:



Enhance connections in water across the university, specifically between all eight of CSU's Colleges and within our three land grant mission areas—research, education, and engagement.



Support CSU faculty, staff, students, and visiting scholars and the missions of their departments and colleges.



Increase capacity at CSU to serve local, regional and global communities to better manage, understand, and utilize water resources.



Engage and partner with CSU faculty and students through research and service projects, educational programs, and campus events.



Inform interested faculty, staff, students, and community members of water-related opportunities, events, jobs, internships, and research funding.



Serve as a tool for faculty to more effectively and efficiently apply their own research, education and outreach efforts.

In the fall of 2016, the Center's Executive Committee developed its first strategic plan that outlines the Center's goals, objectives, and key resource needs for the next three years. This strategic map is available online at watercenter.colostate.edu/map.

RESEARCH

The Center serves to support transformative water research through interdisciplinary collaboration and creative scholarship among CSU faculty and students. This is primarily accomplished through our annual call for proposals. In Fiscal Year 2016-17 (FY17), the Center selected five Water Research Teams, one Water Faculty Fellow, and one Symposium Planning Grant as recipients of competitive grants.

**FY17
\$140,160**

SUPPORTED

- 7 projects
- 25 faculty
- 14 students
- numerous external partners

RESEARCH IMPACTS AND OUTCOMES TO DATE

Since the Center's reset in 2013...

- 30 interdisciplinary and faculty fellow projects have been funded by the Center
- \$545,680 awarded by the Center to faculty for innovative water research and scholarship
- \$11,089,432 awarded in external funding to water research teams and fellows
- 20+ publications, articles, and websites produced
- 85+ oral and poster presentations made

Water Research Teams

Impacts of Oil & Gas Produced Water Discharges on Surface Water Quality: Jens Blotevogel, Thomas Borch, J. Lucas Argueso, Molly McLaughlin, Bonnie McDevitt, and Nathaniel Warner

Investigating Deficit Irrigation as a Climate-Smart Farming Option: Nora Flynn, Louise Comas, Salvador Lurbe, Dale Manning, and Steven Fonte

Evaluating the Energy Cost of Groundwater Production in the Denver Basin Aquifers: Michael Ronayne, Tom Sale, Jordan Suter, and Daniel Shugert

One Health Surveillance of Antimicrobial-Resistant Bacteria in Fort Collins, CO: Elizabeth Ryan, Jake Gilliland, Amethyst Holder, and Adriana Romero

Smoothed-Particle Hydrodynamics: A New Fluid Modeling Technique Applied to Analyze Fish Passage Opportunities in Whitewater Park Structures in Lyons, CO: Andrew Bankert, Peter Nelson, and Christopher Myrick

Water Faculty Fellow *Organic Carbon Storage Along River Corridors of the U.S. Prairies:* Ellen Wohl

Water Symposium *Subsurface Water Storage:* Tom Sale, Michael Ronayne, Ryan Bailey, Sally Sutton, and Helen Dungan.



Colorado Water

Read more about FY17 projects and explore the *Colorado Water* newsletter at watercenter.colostate.edu/grants!



RESEARCH



IMPACTS OF OIL & GAS PRODUCED WATER DISCHARGES ON SURFACE WATER QUALITY

The team's investigations show that chemicals related to oil/gas activities, such as petroleum hydrocarbons and naturally occurring radioactive materials, are present in a Wyoming watershed study site. While the environmental and health impacts of releases of such water are largely unknown, this study will help inform regulators and industry to safely manage produced water discharges for beneficial use.

INVESTIGATING DEFICIT IRRIGATION AS A CLIMATE-SMART FARMING OPTION

This team explored how agriculture significantly impacts climate variables and environmental health. Climate-smart agricultural management is critical for the future of food production and mitigating climate change. They found that deficit irrigation may be a promising management strategy for improving crop water use efficiency, mitigating greenhouse gases, and strengthening rural livelihoods.

Pictured: Nora Flynn, a CSU graduate student in the Department of Soil and Crop Sciences collects soil samples at the Limited Irrigation Research Farm. Photo courtesy of Lee Friesen.



EVALUATING THE ENERGY COST OF GROUNDWATER PRODUCTION IN THE DENVER BASIN AQUIFERS

This project investigated energy requirements for municipal groundwater pumping in the Denver Basin Aquifer System, an important water resource in Colorado feeding more than 800 active municipal wells. Decades of pumping has resulted in falling water levels and a coinciding increase in the amount of energy required to produce water. In response, the team quantified energy intensity and total estimated energy use across the region, and identified management strategies to reduce lifts and, in turn, decrease the amount of energy required for groundwater pumping.



ONE HEALTH SURVEILLANCE OF ANTIMICROBIAL-RESISTANT BACTERIA IN FORT COLLINS, CO

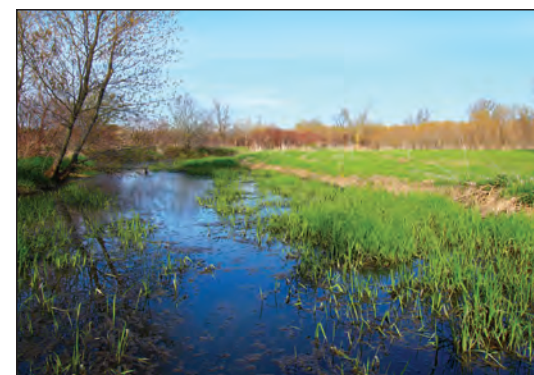
Antimicrobial resistant bacteria (ARB) is an emerging water, sanitation, and hygiene issue, worsened by a lack of reliable, well-documented, and validated human health risk assessments. This project addressed the increasing awareness of water's role in ARB spread and persistence. Through a collaboration with local government, the team developed an effective surveillance method for determining the relative abundance of antimicrobial resistant (AMR) microbes, and their findings from northern Colorado merit extension to additional locations to better understand the relationships to infections occurring in medical and health care settings.

Pictured: Masters students Adriana Romera (Public Health) and Amethyst Holder (Toxicology) collect community sewage samples for AMR isolations in the lab. Photo courtesy of Elizabeth Ryan.

SMOOTHED-PARTICLE HYDRODYNAMICS: A NEW FLUID MODELING TECHNIQUE APPLIED TO ANALYZE FISH PASSAGE OPPORTUNITIES IN WHITEWATER PARK STRUCTURES IN LYONS, CO

As whitewater parks with modified water structures gain in popularity with kayakers, modified flow patterns may be detrimental to the ability of fish to migrate up and down a river. Hydraulic modeling may be used to analyze such flows. This team showed how smoothed-particle hydrodynamics (SPH) may be a powerful new technique to simulate flows through whitewater parks. They developed a methodology that can be used to determine the impacts of future whitewater park structures on fish passage and found that current structures in Lyons, CO

allow larger fish to migrate through the channel but act as a barrier to smaller fish.



ORGANIC CARBON STORAGE ALONG RIVER CORRIDORS OF THE U.S. PRAIRIES

Human activities such as land cover changes, engineered flow regulation, and CO₂ emissions alter inputs, storage, transformations, and outputs of organic carbon (OC) within river corridors. Although these impacts are ubiquitous in temperate river networks, they have received little attention in the context of carbon dynamics. This team conducted field sampling along tall-and short-grass prairie rivers, (cont.)

RESEARCH

revealing high-concentration, buried pockets of stored OC that likely represent abandoned channels or wetlands. While many efforts to increase carbon storage focus on afforestation or forest preservation, this study confirms that greater attention should be paid to river corridors and floodplain wetlands for enhanced carbon sequestration.



SUBSURFACE WATER STORAGE SYMPOSIUM

A one-and-a-half-day symposium addressing subsurface water storage was held on the CSU campus in November 2016. The focus of the symposium was to share emerging knowledge, collaboratively debate critical issues, and prioritize future work to address key water management challenges. More than 75 researchers, practitioners, and water professionals attended the event sponsored by the CSU Water Center with support from the College of Engineering and Warner College of Natural Resources.

Pictured: Staff at the Calleguas Municipal Water District in southern California discuss the capacity of their aquifer storage and recovery well . Photo courtesy of R. David G. Pyne, P.E.

WATER EXPERTS

In addition to the Water Research Teams and Fellows who completed projects in FY17, **more than 200 faculty and research scientists from upwards of 50 CSU departments** apply their disciplines to water issues and problems. Topic areas include agriculture, sociology, history, policy, climate science, wildlife and fisheries, groundwater, water management and planning, water quality, and water and wastewater treatment. CSU's water experts are involved in cutting-edge research to address the local, regional, and global water challenges of today and the future. These experts are located on our main campus in Fort Collins, CO, and at satellite campuses across the globe. Moreover, many of our water experts teach formal and informal water courses on the main campus, online, and in the community. CSU water faculty and staff are proud to be the leaders for the next generation of water stewards!

Meet CSU's water experts at
cwi.colostate.edu/CSUWaterExperts!

INTERNATIONAL WATER WORKGROUP

In addition to sponsoring research, the Water Center also fosters faculty's work on international water-related research, teaching, and engagement activities. As part of this effort, the Center inventories faculty, staff, and alumni projects on international water; showcases the work of international water activities on the Water Center website and social media; and sponsors various campus meetings to nurture collaborations among faculty.

VISITING SCHOLARS



Visiting fellows are faculty scholars and staff researchers from universities worldwide

with expertise in broad areas of water. In FY17, the Center welcomed Farhet Shaheen from India. Dr. Shaheen is an agricultural economist from Kashmir, India, where he serves as faculty at Sher-e-Kashmir University of Agricultural Sciences and Technology and is a visiting scientist at the University of Connecticut. His research focuses on the Himalayas (*pictured above*) hydro-economic modeling for transboundary river basin management in the Indus basin. As a visiting scholar to CSU, Shaheen met with faculty from the Colleges of Engineering, Agricultural Sciences, and Liberal Arts. He hosted a special seminar, *High Altitude Water Conservation Technologies in Cold Arid Desert of Northwestern Himalaya in Wake of Climate Change*, in which he explored how restoring and developing the art of glacier grafting may be used to address water problems in the region.

Situated in the northern extremity of India, Ladakh occupies a unique niche: physiographically, climatically, and culturally. Lying north of the Himalayan watershed, Ladakh does not receive any summer monsoon, and the annual rainfall is less than 70 mm, making it one of the world's highest cold deserts. Despite hostile conditions, the region has been inhabited for centuries, and its people have learned to survive by establishing a synergistic relationship with their environment. Glaciers and snowmelt play a very important role in the sustenance of life as they are the only source of water, be it for irrigating the fields or for any other domestic purpose. Yet in the face of climate change, most glaciers have been retreating at a rate that ranges from a few meters to several tens of meters per year. To help the region adapt and mitigate this challenge, Shaheen and others are experimenting with new water management techniques based on traditional knowledge blended with modern science to sustain livelihoods in harsh environs.

EDUCATION

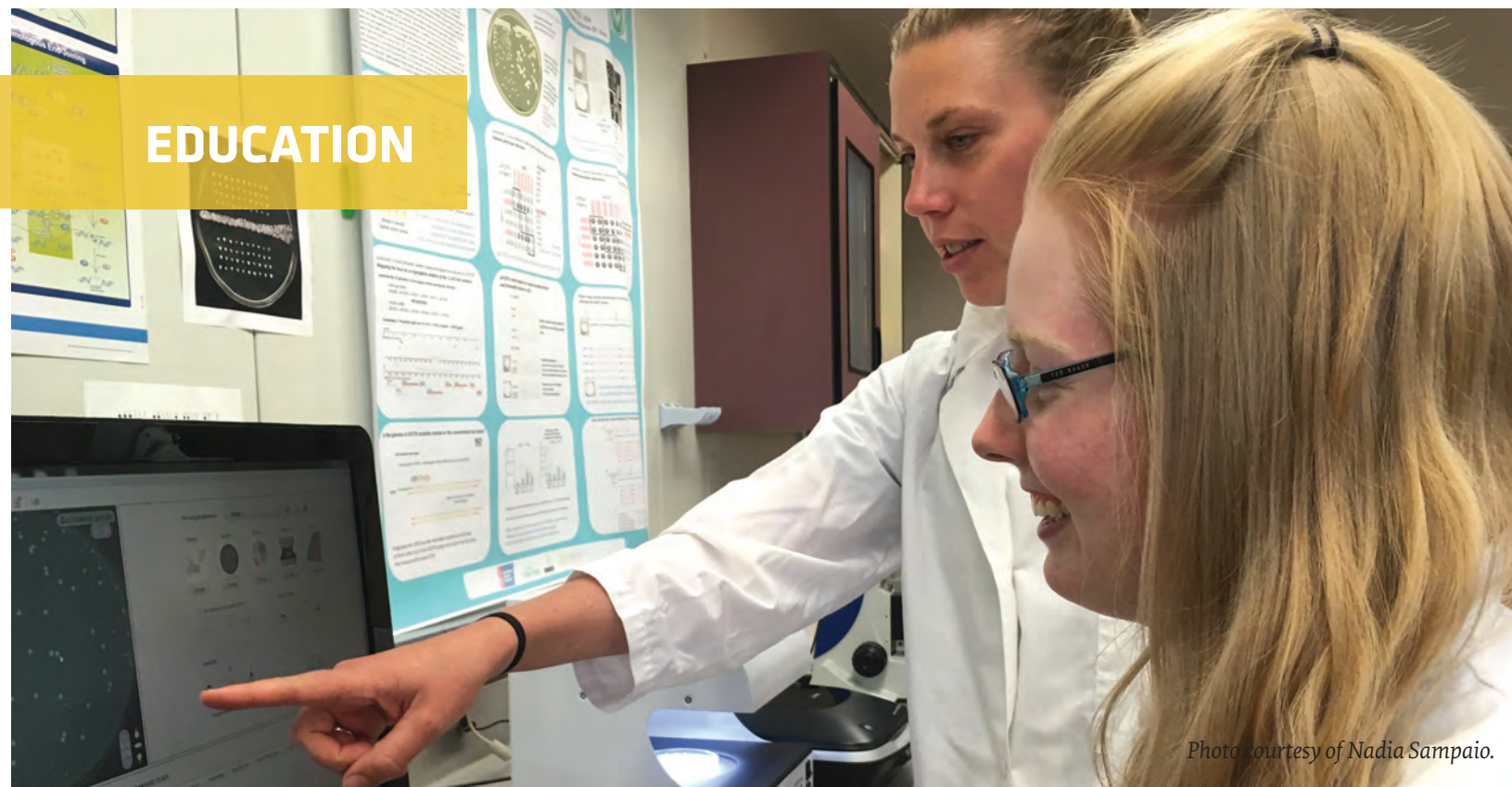


Photo courtesy of Nadia Sampaio.



CSU faculty teach more than 130 water related courses at the undergraduate and graduate levels. New courses related to water are being developed as water issues and priorities evolve.

Offered in partnership with the School of Global Environmental Sustainability (SoGES) and administered through the Water Center, the **Sustainable Water Interdisciplinary Minor (SWIM)** offers undergraduate student in any major an opportunity to gain a deeper knowledge of the many dimensions of water management. By taking advantage of the outstanding water expertise available at CSU, students can better prepare themselves for careers in water management or graduate study in a water-related area. SWIM students complete 21 credits in core and elective courses, including economics, water law and policy, sustainability, natural and social sciences, natural resources, agriculture, and engineering.

GRAD 592, Interdisciplinary Water Resources Seminar is a one-credit graduate level seminar is offered each fall semester. Seminars focus on different water-related themes and feature guest lectures by prominent Colorado water professionals. The theme for Fall 2016 was **Topics in Western Water Law**. Over the course of the semester, students explored the history and evolution of state, regional, and federal water laws and water-related court cases, and interacted with prominent water professionals to better prepare for water-related careers. CSU students from varying majors are enrolled in the course, and many others from the campus community attend and participate in the weekly discussions.

This year, CSU's Osher Institute offered a course on **How Agriculture, Urban and Environmental Stakeholders Collaboratively Address using the Poudre River**, exploring how different water users are collaboratively working together to make the Poudre River the world's best example of a healthy working river. Members of the Poudre Runs Through It Study/Action Work Group lead a six-part series covering perspectives from agricultural, urban, environmental/ecological, business, and recreational water sectors; how water users are working together; and how the issues on the Poudre River relate to what's going on regionally and nationally. The course also included discussions about the role of values, interests, and trade-offs in addressing water issues.

6 students from 4 different majors were enrolled in SWIM in FY17

33 students enrolled in GRAD592 Topics in Western Water Law

Osher welcomed **15** participants, including water professionals, educators, and community members



“Having this specialization in water better prepares me for the work I hope to do after graduation.”

– Christina Neel, SWIM student and Spring 2016 graduate in in Ecosystem Science and Sustainability



“I enjoyed the course on water law and policy. It was a great overview of a complicated and misunderstood system.”

– Thomas Shields, SWIM student and Spring 2016 graduate in Natural Resource Management and Environmental and Natural Resource Economics



Pictured: SWIM students graduate in Spring 2017 (from left), Julie Kallenberger, Water Center Education and Outreach Specialist; Students Ry Weber, Katrina Puck, and Morgan Salter; and Reagan Waskom, Water Center Executive Committee Chair. Photo courtesy of Kristin Pintauro.



ENGAGEMENT & SERVICE



Photo courtesy of Beth Plombon.

The Water Center serves and engages CSU students and various local, regional, national and international stakeholders on water resources issues. Activities include:

- Dissemination** of water-related opportunities, including events, jobs, internships, scholarships, and funding
- Partnerships** to translate research into practice and **interaction** with governmental bodies to inform water policy
- Promotion** of knowledge about water resources and issues in K-12 schools and educational organizations



In FY17, the Center brought together the CSU campus and local communities by hosting more than two dozen seminars, conferences, and activities on important and relevant topics. It also served as a sponsor and provided funding for CSU students to attend select events such as the Poudre River Forum and CSU Hydrology Days. Each year, the Center also hosts the Dr. Norm Evans Lecture series in partnership with the Colorado Water Institute. In celebration of World Water Day on March 22, the series featured Eleanor Allen, the CEO of Water For People (pictu. Allen spoke about water availability and infrastructure in areas such as Latin America and India. The Center also hosted two film screenings—*Thirsty Land* about water availability in the America West and *UpRiver*, a documentary by CSU alum Jeremy Monroe about the current efforts to restore the Willamette River. Both screenings were attended by numerous students, faculty, and community members.

Stay up-to-date with Water Center events at cwi.colostate.edu/calendar.asp!

COLLABORATION



Photo courtesy of Julie Kallenberger.

The Water Center collaborates with both on- and off-campus centers, institutes, and organizations, as well as industry and other private sector interests, for the purposes of academic scholarship, outreach, and educational activities that pertain to local, regional, and global water resources.



STAFF



Julie Kallenberger
Water Education and
Outreach Specialist

Water Center staff include one full-time coordinator and a number of undergraduate and graduate student interns who study fields such as engineering, agriculture, social sciences, and natural resources. The staff coordinates all of the Center's research, education, outreach, and service activities and provides support to CSU faculty and students involved in water.



Emilie Abbott
Student Intern
Civil and Environmental
Engineering



Sarah Ehrlich
Student Intern
Journalism and Media
Communications



Beth Plombon
Student Intern
Sociology

Follow us
@CSUWaterCenter

We ensure the Water Center connects CSU with its surrounding communities.



352 followers



141 followers



69 followers

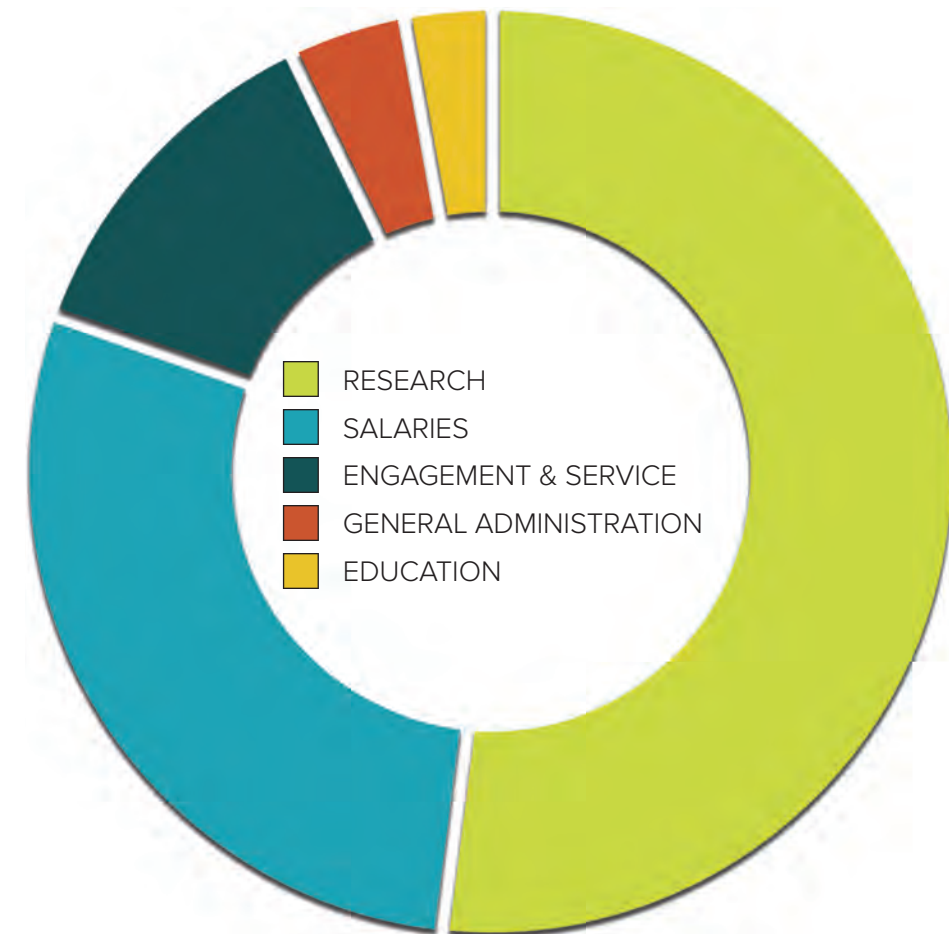


113 views of *Is the Poudre River Ecologically Sustainable? What Does the Science Say?*

790 subscribers reached each month through the Center's e-newsletter, *The Current*
[Subscribe at watercenter.colostate.edu/current.shtml](http://watercenter.colostate.edu/current.shtml)

1,800+ subscribers reached bi-monthly through the Center's newsletter, *Colorado Water*
[Subscribe at watercenter.colostate.edu/colorado_water.shtml](http://watercenter.colostate.edu/colorado_water.shtml)

FINANCIAL SUMMARY: FY17



RESEARCH	\$115,600.93
Faculty research teams	\$105,630.93
Faculty fellows	\$9,970.00
EDUCATION	\$6,282.65
Sustainable Water Interdisciplinary Minor (SWIM), GRAD592, Youth Water	\$316.65
The Current e-news	\$966.00
Colorado Water newsletter	\$5,000.00
ENGAGEMENT & SERVICE	\$27,921.79
Conferences, seminars, and workshops	\$23,655.33
Student Clubs	\$876.46
Student Event Registration	\$3,390.00
SALARIES	\$62,892.45
Coordinator	\$43,067.50
Student Interns	\$19,824.95
GENERAL ADMINISTRATION	\$9,559.57
Materials and supplies	\$5,311.58
Operating expenses (phones, mail, hardware, software)	\$4,247.99
TOTAL	\$222,257.39





WATER CENTER

COLORADO STATE UNIVERSITY

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