



COLORADO WATER

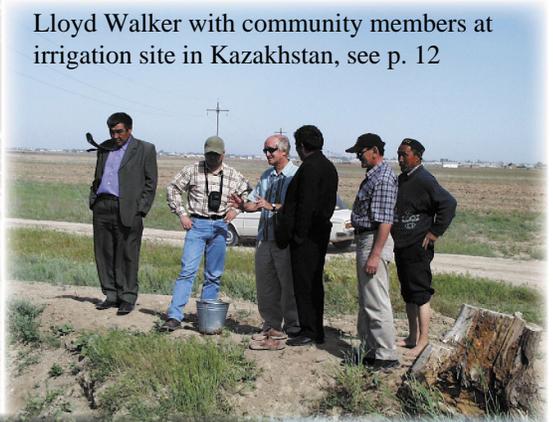
Newsletter of the Water Center of Colorado State University

October 2004

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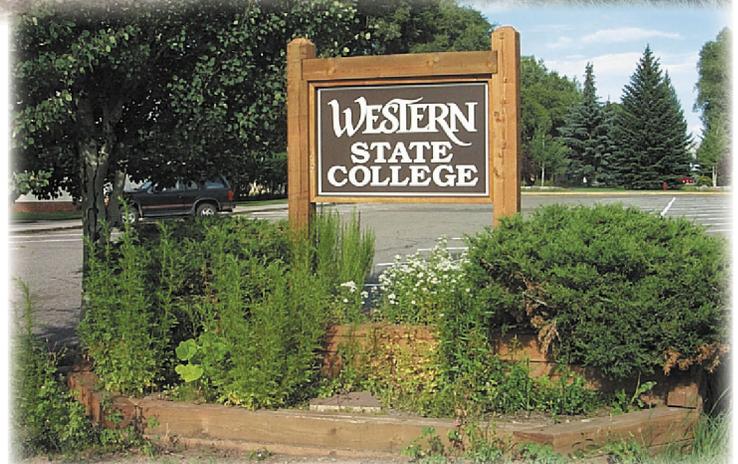


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on International Water Connections

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Colorado Water Resources Research Institute
Colorado State University Agricultural Experiment Station
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**Colorado
State
University**
Knowledge to Go Places

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EDITORIAL**International Water Connections**

*By Robert C. Ward, Director
CWRRI*

Colorado has a long history of international water connections. When Europeans first settled in semi-arid Colorado, they realized the need to manage water differently than in the Eastern U.S. There were a number of efforts of societies around the world to manage water in semi-arid and arid climates, e.g. Spain, north Africa, and Mexico.

A number of the early water attorneys and faculty members, associated with higher education in Colorado, were widely read in the ways water was being managed around the world. In fact, Luis Carpenter, who took over the fledgling irrigation engineering program at CSU from Elwood Mead in 1888, noted the lack of irrigation texts in English as limiting the ability of the U.S. to develop courses in irrigation engineering. He obtained texts from other parts of the world and, in fact, visited such places as Spain and northern Italy to learn about the practice of irrigation in countries where it had been practiced for millennia. Thus, in the early days of Colorado's agricultural development, water management knowledge from other countries was valuable in developing Colorado's water expertise.

Colorado, using its own water management needs and experiences and combining them with lessons learned in other lands, further refined its approach to the use of water science and technology and developed a water management system that, today, is admired around the world.

Many foreign visitors tour the Colorado-Big Thompson Project and admire the way Colorado permits water to be moved to meet the changing needs of society. In some

countries, lack of water rights and supporting institutions prohibits investment in water development. In other countries, too rigid a system of water rights prevents society from adapting its use of water to new societal needs. The way Colorado manages its water resources is often viewed as providing the proper balance between rigidity and flexibility that captures the best of both sides of the water management spectrum.

In fact, when improving water management was viewed as a key element of the U.S. foreign policy after WWII, CSU, under the leadership of Maury Albertson, assumed a major leadership role in helping foreign countries establish modern water management technology and institutional arrangements. This leadership resulted in major water management projects in a number of countries around the world, such as Pakistan, India, Egypt and Ethiopia. It was not only higher education that interfaced water management in Colorado with water management around the world. Larry Simpson, former Manager of the Northern Colorado Water Conservancy District, after leaving the Northern District, went to work for the World Bank assisting with introducing new water management considerations into Brazil's water law. Larry worked closely with several former CSU students during his time at the World Bank.

Colorado's water management system, including its higher education component, continues to engage in an active relationship with water management colleagues around the world. The purpose of this *Colorado Water* issue is to highlight a few of the international connections Colorado's water management system has with foreign colleagues.

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International Connections Indicate Diversity of CSM Water Faculty Expertise

*By Dr. Robert L. Siegrist, Professor and Director
Environmental Science and Engineering, Colorado School of Mines*

The Colorado School of Mines (CSM) has diverse and far-reaching international activities encompassing water resources management, water supply engineering, and wastewater reclamation and reuse. Activities in the departments of Environmental Science and Engineering (ESE), Engineering (EG), Geology and Geological Engineering (GEGN), Geophysical Engineering (GP), and Liberal Arts and International Studies (LAIS) span the globe and even reach into space.

International activities involve focused research collaborations between CSM faculty/staff with their counterparts around the world, CSM center activities, CSM faculty working with international students, and CSM senior design projects. A glimpse of the international water connections at CSM is illustrated through a few highlights as provided below.

In the area of water supply and wastewater reclamation, many CSM faculty/staff are working with researchers in several countries.

- Dr. Jorg Drewes (ESE) has working relationships concerning water reuse with: the Water Competence Center, Berlin, Germany; the University of Technology Dresden, Institute of Water Chemistry; the University of Poitiers, Environmental Engineering Department, France; the University of Hokkaido, Civil and Env. Eng. Depart.; and the Gwangju Institute of Science and Technology, Env. Science & Engineering Dept.
- Since 1988, Dr. Robert Siegrist has been working closely with Dr. Petter Jenssen and others at the Agricultural University of Norway on research related to ecological engineering and appropriate technologies for wastewater reclamation and beneficial reuse.
- Dr. John McCray (ESE) is working with Dr. Ron Chaoka at the University of Botswana in Africa on research related to water resources and quality management.
- Dr. Phil Ross (ESE) has been working on a research collaboration for the past 11 years with

A. Soares and A. Nogueira and the Ecotoxicology Group at the Department of Biology, University of Aveiro (UA), Portugal. This research is concerned with the elucidation of factors affecting the bio-availability of toxic heavy metals in terrestrial and aquatic environments.

- Dr. Hussein Amery (LAIS) has been researching transboundary water issues in the Middle East for the last 12 years. He recently started working on cultural and water management (focusing on the Islamic perspective), and spent a sabbatical year (2003-04) researching desalination issues in the Arabian Peninsula.

In the area of remediation of contaminated land and water, CSM faculty and staff have international connections.

- During the 1990's, Dr. Robert Siegrist (ESE) was a Fellow with the NATO Committee for Challenges to Modern Society and an active participant in their study on evaluation of demonstrated and emerging technologies for cleanup of contaminated land and groundwater.
- In 1997, CSM hosted an international environmental meeting for NATO during which more than 75 participants from over 20 countries were on Campus discussing remediation science and technology and exchanging lessons learned and developing best practices.
- Dr. John McCray (ESE) is collaborating with Dr. Marcos Adrian Ortega at the National University of Mexico on research related to remediation of organic solvents and fuels in ground water.
- Dr. Eileen Poeter (GEGN) is currently working on Jupiter (Joint Universal Parameter Identification and Evaluation of Reliability), a joint project between IGWMC/CSM, EPA, USGS, and the University of Queensland Australia, to facilitate advances in: sensitivity analysis, data needs assessment, calibration, and uncertainty evaluation. Dr. Poeter has also collaborated with the Amsterdam Water Supply in The Netherlands and Pusan Na-

tional University in Korea on water resources and modeling projects.

- Dr. Ron Cohen (ESE) was selected to complete environmental audits of three gold mines in Mali, West Africa. Dr. Cohen was tasked with examining potential water contamination from the open cast mine, mine pit waters, waste rock piles and tailings repositories. From 1999 to present, Dr. Cohen has been traveling to South Africa for part of every summer to work collaboratively with colleagues in the mining industry and universities on treatment of water related mining wastes.

A number of centers at CSM have been involved internationally in water research and educational activities. A prime example is the International Ground Water Modeling Center (IGWMC), directed by Dr. Eileen Poeter (GEGN) which was created in 1978 as a focal point for ground water professionals to support and advance the appropriate use of quality-assured models in ground water resources protection and management (see <http://www.mines.edu/igwmc/>). The IGWMC is internationally oriented and provides advice on ground water modeling problems, distributes ground-water modeling software, manages short courses and workshops, conducts research in practical, applied areas of ground water hydrology and modeling, and provides technical assistance on problems related to ground water modeling. In September 2004, a conference in the Czech Republic, FEM_MODFLOW, was jointly convened by the IGWMC and Charles University (Universita Karlova), Prague, Czech Republic, International Commission on Groundwater (ICGW), the International Association of Hydrological Sciences (IAHS), and the U.S.G.S. The IGWMC also co-sponsors conferences every 2-3 years with the IGWMC, the U.S.G.S., and the United Kingdom Environment Agency, National Groundwater and Contaminated Land Centre.

Another CSM center with strong international connections is the Center for Experimental Study of Subsurface Environmental Processes (CESEP). CESEP was established at CSM five years ago to enhance environmental quality through experimental investigation of subsurface environmental processes and remediation techniques leading to improved and cost effective cleanup methods and decision-support tools (see <http://cesep.mines.edu/>). CESEP has state-of-the-art experimental and modeling facilities and carries out collaborative research with several affiliates around the world, including: the Asian Institute of Technology, Thailand; Cambridge University, United Kingdom; Czech Technical University, Czech Republic; Utrecht University Department of Earth Sciences, The Netherlands; Okayama University, Japan; Seoul National University,

South Korea; Technical University of Catalonia, Barcelona, Spain; University of Copenhagen, Denmark; and University of New South Wales, Australia.

CSM faculty routinely work on educational initiatives with faculty, students, and organizations around the world. Water-related projects are often carried out by exchange students attending CSM or those who are studying abroad, including those from France, Germany, Austria, Spain, Italy, Czech Republic, Denmark, Sweden, Norway, India, Nepal, and Korea. During 2003-2004, Dr. Ron Cohen (ESE) worked on a USAID project to develop curriculum and courses on water and wastewater treatment in collaboration with the Institute of Engineering, Tribhuvan University, Nepal. Similarly, Dr. Cohen delivered lectures and worked in India with the Ministry of Environment and Forests, Government of India, and the Indian School of Mines, Dhanbad, India. The efforts focused on environmental management capacity building, particularly in regard to mining related water pollution.

Through CSM's senior design curriculum and with funding provided by a grant from the Hewlett Foundation, international water projects have been completed by CSM students working in several countries around the world. During fall 2004, CSM students are involved in a drip irrigation project in Senegal. According to Cathy Skokan (EG), "They (students) will be putting in a well, checking for salt water intrusions in the well, and then putting in an irrigation system." Another project involves water purification, sewage treatment, and electrical power development in a small village "in desperate need" called Colonia Suiza, near Villanueva, Honduras. This project is in collaboration with a group of civil engineering students from UNITEC, a small private engineering school in Tegucigalpa, Honduras. Previously, a senior design team was involved in San Pablo, Belize where they designed a solar-powered water pumping and water distribution system. The team of CSM students designed a low cost (less than \$15 U.S.) foot pump design which can be easily manufactured by local villagers using local materials, easy to reproduce and run, and durable. In another project, CSM students were responsible for design of a water purification system for Yarmasing, Nepal.

The collective activities at CSM support water resource management and water quality protection in Colorado by providing enhanced knowledge as well as mathematical models and decision-support tools. These products have and will continue to help ensure cost-effective watershed management at the local, State level, and national level. Internationally, the work at CSM helps provide appropriate technology for water and sanitation, the provision of which are critical to mitigating poverty and facilitating environmental security, particularly in areas with trans-border resource and public health impacts.



CSU ISWR Fosters International Efforts

By Dr. Darrell Fontane, Director
and Marilee Rowe, Coordinator

International School for Water Resources, Colorado State University

The International School for Water Resources (ISWR) and the Colorado Institute for Irrigation Management (CIIM) are programs within the Department of Civil Engineering, College of Engineering, Colorado State University (CSU).

Established in 1967, ISWR provides advanced training for engineers and managers concerned with water resources engineering and technical management alternatives. Since 1967, the ISWR has provided training at Colorado State University for over 450 participants from more than 65 countries. Typical ISWR participants are water agency managers, academic faculty, engineers, and technical support staff who already hold a college degree or title, but want advanced training in a water-related field without having to complete requirements for a formal degree.

The ISWR provides a flexible structure for non-degree training. Customized training programs are developed for each participant and range from a few weeks to two years and include regular graduate courses at CSU, formal short courses such as those organized by CIIM, or specialized short courses with CSU faculty or local water resource experts like the professionals at the U.S. Bureau of Reclamation. Field trips, study tours, and partnership training with other universities, government agencies, and private industry are all possible components of an individual program. The ISWR can also plan, organize, and conduct training programs at other locations within the U.S. and abroad.

The variety of opportunities for interaction are represented in the ISWR activities which follow.

Symposium in Korea

Seven faculty members from Colorado State University's Department of Civil Engineering participated in a symposium May 25-28, 2003, at Seoul National University. This symposium focused on recent water, wind and environmental civil engineering research issues concerning both Korea and the United States with a goal of pursuing additional collaborative opportunities between CSU faculty members and Korean alumni. CSU Civil Engineering faculty Darrell Fontane, Bogusz Bienkiewicz, Neil Grigg, Pierre Julien, John Labadie, Jorge Ramirez and Jose Salas attended the symposium.

This was the second such symposium, and included sessions in water resources engineering, hydrology, hydroau-

tics and environmental engineering, and hydro technology and wind engineering. In addition, attendees participated in a full-day field trip that included an overview of the Lower Han River and visits to the Unification Observatory and the Tidal Barrier and Ecological Wetland Park in the Sihwa Reclamation Project.

Hosted by the Colorado State Korean alumni, the symposium was sponsored by Myungji University, Korea Water Resources Corporation, Chungbuk National University, KwangJu Institute of Science and Technology Advanced Environmental Monitoring Research Center, and the Korea Institute of Construction Technology.

The first symposium was inspired by Dr. Hyoseop Woo, Vice President of the Korea Institute of Construction Technology, and Dr. Darrell Fontane, Colorado State civil engineering professor, and was held at Colorado State University in August of 2002.

"Our Korean alumni hold prestigious positions in the water sector of Korea. They are the leaders of the water resource agencies and of universities in Korea. The United States and Korea have common water resource and wind engineering problems. We look forward to working collaboratively to



Front row (left to right): Dooho Park (Ph.D. 2002, Agricultural Economics), Hung Soo Kim (Ph.D. 1997, Civil Engineering), Young Jun Kim (Ph.D. 1989, Economics), Seok-Ku Ko (M.S. 1985, Ph.D. 1989, Civil Engineering), Darrell Fontane, Jung Ho Sonu (Ph.D. 1973, Civil Engineering), John Labadie, José Salas, Neil Grigg, Ick Hwan Ko (Ph.D. 1997, Civil Engineering). Back row: Jerry Stedinger (friend of the department), Kyu-cheoul Shim (Ph.D. 1999, Civil Engineering), Dong Ryul Lee (friend of the department), Chang Wan Kim (friend of the department), Hyoseop Woo (Ph.D., 1985 Civil Engineering), Pierre Julien, Bogusz Bienkiewicz, Jorge Ramirez, Gye Woon Choi (Ph.D. 1991, Civil Engineering), Chea-Won Kim (friend of the department), Boosik Kang (Ph.D. candidate, Civil Engineering), Jun-Haeng Heo (Ph.D. 1990, Civil Engineering), Sungsu Lee (Ph.D. 1997, Civil Engineering), Jaeeung Yi (M.S. 1987, Ph.D. 1996, Civil Engineering) and Sung-Je Park (Ph.D. candidate, Civil Engineering).

solve these problems for the mutual benefit of both Korea and the USA,” Fontane said.

Pilot internet course

Instructors from CSU, universities in Portugal and Brazil, and World Bank staff members have interacted with 29 participants in a Pilot Internet Course on Water Resources Allocation organized by the World Bank and the Bank-Netherlands Water Partnership Program (BNWPP). This course is part of an effort from the World Bank and the BNWPP to share experiences and develop knowledge in water rights administration, which is a key element to sustainable development and rational use of water resources. The course is tailored for those involved in WB-financed projects, with the objective of providing an introduction to water resources allocation and management and introducing tools that can make their work more effective.

The course consists of four modules. The first one is an introduction to Water Resources Management (WRM), the second is an overview to Water Rights Administration (WRA) and the other two will focus on two important elements of water management: Water Pricing and Water Markets (WP&WM) and Water Management Models (WMM). Conceptual and practical aspects will be presented in each module, discussing contexts, frameworks, and approaches that have been followed in different countries. The WMM module will also include a practicing section on modeling, when ACQUANET and MODSIM models will be introduced.

In this pilot, participants will contribute to the development of the course. Participant feedback will be analyzed to develop recommendations for improvements to the course and potential transition into a regular training activity. The pilot course was offered in the summer of 2003, and resources developed for the World Bank course could provide the basis for similar courses accessible to water managers all over the world, including those in Colorado.

Integrated river-reservoirs systems

Four CSU ISWR and Civil Engineering faculty members – Dr. Darrell Fontane, Dr. John Labadie, and Mr. Marc Baldo – are engaged in a project to provide technical assistance to the Korea Water Resources Corporation with respect to KOWACO’s study for the Geum River Basin. Dr. Fontane and Dr. Labadie are co-project managers.

The goals of the project are to

Develop normal and emergency operating rules for the Geum river basin

- Develop an interactive evaluation and display model of system performance based on MODSIM
- Customize the model to Korean language and local conditions

As a result of the joint research project with KOWACO, a new capability has been developed for the MODSIM model which allows the model to route flows for multiple time steps within the system. The advantage of this new feature is that reservoir releases can be timed to more exactly meet downstream demands. Since the MODSIM model is used by various water management organizations in Colorado, this project provides local organizations with a better management tool.

Drought impacts management in developing countries

Zan N’Tio Traore’s work illustrates a variety of concepts –both similar and different – used in managing drought impacts in developing and developed countries. Droughts occur in many regions of the world with varying frequency and severity. To deal not only with the immediate effects, but also with the long-term and persistent impacts, researchers are working to define and implement new strategies for drought impacts management that are proactive and comprehensive. Zan proposes a multi-criteria decision analysis (MCDA) based methodology specifically oriented towards management of drought impacts in developing countries.

The methodology will take into account

- Prevailing status of water resources
- Demands and different players in the decision making process
- Conflicting management objectives such as immediate drought impacts management and strategic objectives of water resource management
- Various management options and their timing and sequence
- Different phases of a developing drought and other climatic and environmental changes

In a state with recurring drought conditions, the methodology may provide insight into possible actions for counties with less population and therefore fewer resources.

Fontane Named Outstanding Faculty

Professor Darrell Fontaine, associate department head in the Department of Civil Engineering and director of the International School for Water Resources, received the 2004 George T. Abell Outstanding Faculty Teaching and Service Award from the College of Engineering. As director of the International School of Water Resources, Fontaine is responsible for organizing and administering special, non-degree training for international engineers in various aspects of water resources engineering and has conducted water resources training in eight countries. His research interests include water resources decision support systems, water resources simulations and optimization models and internet-based education.



Global Water Management: CSU's Contribution

*By Dr. Neil S. Grigg, Professor
Civil Engineering, Colorado State University*

During its colorful history, Colorado State University (CSU) has had important impacts in water management in the state and around the world. For CSU, advancing water knowledge has been a central theme during its 125-year history and the university has had visionary leadership for international programs.

How did Colorado State come to be involved with water? The best answer probably lies in the needs when settlers began arriving in Colorado in the 1850s and needed practical knowledge about water for western conditions.

Colorado State faculty and students were in lead positions from the beginning of the water development era. Colorado State's work in water began soon after the university's founding in the 1870s. In the 1880s Elwood Mead proposed a course in irrigation engineering, which was the first course in water resources at Colorado State and maybe the first in the nation (Hansen, 1977). Later, Mead, taught courses about water flow in canals, reservoirs and closed conduits. In 1888, he became Wyoming's first state engineer and wrote the first irrigation code for arid and semi-arid regions.

During 1898-1905, investigations by Colorado State students began for the water development project now known as the Colorado-Big Thompson Project.

Ralph Parshall was one of Colorado State's first students in the department of civil and irrigation engineering. He and his colleagues drew recognition to Colorado State's contributions to irrigation technology and hydraulics laboratory work. In 1925 Parshall patented the Parshall Flume, which is used throughout the world.

Colorado State's Hydraulics Laboratory has been a centerpiece of the water programs. Ralph Parshall and colleagues designed the first lab, which was completed in 1913. It led to many productive research projects by the university and government agencies located nearby. The Bureau of Reclamation used the lab to study plans for the Hoover, Grand Coulee and Imperial Dams.

Graduates from Colorado State achieved distinction in the water industry. Many were leaders in the Bureau of Reclamation, and they participated in the federal government's most important water projects.

After World War II, the stage was set for growth in Colorado State's water programs. Maurice L. Albertson arrived in 1947 to become a key player in program development, and was a leader in promotion of international projects.

President Morgan presided over the period when Colorado State's water programs experienced their rapid post-war growth and were expanded globally. He served as Chair of the Water Committee of the National Association of State Universities and Land Grant Colleges at the time of the passage of the Water Resources Research Act.

Colorado State faculty were leaders in international water forums and projects. For example, Vujica Yevjevich joined Colorado State in 1957 after a research career in his native country of Yugoslavia. He established a famous program in hydrology and stochastic hydrology, and advised a number of graduate students who went on to distinguished careers in the U.S. and other countries. In 2002, one of his students, Ignacio Rodriguez-Iturbe, won the Stockholm Water Prize. In that same year, another student, Francisco Gomide, was named Brazil's Minister of Mines and Energy. Another Yevjevich student from Brazil, Jerson Kelman, had earlier been named Director of Brazil's national water agency.



Ralph Parshall and his flume

Colorado State's international water programs began in the mid-1950s, when the university helped develop graduate-level water programs at the University of Peshawar in Pakistan, where the university's influence is still felt more than 30 years later, especially for irrigation systems and on-farm water management. Similar projects were conducted in Afghanistan. In 1959, Colorado State helped establish the Southeast Asia Treaty Organization graduate school in Thailand. The school is now known as the Asian Institute of Technology. In the early 1960's Colorado State researchers, under Maurice Albertson's leadership, had an active part in creating the Peace Corps (Albertson, 1997).

Colorado State has been active in international training and in 1967 established the International School for Water Resources. In the 1970s, Victor Koelzer retired from his post as Chief Engineer of the National Water Commission and assumed the directorship. Koelzer introduced a course on water resources planning, modeled after his experience with U.S. Bureau of Reclamation and Harza Engineering Company. Later, Warren A. Hall, a pioneer in water resources systems engineering and former Director of the Office of Water Resources Research, joined the faculty and took over the school. In its first 25 years, the ISWR organized training programs for over 350 professionals from 57 nations.

Colorado State faculty led several irrigation management projects in Egypt's Nile Valley. Everett Richardson and Dan Sunada directed key projects in the series. A \$25 million contract awarded by the Egyptian government was the culmination of over two decades of work. About 40 Colorado State faculty members provided technical assistance to the project. About 55 Egyptian students enrolled in graduate programs in the United States; 30 at Colorado State University.

Colorado State was especially active in Pakistan irrigation research, and operated a number of projects for the Agency for International Development. One of these, the Water Management Synthesis Project, was directed by Wayne Clyma and produced many reports about irrigation technology and management.

After about 1990, U.S. foreign policy shifted away from direct support for water projects. Still, Colorado State faculty remained active in programs in other countries. Today, the university has cooperative water projects and ventures in several countries. For example, the current president of the Korea Water Resources Company is a Colorado State graduate and has organized several cooperative programs. The director of the International Water Management Institute in Sri Lanka is a graduate, and he directs investigations around the world. Colorado State also has graduates in high positions in the water ministries of Indonesia.

In 2004, Colorado State was selected to give advice on developing a new water law in Colombia. The goal of this project is to study needs for Integrated Water Resources Management and to adapt the law to accommodate them. As with other projects, interdisciplinary inputs are required.

Located at the top of South America and just adjacent to Panama, Colombia is about the size of Texas, New Mexico, and Oklahoma combined. The 2004 population is 42 million, about 70% urban. Colombia has rich natural resources, including water.

Unfortunately, it has a long history of armed conflict. In spite of its challenges, Colombia has made surprising advances in delivery of public services and in development of its water laws.

During 2004, a team from Colorado State University worked with staff and consultants of Colombia's Ministry of Environment, Housing, and Territorial Development toward a new draft water law to be introduced in Congress in October of that year. As it recovers from its legacy of conflict and violence, Colombia has many lessons to offer to its neighboring countries in Latin America, to other developing countries, and to North Americans. As with other international projects, Colorado State's Colombia project should open the door for regional cooperation and education so that countries can learn from each other.

Now that the era of large international projects seems over, Colorado State's activity is focused on smaller scale and individual projects. Some faculty members have very extensive activity. For example, Evan Vlachos, a Professor of Sociology and Civil Engineering, is active in European and Mediterranean water affairs. Darrell Fontane, of the Department of Civil Engineering, organized a cooperative program with Brazil. Grant Lee, a Professor of Philosophy, took the lead to coordinate exchange programs with Korea.

In addition to direct water programs, Colorado State has extensive coursework and student programs for international development. The Office of International Programs coordinates certificate programs at the undergraduate and graduate levels to enable students to gain a better understanding of the world of international development.

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Global Issues in Water Resources Development and Management

By Dr. Ranchand Oad, Professor
Civil Engineering, Colorado State University

Colorado State University (CSU) is one of the world's leading universities for training, research, development and institutional support in water resources and irrigation. As early as 1889, the Governing Board of the Agricultural College had established "Irrigation Engineering" as one of only three elective courses of study available at the time. CSU faculty continues to work in several developing countries on issues related to sustainable development and management of water resources. This is beneficial both for the developing country institutions and for Colorado, since the CSU faculty enrich their expertise and experience by working in diverse physical and socio-economic settings.

Challenges for irrigated agriculture

There is an ever increasing competition for the use of limited water resources; the most recent addition to demand being the environmental concerns for preserving healthy river habitats for fish and wildlife. Since irrigated agriculture is by far the largest water user and since it is perceived to be comparatively inefficient user, it is frequently asked to decrease its water consumption. Another factor that is working against irrigated agriculture sector is that its relative importance in the national economies has declined. For example, in Egypt, irrigation uses more than 85 percent of the available water resources. In 1980, the sector accounted for 40 percent of GDP, whereas in year 2002, the contribution declined to 16 percent. These concerns are resulting in calls for policy reforms and governance related to water rights and its efficient use. Irrigated agriculture will face serious challenges in the future, since it will be expected to:

- Increase crop productivity
- Reduce operational costs, and
- Reduce its water consumption, so that water is available for diverse societal needs.

Strategies and options for Improvement

Nile Basin Initiative

The case of Nile Basin Initiative (NBI, 1999), sponsored by the World Bank, illustrates the need and strategy to re-think water resources management at the whole river basin level. NBI is a regional partnership uniting ten countries for the purpose of "...development through efficient and equitable utilization of Nile River water". The Nile River

is one of Africa's greatest natural resources, and it is water source to 250 million people in ten countries. The Nile Basin Initiative follows a participatory approach from the ground up and encourages decision making from the lowest possible levels. It has planned actions that are needed across the basin to foster the right enabling environment for investments, and these are:

- Build confidence and involve all stakeholders,
- Improve capacity in public and private institutions,
- Build necessary information and database for development planning.

At the sub-basin or country level, NBI will promote joint development projects to bring tangible benefits including following:

- Promote power trade
- Efficient use of water for agriculture
- Socio-economic, environmental and sectoral analysis
- Water Resources planning and management

Irrigation Reform in Egypt

Irrigation of about 3.2 million ha consumes 85 percent of Nile water share (55 billion m³). In addition, the govern-



Arikaree river
with inset of
silvery minnow

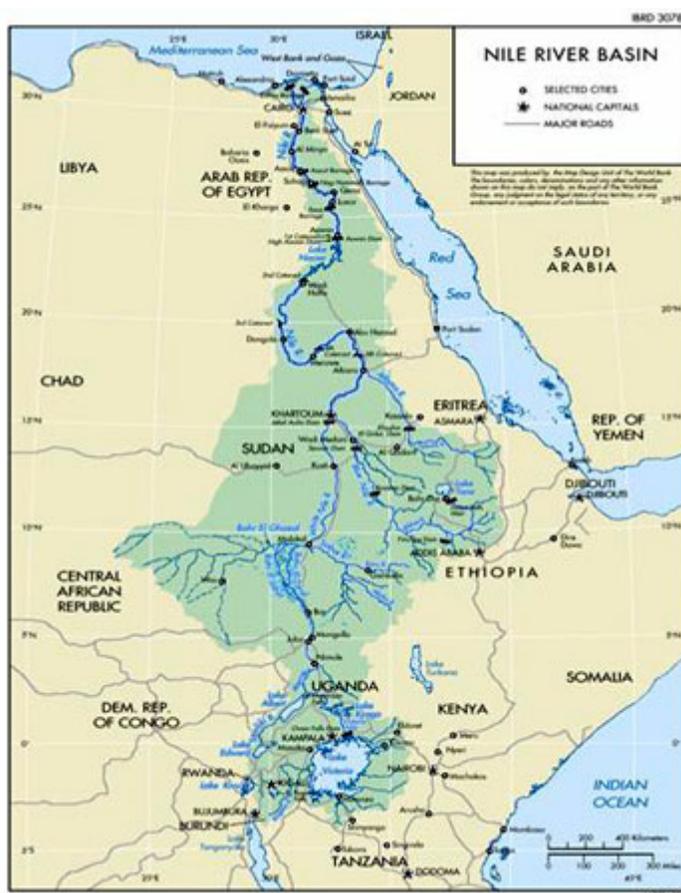


ment is expanding irrigation coverage to a further 0.5 million ha in Sinai and Toshka. Efficient use of irrigation water resources is therefore of critical importance. However, there is no really effective policy mechanism to control demand for water in agricultural sector. For example, farmers grow rice in the delta region and sugarcane in the Upper Egypt, both of which use large water quantities.

The Ministry of Water Resources and Irrigation is currently working on several policy reform and performance improvement programs including the following.

- Promote water users' associations for better on-farm water management and efficient use
- Cultivate short-season rice instead of long-season rice and sugar-beets instead of sugarcane
- Rehabilitate irrigation canals and control structures
- Better management of water delivery and distribution using information systems.

CSU faculty has been involved in these efforts. I worked with most of the programs since 1999, and the field demonstration program for cultivating short-season rice is especially noteworthy. We asked farmers in "demonstration" canals to cultivate short-season variety (120 days), whereas farmers in "control" canal cultivated traditional varieties (160 days). The results over a period of two years showed that the seasonal water use in control canals averaged about 1900 mm, and that in demonstration canals about 1600 mm. This represents real water saving of 16 percent, which is highly significant when considered over a



million ha of irrigated rice. Since year 2000, farmers in the delta region have fully adopted the practice of cultivating short-season varieties.

Colorado Water Resources Research Institute Publications Now Available

CR 194 - EUTROPHICATION OF RESERVOIRS ON THE COLORADO FRONT RANGE, by Brian Gelder, Jim Loftis, Marci Koski, Brett Johnson, and Laurel Saito, May 2003

For a CD contact Gloria.Blumanhourst@research.colostate.edu

Eutrophication has been observed in many, if not most, reservoirs along the Colorado Front Range. While Eutrophication is a natural process, the rapid pace with which it is occurring in Front Range reservoirs is a cause for concern. This study attempts to answer the following question: Is a regional approach to monitoring, modeling, and managing Front Range drinking water justified? The study identifies similarities, differences, and knowledge gaps that are important for developing an answer. This study has three components: (1) A survey of reservoir characteristics, water quality and management approaches; (2) an evaluation of existing Eutrophication models, and (3) an evaluation of the importance of food web dynamics in determining reservoir water quality.

A Water Resources Volunteer in Kazakhstan

*By Lloyd Walker, Extension Agricultural Engineer
Cooperative Extension, Colorado State University*

Cooperative Extension's mission is "to provide information and education, and encourage the application of research-based knowledge in response to local, state, and national issues affecting individuals, youth, families, agricultural enterprises, and communities of Colorado." The means and mechanisms employed to transfer knowledge to people varies widely, depending upon, among other things, the nature of the information being transferred and the 'culture' in which the information will be used. To enhance and broaden skills in Extension work, a number of CSU Cooperative Extension employees participate in international projects, often in a volunteer mode. International experiences stretch the skills of Extension employees, thus enhancing their ability to transfer knowledge in Colorado in more effective and efficient ways.

International experiences also provide a 'looking back' perspective on our life and work in the U.S. When working in a foreign country and observing different ways of, for example, developing and using water, one begins to refocus attention on practices in the U.S. This renewed perspective heightens interest and enthusiasm for transferring knowledge in Colorado that solves problems in creative and practical ways.

Kazakhstan Experience

To provide additional insight into one Cooperative Extension employee's international experience, I am providing a summary of my work as a water resources volunteer in Kazakhstan.

In May 2004 I spent three weeks in the Central Asian Republic of Kazakhstan as a technical volunteer for merged Agricultural Cooperative Development International and Volunteers in Overseas Cooperative Assistance (ACDI/VOCA), a non-governmental organization (NGO) involved in development work. I was part of a team of two engineers assessing water resource issues in the country, specifically: rehabilitation of irrigation systems and expansion of municipal/village potable water supply systems.

ACDI/VOCA is one of several NGOs engaged in using volunteers to provide technical expertise for short-term assignments (4-6 weeks maximum). Many volunteers are active or retired university faculty or professionals willing to volunteer their time in support of development activi-



Irrigation ditch in Kazakhstan

ties. In return, ACDI/VOCA covers travel expenses of the volunteer.

My partner, Theo Dillaha, agricultural engineer from Virginia Tech, and I first visited an irrigation system rehabilitation project. The system had fallen into disuse with the collapse of the Soviet Union, of which Kazakhstan was a member.

Kazakhstan's link with Russia goes back over two hundred years. At that time Kazakhs and Russians formed an alliance for mutual benefit. The Kazakh heritage is that of nomadic pastoralists of the Asian steppe. However they adopted crop production along with their pastoral ways as they became settled in what is now Kazakhstan. The creation of the Soviet Union and its emphasis on development greatly raised the standard of Kazakh living. Literacy (in Russian) is almost total. Infrastructure of roads, electricity, water, sewer, medical care, and improved housing is aging, but available. The Soviets developed large irrigation schemes in Kazakhstan, an appropriate response in a country very similar to the semi-arid western United States in climate, topography and water resources. The principal crop grown is cotton with water diverted from rivers feeding the Aral Sea. Cotton growing has been successful but at a cost of environmental degradation of the Aral Sea through diminishing of the river flows.

The collapse of the Soviet Union meant that Kazakhstan was responsible for its own economy and destiny. This

has proven challenging as the collapse caused some Russian managers to leave and left those remaining with operating budgets in disarray. The Soviet system did an inadequate job of training Kazakhs to assume management of the irrigation systems. Consequently irrigation system maintenance halted, canals filled with sediment and became choked with vegetation. Land irrigated by pumping underground aquifers went out of production as pumps, transformers, control systems, power lines and power poles were stolen during the power vacuum created by the Soviet Union collapse.

ACDI/VOCA, under a contract from USAID, is demonstrating how such systems can be rehabilitated. As Theo and I viewed the work completed in the rehabilitation process, we were satisfied with the clearing of the canals and reinstallation of the pumping systems. However, we have concerns with long-term sustainability of these systems since water user associations, which would maintain the systems, are inadequate in organization and training. Further, basic support systems that make western US irrigated agriculture so successful--land grant universities with extension/outreach, research and testing facilities; a system of prioritized water allocation; ownership of land; and government policy favoring water resource development--are nonexistent or inadequate.

The other part of the assignment assessed potable water supply systems in several locations. In villages this consisted of providing public water taps in the village streets. In municipal areas taps were brought into yards of housing compounds. Theo and I were asked to assess a proposal to rehabilitate a welded metal water tank on a 60-foot brick tower in the city of Turkestan. The tank is to store water and pressurize the system, however it is rusted and leaking and has been out of service for twenty years. There are no cranes to remove and replace the tank; funds are limited. The proposed solution was to dismantle the existing tank with cutting torches and weld

a new one in place. Aside from being a complicated task, it wasn't going to be an upgrade to the system -- merely installing another metal tank, susceptible to rust.

Theo and I suggested assessing and reinforcing (as needed) the existing tank to insure structural integrity, and lining it with a geo-textile lining. This would upgrade an existing unit at a reasonable cost and provide a system having a useful service life of over 50 years. An Internet search yielded companies that could do the work and a cost estimate for the liner of \$7,000. This would introduce a new, low cost solution to a widespread problem in the country. It is a technology that, if introduced to Kazakhstan, could be provided by properly trained local contractors. USAID had never heard of such a solution and were interested. American oil companies operating in Kazakhstan have subsidiaries that produce the geo-textile fabric and may be willing to become partners in the project. As of this writing, ACDI/VOCA is working with Theo and I, USAID and the oil companies to develop a workable project.

As a volunteer in Kazakhstan my significant contribution was to provide an outside expert's assessment and recommendations and provide training on improved practices. It was also a great opportunity for me to expand my knowledge of water resources as seen in a different context.

I found this service as a volunteer particularly rewarding. I used knowledge accumulated over a career to address a development issue in a country struggling to improve its water resource use. The short-term volunteer service commitment is manageable since it minimizes disruptions of family life routines and work commitments. And the opportunity to do meaningful work in another country provides a unique insight to its people and culture.

Colorado Water Congress

2004	
Oct. 13	Workshop on Water Quality.
Oct. 14	Endangered Species Conference.
Oct. 20	A Review of Federal Environmental Laws.
Oct. 27	Workshop on the Initiative Process.
Oct. 29	Leadership Workshop for Board Members of Water Conservancy and Conservation Districts.
Nov. 1	What You Should Know About The Legislative Process: The Law, The Rules, And The Practices.
Nov. 3	Legal Ethics In Water and Environmental Law.
Nov. 10	What You Should Know About the Nine Interstate Compacts that Colorado Is A Signatory.
2005	
Jan. 27-28 2005	Colorado Water Congress 47th Annual Convention. Denver International Airport Hotel and John Q. Hammons Convention Center, 15500 East 40 th Avenue, Denver, CO.

All meetings are held in CWC Conference room, 1580 Logan Street, Suite 400, Denver, Colorado unless otherwise noted. For more information:

- go to www.cowatercongress.org
- phone 303/837-0812
- or email macravey@cowatercongress.org

Walker Retires With 30 Years Service to CSU and Cooperative Extension

Lloyd Walker, Extension Agricultural Engineer with Colorado State University Cooperative Extension, is retiring September 30, 2004 after almost thirty years with CSU. Lloyd began his career in February, 1975 and through the years has been involved in a variety of Extension programming: 4-H engineering projects; energy conservation and alternative energy resources; housing and agricultural structures, notably barn preservation; computer applications including implementation of email within Cooperative Extension; aerial pesticide applicator spray pattern assessments; and water resources. In 1990 he assumed leadership of the Extension Water Quality Program. Since 2000 he has provided leadership of a six state regional USDA funded Water Quality Education program and is a member of the USDA National Water Quality Program Leadership Committee. He served as a volunteer assessing water resource development projects in Kenya and Kazakhstan.

In retirement Lloyd plans to combine his knowledge in water resources with his interest in international development to continue serving as a volunteer/consultant on international water resources development projects. He and his wife

Martha will continue their worldwide travels. And while at home he will pursue his interest in landscaping, gardening, tai chi, community involvement, and study of history. He looks forward to having more time to be with family and friends and visit his favorite places.



Walker with a Bagys village council member in Kazakhstan

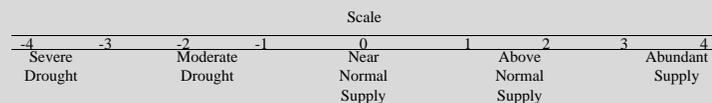
Water supply

All areas of the state are suffering from the drought that has impacted Colorado for the last 5+ years. Virtually all stream flows continue at well below normal levels, with some approaching 2002 levels. During August the South Platte River was an exception, as the basin received sufficient precipitation during the month to boost stream flows to levels that benefited more than just the most senior diverters. The Arkansas River Basin also had precipitation events that allowed storage to occur in John Martin Reservoir. The rest of the state received below normal precipitation during August.

Lack of precipitation and the resulting affect on stream flows are reflected in the drop in SWSI values from last month for all but the South Platte Basin.

While individual reservoir storage levels vary significantly, statewide the reservoir storage as of the end of August is about 85% of normal. Those who have access to reservoir storage value that source of water.

Basin	SWSI Value	Change From Previous Month	Change From Previous Year
South Platte	1.1	+0.2	+0.7
Arkansas	-2.2	-0.5	0.0
Rio Grande	-3.0	-0.9	+0.2
Gunnison	-3.3	-1.5	-0.2
Colorado	-3.0	-0.1	-1.6



The Surface Water Supply Index (SWSI) developed by the Colorado Division of Water resources and the U.S.D.A. Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on stream flow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, stream flow is the primary component in all basins except the South Platte basin where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for September 1, 2004, and reflect the conditions during the month of August. For this and all archived updates, go to www.water.state.co.us and select "surface Water" and then "Water Supply Index."



Tamarisk Threatens Colorado Waterways

By Katherine Timm
Colorado State Forest Service

Tamarisk was once valued as an ornamental plant, but now it's known as the "poster child" of weeds in Colorado.

Tamarisk (*Tamarix ramosissima*), aka salt cedar, is a shrubby tree that is native to Central Asia, China and the Mediterranean region. Various species of tamarisk were introduced in the United States more than 100 years ago as ornamentals. Additional introductions occurred during the early part of the 20th century for use as windbreaks and streambank stabilization. Tamarisk is well-adapted to the climatic conditions of the Western United States and can be found from sea level to 7,500 feet in elevation.

"Tamarisk plants flourish along streambanks but also do well on higher, drier sites due to deep root systems," said Kelly Uhing, Adams County weed specialist. "Water consumption is a major concern in areas where infestations are dense because each mature tamarisk plant can consume up to 200 gallons of water a day—one acre of tamarisk uses approximately 2.8 million gallons, or 7.7 acre feet, of water annually."

One mature plant can also produce thousands of flowers during spring and summer, generating as many as 600,000 seeds in one year. Fortunately, the seeds are short-lived and remain viable for just a few months after they disperse. Tamarisk seedlings grow as much as 6 feet within a season and can flower within a year of germination. Mature trees can grow up to 20-25 feet tall.

Tamarisk plants bring up salts, typically calcium, magnesium and/or boron through the root system and exude the salts through their leaves. The exuded salts, along with the salt contained in plant litter deposited around the base, create a saline environment that prevents the establishment of desirable vegetation that is intolerant to such conditions.

Throughout many of the waterways in the Western United States, tamarisk has displaced native cottonwoods and willows. In many cases, it has formed pure, or monotypic, stands that destroy plant diversity and wildlife habitat and consume large quantities of water.

Water consumption has become a major issue in the West, particularly in drought years, and is the driving force behind control efforts in several Western States. In Colorado, dense infestations of tamarisk occur along the Arkansas and Colorado rivers and their tributaries. In northeastern Colorado, tamarisk is present along the South Platte River and many tributaries such as the Cache La Poudre, Big Thompson, St. Vrain, Clear Creek and Bijou Creek. It can also be found around ponds, lakes, reservoirs and gravel pits.

Due to the significance of the problem, the Tamarisk Coalition, an alliance of state and federal agencies, private landowners and other non-governmental organizations was formed in 2003 to begin the task of restoring riparian lands. The USDA, Department of Interior scientists and others have conducted extensive research on tamarisk control measures, and the coalition's goal is to start the implementation of these control measures. Although tamarisk is the primary invasive plant impacting Western rivers, other plants, most notably the Russian olive, co-habit with tamarisk and must be included in any riparian restoration effort.



Demonstrating the "cut-stump" method for managing tamarisk, Tim D'Amato, Boulder County Parks and Open Space (left), cuts down tamarisk while Dr. Scott Nissen, CSU Cooperative Extension, waits to apply an herbicide to the freshly cut stump.

Photos by Kelly Uhing, Adams County weed specialist

Concern over the spread of tamarisk has also brought together a group of vegetation management specialists comprised of county weed managers, city open space managers, and representatives from state agencies, universities and private businesses. The group is known as the Northeast Colorado Tamarisk Task Force—or NoCo TTF—and seeks to promote education and awareness relating to the impact of tamarisk on the lower South Platte River watershed. Participating agencies and organizations include the Adams County Weed Department, Boulder County Parks and Open Space, BASF Corp., City of Longmont Parks and Open Space, Colorado Department of Agriculture, Colorado Division of Wildlife, Colorado State Forest Service, Colorado State Parks—St. Vrain State Park, Colorado State University Cooperative Extension, Digital Globe Satellite Imagery, Jefferson County Weed and Pest, Lafarge Inc., Larimer County Weed Control District, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, Weld County Public Works and Yuma County Weed Control.

Representatives of NoCo TTF developed workshops to disseminate information on the identification and impacts of tamarisk, recommend best management practices for control, suggest best-suited species for revegetation and conduct research investigating current and innovative control methods. The overall goal of the group is to find solutions to contain and eliminate tamarisk infestations before the problems become as severe as in other areas of the state.

“Northeastern Colorado landowners are in the enviable position of having the ability to eliminate tamarisk at an early stage of infestation, as opposed to facing potentially extensive solid or near-solid stands such as those along the Arkansas or Colorado River systems,” said Uhing, who chairs the taskforce.

Earlier this summer, NoCo TTF hosted educational events and tours for county decision-makers and weed management personnel to make them aware of the extent of the tamarisk problem and what they can do to stop its spread. “The purpose of Tamarisk Awareness Day was to help decision-makers in northeastern Colorado understand the importance of implementing management programs to eradicate this costly pest now,” Uhing said.

The tamarisk problem is so significant that it has also captured the attention of state and federal legislators who want



At Tamarisk Awareness Day, Dr. Scott Nissen, CSU Cooperative Extension, describes management techniques in front of a dense tamarisk infestation.

Photos by Kelly Uhing, Adams County weed specialist

to manage this invader and increase water flows, and it is a priority of Colorado Gov. Bill Owens. “Eradicating Tamarisk in Colorado is a priority for my administration, especially as we continue to battle drought,” said Gov. Owens. “Doing so will reduce non-beneficial consumptive use of scarce water resources, improve water quality and enhance wildlife habitat by restoring native riparian vegetation. I commend the Northern Colorado Tamarisk Task Force for helping to spread the word.”

Recommended Management Methods for Controlling Tamarisk

Experts have identified the following three management options to control tamarisk:

Cultural—After managing tamarisk infestations, other vegetation must be established to prevent reinvasion. Competitive grasses and planted cottonwood or willow cuttings are effective in reducing the chances of reinvasion. Contact your local Colorado State University Cooperative Extension office or Natural Resources Conservation Service office for proper seed mix recommendations. Seedling trees are available from the Colorado State Forest Service at a discounted rate for private landowners who own two or more acres of land.

Mechanical—A bulldozer or prescribed fire can be used to open large stands of tamarisk, followed by the application of an herbicide to resprouting plants when they are 3-6 feet tall. Be sure to obtain a burn permit and check weather conditions before conducting a prescribed burn.

Herbicides—For large stands of tamarisk around which no other vegetation is evident, foliar applications of the herbicide Arsenal or Habitat are effective. Habitat is labeled for use in riparian areas where overspray may contact water. Late summer and early fall are the best times to apply this herbicide, which is recommended for areas with little to no desirable shrubs and trees.

In areas where desirable woody native plants are present, it may be necessary to cut and treat tamarisk stumps with an herbicide. Cuts should be made within 2 inches of the soil surface, immediately followed by an herbicide application to the perimeters of the cut stems. Arsenal and Garlon are effective but must be applied within one minute of after cutting because wound healing occurs quickly and decreases herbicide penetration.



The 1944 Water Treaty 60 Years On

Dr. Stephen P. Mumme

Department of Political Science, Colorado State University

Sixty years ago last February, towards the end of World War II, U.S. Secretary of State Cordell Hull put his signature on a landmark agreement, the *Treaty between the United States of America and Mexico on Utilization of the Waters of the Colorado and Tijuana Rivers, and of the Rio Grande*. Ratified by the U.S. Senate in April, 1945, the treaty was signed into law by President Harry S. Truman in November the same year. While a few of the finer points of its significance might be debated today, this treaty, the 1944 Water Treaty, remains indisputably the most important international agreement between the United States and any other country for the State of Colorado. It is worth a few moments to reflect on what the Treaty does, what it has accomplished, and why this international agreement remains important for Colorado in this 21st century.

To even a greater degree than its advocates may have fully understood at the time, the 1944 Water Treaty helps fix the parameters of Colorado's water endowment, superseding national and state law. Its lead provisions, found in Articles 2, 3, 4, 10, and 21, apportion the water of the middle and lower Rio Grande River and the Colorado River between the United States and Mexico, provide for binational solutions to border sanitation problems, and set the institutional machinery for resolving international disputes related to its interpretation and the interpretation of earlier treaties allocating water and fixing the boundary between the two nations. On the Rio Grande, the U.S. receives more than 90 percent of the average flow of the upper portion of the river under the provisions of an earlier treaty, the 1906 Water Treaty, that is administratively grand-fathered to the 1944 document, and one-third of the flow in the middle and lower reach of the river as drains to the Gulf of Mexico. On the Colorado, the treaty allocates nearly 85 percent of the river's average annual flow to the U.S.

The 'Treaty', or 'el Tratado', as it simply known by a legion of water managers on both rivers in either country, is historically the last critical piece of the institutional foundation for water development in these river basins. By setting national endowments on the major international rivers, it laid the step for final development of the hydraulic infrastructure required to harness the water of both rivers for economic development and flood control. It provided water security in matters of supply and management that enabled both countries to proceed with reclamation projects vital to the basin states.

With Colorado at the headwaters of both these major rivers, the treaty's interpretation remains crucial for Colorado's long-term water budget and by dint thereof, its development horizon. In the case of the Colorado River, Mexico's entitlement of 1.5 million acre feet of water annually remains, under normal circumstances, the topmost priority on the river. Excepting "extraordinary drought" conditions or catastrophic accident to its upstream dams this obligation limits the water available upstream. These remaining waters are rationed under the terms of the 1922 Colorado River Compact. In the case of the Rio Grande, where Mexico receives 60,000 acre feet of the upper river's waters under the 1906 Treaty, the same rules generally apply in the upper river, and remaining waters are allocated among Colorado, New Mexico, and Texas by the 1938 Rio Grande Compact. The system changes for the middle and lower reach of the Rio Grande. There, Mexico is obligated to deliver to the U.S. 350,000 acre feet of water annually as averaged over five year cycles.

Over the better part of 60 years the Treaty has rightly been praised as one of the world's premier examples of peaceful management of international rivers. Today, however, with extraordinary regional development, rising water demand, and natural shortages caused by prolonged droughts on both rivers, this remarkable document is drawing new scrutiny.

The Treaty's 1944 draftsmen adroitly sidestepped certain problems and could not have envisioned others. Water quality in the form of salinity was the first problem to arise, provoking a decade long dispute resolved in 1973. While Article 11 of the treaty addressing the Colorado River stipulates that Mexico accept water "whatever their origin," it does not specify the quality of water to be delivered at the border. Quality, as any good water manager knows, affects quantity, that is, the volume of water available for a specific purpose. In 1973, by IBWC Minute 242, the U.S. accepted an obligation to deliver water of a salinity level roughly commensurate to the quality of water available at Imperial Dam, the lowermost U.S. impoundment on the river.

Uncertainties as to how the treaty should apply to pollution, that is, water quality problems other than salinity, persisted, however. In 1979, drawing on treaty authority in Article 3 dealing with sanitation, the IBWC, in Minute 261, reached an agreement extending the treaty to accommodate international problems arising from the pollution of boundary waters.

In the 1990's, new measures to manage Colorado River water more efficiently combined with prolonged drought in both basins to aggravate water shortages and complicate the legal equation. In 2001, for the first time in nearly 30 years, water disputes reached the summit of the binational agenda. Prolonged drought in Mexico's Rio Grande tributaries after 1992 led Mexico to withhold treaty water for domestic use, contributing to downstream agricultural losses in Texas. Over U.S. objections, Mexico, in 1999, invoked the treaty's Article 4 "extraordinary drought" clause, arguing it temporarily released them from their treaty commitment till such time as mother nature cooperated with greater precipitation. This dispute, which is still unresolved in terms of the legal principles involved, has partially abated due to mother nature's cooperation. It has drawn attention, however, to a major lacunae in the 1944 Water Treaty, namely, that its "extraordinary drought" provisions on both rivers tend to operate as a unilateral regime for drought management in the absence of further definition and operating language for these terms. Fortunately, the dispute has led to very fruitful binational negotiations aimed at improving water management on the Rio Grande.

On the Colorado River, the landmark 1999 water conservation agreement between California and the remaining basin states arranged by the U.S. Bureau of Reclamation has intensified utilization of river waters upstream. While much of this involves adjustments amongst California water users, a side effect is to practically eliminate the river's surplus flows to Mexico. Even though Mexico has no legal claim to these

waters, these episodic flows are now known to be vital in sustaining a thriving wetland ecosystem downstream. An international effort is underway to determine the needs of the Colorado River Delta ecosystem and secure an adequate source of water for the system. It is instructive that the issue is so delicate at the moment that the IBWC functions in this area are attached to its authority under the 1970 Boundary Treaty, not the 1944 agreement.

While these contemporary treaty related problems may seem distant to Colorado water users they are not. As Roger Eldrige, a former executive with the Colorado Commission on Education once said of the Colorado, "this a river that runs north to Denver and south to Mexico." Given today's extraordinary demands on both our treaty rivers, decisions related to managing our treaty relations with Mexico have a way of rippling upstream. Resolving our current disputes in a treaty congruent manner is not only an international obligation, it is essential to sustaining an architecture for water utilization of enormous benefit to all the basin states, including Colorado.

In sum, the 1944 Water Treaty, 'el Tratado', remains vital for Colorado's present and long term strategy for managing agricultural and urban water demand, for how we deal with drought, and how we sustain the quality of our ecosystems. It is, in fact, the most cardinal element of the so very cardinal "law of the river"—or, in this case, "rivers." Now 60 years on, the Treaty is a venerable, even bedrock component of our state's hydraulic expectations. If past is in any sense prologue, the treaty, with a few more tweaks, is likely to remain so.

Colorado Water Resources Research Institute Publications Now Available

CR199 - PROTOCOL FOR A STATE-WIDE GROUND WATER QUALITY MONITORING PROGRAM AND ESTABLISHMENT OF A GROUND WATER CLEARING HOUSE, by Nancy O'Keeffe and Grant Cardon, February 2004

In 1997, the Colorado Water Quality Control Commission concluded that a comprehensive state groundwater protection plan was needed for adequate groundwater quality protection. This study was conducted to identify aquifers that complied with the Domestic Use-Quality criteria, gather data on wellhead protection plans, and determine projected areas of state growth. Study results were obtained using existing government databases, reports and records, and other data sources.

Part I.

http://cwri.colostate.edu/pubs/series/completionreport/CR199_I.pdf

Part II

http://cwri.colostate.edu/pubs/series/completionreport/CR199_II.pdf

An International Perspective of Water Resources Management from the Colorado Division of Water Resources



by *Kenneth W. Knox, Ph.D., P.E., Chief Deputy State Engineer*
Colorado Division of Water Resources

Management of water resources is an exciting and dynamic challenge, particularly in Colorado and other arid regions in the southwestern United States. The authority to manage the allocation and distribution of water resources in Colorado, including the obligation to meet specific water distribution and management requirements in nine interstate river compacts, is vested exclusively to the Division of Water Resources (DWR). For many years, the DWR has recognized the cogent need and value of working with the international community to share technical, legal, and water management perspectives with the mutual intent to further the knowledge base of all interested parties and to provide enhanced service to all of our constituents – the water users and individual citizens. To help facilitate these mutual exchanges of information, the DWR has enjoyed a long-standing collaborative working relationship with the Colorado Water Resources Research Institute and Colorado State University in many professional disciplines that advance the technical and engineering expertise surrounding water resources planning and management activities in the international community.

The predominant forum for the exchange of technical/engineering expertise and management principles is through informal seminars that are initiated by guests from other countries that target Colorado as a destination for consultation because it is recognized as an international leader in water resources engineering, planning, and management. The seminars are typically held at the DWR central office in Denver, Colorado and are designed to address the pre-requested topics from our international guests. The number of international attendees varies from two to twenty-five individuals that are typically mid- to high-level government officials or corporate officers. The following three examples serve to describe the scope of international relations and topics of interest:

Republic of Korea: Dignitaries from the Korea Institute of Construction Technology and Korea Water Resources Corporation visit the DWR frequently. Officials from these two professional organizations represent the South Korean government in seeking counsel and experience from the DWR toward meeting their quest to design an equitable and enforceable water distribution system that satisfies the historic demands for water in their major river systems. These dedicated officials are seeking to manage river systems such as the Han River Basin that includes multi-cen-

tury irrigation practices, a dramatic increase in industrial consumptive use, an estimated 42 million residents, and the desire to designate and protect streamflows deemed necessary to protect the natural environment. To complement the water management aspect, the Korean delegations often include senior scientists and engineers interested in the development and application of decision support systems, ground water modeling, and remote sensing equipment used to monitor streamflows as tools to aid in their water management objectives.

Republic of Tajikistan, Republic of Kyrgyzstan, Republic of Uzbekistan, Republic of Kazakhstan, Republic of Turkmenistan: Upon gaining independence from the former Soviet Union, these Central Asian Republics are seeking to define a method to divide and equitably share the use of water resource system in a depressed economy with severe environmental problems. Compounding the difficulty of working with deteriorating water supply infrastructure, the temporal use of water diversion and storage is another significant management issue due to the conflicting demands to release water during the winter for power generation to heat homes and serve industrial demands versus storage during the winter months in anticipation of the delivery of water for irrigation in the summer months. The focus of our seminar targeted various water administrative schemes to address the central issue of concern by these cabinet-level officials -- improving transboundary water cooperation among their respective nations in the Syr Darya Basin and developing the technical tools (decision support systems, streamflow measurement and reporting stations, etc.) that may be of assistance in their pursuit of designing and implementing an international river basin allocation system.

Egypt, Ethiopia, and Sudan: Ministers from these three nations represented their respective countries and the consolidated Eastern Nile Council of Ministers (ENCOM) and traveled to Colorado to learn from our experience in interstate river water management. The primary purpose of ENCOM is to form a collaborative strategy among the nations that share the Nile River to develop the water resources of the Eastern Nile Basin in a sustainable and equitable manner to ensure prosperity and security for all peoples in the basin. The DWR provided documentation and presented information to the Ministers that targeted their specific request for information regarding (1) the development, implementation, and integration of water resources projects

in a policy environment that includes multiple interests and diverse stakeholders; (2) the relationship between federal-state-local agencies in water management and project planning; (3) the equity in water allocation and approaches for resolving conflicts over water; and (4) the utility of various data collection networks, allocation models, decisions support systems, and other supporting technologies.

To complement the local seminars provided by the DWR to international guests in Colorado, dignitaries and corporate representatives from other countries have invited Colorado water officials to travel to their respective nations to speak and share water resources management and technical expertise. For illustrative purposes, in May 2000 Colorado State Engineer Hal Simpson accepted an invitation to spend a few days in Brazil explaining the application and value of decision support systems (DSS) in daily water management applications to water resources managers in that country. This visit to South America served as a foundation for another international exchange of information a few months later when a delegation of governors and other top government officials from several Brazilian states came to Denver, Colorado to seek Mr. Simpson's counsel and experience in administering interstate river compacts because the Brazilian representatives were in the process of developing a water allocation system for the interstate São Francisco River in northeastern Brazil.

During the autumn of 2003 at the request of a consortium of Australian representatives, Chief Deputy State Engineer Ken Knox spent approximately two weeks meeting with cabinet-level officials and state/local water managers in the State of Western Australia and the State of New South Wales to address the technical and administrative intricacies associated with two distinct water management issues

driven by different needs in the two opposing geographic regions on that continent. The first issue was driven by a need to supplement diminishing water supplies to meet increasing water demands. The State of Western Australia approximates 1/3 of the geographic area of the continental United States and it is suffering a severe drought that has extended for over 28 years. Reservoir storage supplies have been decimated and natural streamflows are a mere fraction of long-term averages. The focus of discussion was upon the development of a conjunctive water management system to address surface water and ground water supplies, temporary and permanent water trading, and the application of DSS and other analytical tools to aid Western Australian decision makers in meeting critical water supply deficits while protecting the long-term sustainable yield of their ground water aquifers. The second aspect pertained to time spent in New South Wales providing consultation to water resources managers representing four eastern states in Australia seeking to develop an equitable allocation system for the interstate Murray-Darling River system and address the environmental impacts to the watershed in a holistic water management plan.

The Colorado Division of Water Resources is grateful for the opportunity to share our experience and expertise in conjunctive water resources engineering, planning, and management with water resources managers and officials from around the world. We are most appreciative for the mutual and collegial exchange of information from our international colleagues and the net result from these discussions is an advanced service and benefit to all water users and citizens, including those in Colorado.

For additional information or inquiries, contact Ken Knox at ken.knox@dwr.state.co.us or by telephone number 1-303-866-3581.

Sam Maynes, Water Law Expert, Dead at 70

From an obituary written by Lindsay Nelson and published in the Durango Herald

Frank. E. "Sam" Maynes, a Silverton miner's son who grew up to become a powerful lawyer and water lobbyist both regionally and nationally, died at his home in Durango of cancer in July. He was 70.

As an attorney for the Southwestern and Animas-LaPlata water districts, Maynes worked since the mid -1960s to steer the Animas-LaPlata project through the various approval processes including objections to the project. Work on the \$500 million project is under way, scheduled for completion in 2010.

Maynes, one of the nation's foremost experts on water law, has received the Bureau of Reclamation's Citizen Award, the Wayne N. Aspinall Water Leader of the Year Award, and the Durango Area Chamber Resort Association's citizen of the Year award. U.S. Rep. Scott McInnis, R-Colorado, paid tribute to Maynes last November on the House floor.

"Sam redefines 'zealous advocacy,'" McInnis said then. "He is renowned for fighting ferociously for what he believes in. Sam is a man of conviction and principle, and he is willing to go to the ends of the Earth to assure that justice prevails."

CWRRRI

Colorado Water Resources Research Institute 2005 Water Fellowship Program Announcement

The Colorado Water Resources Research Institute* (CWRRRI) announces a new Graduate Research Water Fellowship program for 2005. The CWRRRI Fellowship program replaces CWRRRI's former state-based competitive grants program. The change is in response to a budget reduction suffered by Colorado's higher education system.

Graduate students who are conducting or planning research in water resources areas may apply for fellowships, stipend only, varying from three summer months to a full year in duration. Stipends may be requested in the range of \$800 to \$1,400 per month, depending upon the level of study and tasks involved. The fellowship funds must be applied between March 2004 and February 2005.

Projects proposed for fellowship support should relate to water resources research priorities identified by the CWRRRI Advisory Committee on Water Research Policy (ACWRP). 2005 priorities are listed below. Regional, state, or local collaborations; external co-funding; and/or specific plans to prepare proposals to seek additional external funding for water research, will strengthen an application.

Applications should be prepared using the guidelines that can be obtained at: (<http://cwrrri.colostate.edu/>). The CWRRRI Fellowships are partially funded by Congress and have a 2:1 matching requirement (i.e. two non-federal dollars must match each federal dollar). CSU, through its support of CWRRRI, provides the match for CSU graduate students. Applicants and advisors who have questions about the program are urged to contact the CWRRRI director, Robert Ward, at (970) 491-6308, or via e-mail at: Robert.Ward@ColoState.edu.

The deadline for receipt of applications is 5:00pm, November 1, 2004. Send applications to Gloria Blumanhourst, Colorado Water Resources Research Institute, E-102 Engineering Building (2033), Colorado State University, Fort Collins, CO 80523. You may submit applications in Word for Windows format to Gloria.Blumanhourst@colostate.edu.

Fellowships are competitive, and applications will be evaluated by faculty referees for sound science and the CWRRRI ACWRP for relevance to Colorado water research priorities.

Congressional funding for the CWRRRI Fellowship Program is dependent upon inclusion of funds for the national water institute program in the FY 2005 USGS budget.

CWRRRI Fellowship Criteria:

- Fellowships are available to graduate students who are performing M.S. or Ph.D. level research, in water resources, at a Colorado research university. Fellowships provide the stipend for the graduate student. (Other costs are met by the advisor's research grants, department, or college)
- For 2005, the monthly Fellowship stipend may range from \$800 to \$1,400, depending upon tasks and level of study. Fellowships may be requested for three summer months, for a semester plus the summer (7.5 mo or 8.0 mo), or a full year. Preference for the full-year awards will be given to students in the latter stages of thesis or dissertation research who can demonstrate good research productivity on a CWRRRI research priority.
- CWRRRI Fellows are expected, as the final 'deliverable' of their fellowship, to produce a CWRRRI report as well as a formal proposal to a funding organization, a Colorado conference presentation, and/or a manuscript submitted to a peer reviewed journal.
- Depending on the overall evaluation of the application, a smaller/shorter award than requested may be offered.
- Multiple applications from a research group are permitted.
- Applicants should have a thesis project defined and approved by their graduate advisory committee.
- The advisor (through existing grants, or funding from within the university) will provide for research support costs (e.g. supplies and travel).
- The fellowship must be matched by twice the amount awarded from non-federal sources. The source of this match will vary by institution.
- Students who received CWRRRI support in past may apply for a CWRRRI Fellowship.
- Fellowship funding is available from March 1, 2005, through February 28, 2006 (or as soon thereafter as the USGS authorizes CWRRRI funding).

Reporting requirements

CWRRI Fellows will be asked to provide three reports/products during the course of their Fellowship:

1. November 2005 – oral summary of progress before the CWRRI ACWRP annual meeting in Denver;
2. February 28, 2006 – written *summary* of progress/results for the CWRRI newsletter; and
3. February 28, 2006 - final ‘deliverable’ of Fellowship, per application description.
- 4.

2005 CWRRI ACWRP Water Research Priorities

- Quantification of the amount of Selenium released into surrounding waters by gravel mining operations as well as definition of pathways.
- Measurement of Best Management Practices (BMP) effectiveness to control non-point source pollution.

- Development of effective BMPs to control selenium.
- Long-term impacts on vegetation from use of recycled wastewater on urban landscapes.
- ‘Healthy forests’ impact on water quantity and quality (particularly related to forest fire reduction which protects source water quality)
- Water transfer mitigation in which economic impacts for all involved are balanced.
- Colorado Water Quality Control Division’s nutrient criteria pilot project participation.

* The Colorado Water Resources Research Institute (CWRRI) is established under the federal Water Resources Research Act, as amended, and is authorized by the Colorado legislature, most recently in 1997, under H.B. 1218. At the federal level, CWRRI is one of 54 water institutes administered by the U.S. Geological Survey in the Department of Interior. Under Section 104(b) of the Water Resources Research Act, CWRRI is to ‘...plan, conduct, or otherwise arrange for competent research...’ that fosters the entry of new scientists into water resources fields, the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena, and disseminates research results to water managers and the public. The research program is open to faculty in any institution of higher education in Colorado that has ‘demonstrated capabilities for research, information dissemination, and graduate training ... to resolve State and regional water and related land problems.’

2005 Water Fellowship Program Guidelines for Preparation of Applications

Applications should be prepared by the graduate student, under the direction of his/her research advisor. The application should contain the following:

1. Title of the thesis project.
2. Introduction of the applicant: major, research specialization, research advisor, post-secondary education, progress in degree program (courses completed, candidacy or comprehensive exams, anticipated completion date), progress in thesis research, previous professional and scholastic accomplishments (presentations, publications, awards).
3. Description of the critical state or regional water problem being (or to be) investigated and relationship to CWRRI ACWRP priorities.
4. Key literature and prior work in your research group (if applicable).
5. Scope and objectives of the proposed research.
6. Methods, procedures, and facilities.
7. Anticipated results and benefits from the proposed study (“deliverables” including proposals to seek additional support for the research).
8. If research is underway, progress to date.
9. Financial information regarding support for the stipend (funding requested, co-funding of the project, sources of any other stipend support of the applicant, and operating support during the fellowship period) and how the 2 to 1 non-Federal to Federal match will be covered.

The application, prepared in a single spaced, 11-12 point format, should not exceed seven pages. Append graduate transcripts (or undergraduate transcripts for a new graduate student). Graduate transcripts should be complete through spring or (if applicable) summer of 2004 (the original grade report sent to the student is acceptable).

The **deadline** for receipt of fellowship applications is 5:00 p.m., November 1, 2004.

Submit the application to: Gloria Blumanhourst, CWRRI, E-102 Engineering Building, CSU, Fort Collins, CO 80523-2033

or as an e-mail attachment in Word for Windows format to: Gloria.Blumanhourst@Research.Colorado.edu

Portions of the successful fellowship applications will be included as part of the Institute’s FY2005 proposal to the USGS. Suggestions for improvement or clarification of points in the text may be forthcoming from the CWRRI ACWRP and/or CWRRI director.



Colorado Institute for Public Policy (CIPP) Sponsors Conference to Discuss Role of Higher Ed in Economic Development

In October 2003, Colorado Water introduced Lyn Kathlene as the new director of the Colorado Institute for Public Policy (CIPP) at Colorado State University. In the intervening year, Kathlene has constructed the institute mission and development plan, and organized the first conference on policy hosted by the organization. The conference, which will be held October 15 in Fort Collins, is entitled "Colorado's Future 2004: Economic Development and Public Policy."

The one-day conference will feature keynote speakers and moderated panel discussions to address questions from an academic, business and policy maker perspective. Topics range from the role of Colorado research universities in economic development to how to form partnerships between universities, business, and public sector on specific economic issues. Speakers include:

- Dr. Larry Penley, President of Colorado State University
- Rick O'Donnell, Executive Director of the Colorado Commission on Higher Education,
- Milan Rewerts, Director of Cooperative Extension at Colorado State University,
- Frank Bruno, Boulder City Manager

To register for the conference, go on-line to www.COFuture2004.colostate.edu or call 970-491-7501.

Colorado Institute of Public Policy
103 University Services Center
Colorado State University
Fort Collins, CO 80523-2010
Phone: 970-491-2544
Fax: 970-491-3106
Email: Lyn.Kathlene@research.colostate.edu

The mission of the Colorado Institute of Public Policy is to bring together basic and applied research to encourage effective public problem solving about the connections among environment, agriculture, and people.

The Institute's work includes:

- The production of white papers – research documents that explore public policy issues by drawing on the expertise of stakeholders, communities and Colorado State's faculty researchers.

- Identification of grant opportunities for faculty research. The Institute provides technical assistance in preparing grant applications and research assistance for projects with an interdisciplinary focus on public policy issues.
- Contract services for local and state government agencies. The Institute works with agencies to apply research in ways to creatively solve problems and address community needs.
- Organizing conferences that share new and informed perspectives with business, academic, legislative and other audiences.

The Institute stresses:

- **credibility** in all of its policy papers, research proposals, conferences and other activities. The Institute emphasizes accuracy, expertise, multiple perspectives and research-based information in all it does.
- **interdisciplinary** research and decision-making models. An interdisciplinary focus brings fresh energy and ideas to problem-solving and is essential to addressing today's complicated public policy issues.
- **partnerships** with local, state and regional stakeholders. Partnerships are crucial to identifying and fully addressing public policy concerns – and translating knowledge so it's most useful.

With these guiding principles, the Institute represents the top-notch research and land-grant university of the 21st century: It works to establish networks that create, translate and apply new knowledge to address some of the most pressing public-policy concerns of our times.

A few examples of policy topics the Institute might address include:

- connections between human and animal-borne diseases
- water management in times of drought and population growth
- transportation planning, air quality and human health
- wildfire risk and tourism
- the spread of wildlife disease and ecosystem health
- food safety and public education
- higher education and economic prosperity in the state
- endangered species and recreational development
- agricultural biotechnology, valued added produce, and rural viability
- changes in agricultural production and products
- the interface of urban and rural areas



Meeting briefs

Watershed Planning Focus of Conferences

by Cynthia Peterson, Project Manager
League of Women Voters of Colorado

The 2004 Colorado Nonpoint Source (NPS) Forum, held on Sept. 8 in Glenwood Springs, provided in-depth information about successful watershed planning. The forum, "Watershed Planning: Blueprint for Action," brought Barry Tinning and Charlie MacPherson from Tetra Tech, Inc. to Colorado with a daylong presentation about the nuts and bolts of preparing a watershed plan.

Gene Schleiger, co-chair of the Colorado Nonpoint Source Council, welcomed a standing-room-only audience to the forum. Laurie Fisher, Colorado Nonpoint Source Coordinator, introduced the program and discussed the critical role watershed plans play in the NPS grant program. She noted that watershed plans should encompass more than just NPS pollution. They should also consider water quantity and quality, catastrophic events, land use, and other resource issues, according to Fisher.

Tinning began the day's presentations with a discussion of what makes a good watershed plan. He emphasized that plans don't have to be perfect. Good decisions can be made with less-than-complete information. He introduced nine critical elements of watershed-based NPS pollution control plans:

- Identify causes and sources of pollution loading to be controlled
- Estimate load reductions expected from adopted best management practices (BMPs)
- Describe NPS management measures and identify areas in which they will be needed
- Identify related water quality success criteria or indicators
- Describe interim, measurable implementation milestones
- Describe a load reduction/water quality monitoring program
- Describe an information and education program needed to promote adopted BMPs
- Estimate sources of technical and financial assistance required for implementation
- Schedule implementation of BMPs

Tinning discussed first three elements of a plan in detail, as well as the role of watershed modeling in developing watershed plans during the morning session.

In the afternoon, MacPherson continued the presentation with a discussion about watershed plan implementation,

and the other six plan elements. She pointed out that effective information and education program must start at the beginning of the watershed planning process.

2004 Nonpoint Source Hall of Fame Awards

The Nonpoint Source Hall of Fame Awards were presented at the 2004 Colorado NPS Forum on Sept. 8 by Gene Schleiger, co-chair of the Colorado Nonpoint Source Council, and Laurie Fisher, Colorado Nonpoint Source Coordinator. Three awards were presented and two individuals received honorable mention.

The award for the Moving Dirt Project was given to the Florida Water Conservancy District. The district was praised for its innovative work in preventing sediment from entering Lemon Reservoir after the Missionary Ridge Fire in June 2002. For example, with the hard work of the Bayfield High School football team, mulch was applied effectively on even extremely steep slopes.

Bette Blinde, of the Colorado Foundation for Agriculture, received the Moving Minds Project Award for the production of "Ten Years of Success: Project Profiles." The booklet showcases 10 of Colorado's most successful NPS projects. To view the booklet, visit www.npscolorado.com/projectfactsheets.htm.



Bette Blinde (Colorado Foundation for Agriculture)
Gene Schleiger (co-chair, Colorado Nonpoint Source Council) and Barb Horn (Division of Wildlife) at Hall of Fame presentations

Longtime Colorado NPS Council member Barb Horn was awarded the Outstanding Individual Award. She has chaired the council's information and education subcommittee for over a decade, and has been instrumental in the success of the NPS program in Colorado.

Honorable mentions were given for two ongoing projects. Curry Rosato accepted the honor for Project 3ME with the H₂O Joe and Flo public education campaign. And Leigh Ann Vradenburg was recognized for the work of the Willow Creek Reclamation Committee.

Focus on the Future

The Fifth Annual Colorado Watershed Assembly (CWA) Conference was held Sept. 9 and Sept. 10 in Glenwood Springs. The theme of the conference was "Planning for the Future," and conference speakers discussed trends in Colorado water resource issues and the role of watershed groups in addressing expected needs.

A new initiative to obtain federal funding for regional watershed protection efforts, the Regional Headwaters State Partnership, was outlined for conference participants. Participating states are Colorado, Montana, Utah and Wyoming. Representatives of the partnership have met with congressional staffers to seek support for a short-term appropriations request and long-term assistance for the regional approach to water quality and quantity concerns.

Rick Brown of the Colorado Water Conservation Board discussed the Statewide Water Supply Initiative (SWSI). The goal of the initiative is to help ensure that Colorado will have adequate water supplies for its citizens and environment. The evaluation of Colorado's current and future water needs was requested by the Colorado Legislature in 2003, with the final report due Dec. 1.

At a lunchtime presentation, Bonnie Pierce, watershed scientist with the group Trees, Water and People, received the CWA Watershed Steward Award. She was recognized for her leadership in publishing the 2004 State of Colorado's Watersheds Report, as well as other watershed support activities.

Mark Pifher, director of the Water Quality Control Division for the Colorado Department of Public Health and Environment, discussed issues related Senate Bill 03-276, which was approved by the Colorado Legislature in 2003. The legislation ended state funding for the Colorado Water Quality Control Division, replacing it with a fee-based system that expires in June 2005. The bill also directed the division to study its business practices and future funding options. A draft SB 03-276 report has been produced, and the division has engaged in an extensive public comment process. Pifher noted that it is not too late to provide comments on the draft report.



Nolan Doesken, H2O Joe, and Russ Clayschulte

RiverWare Rulebased Simulation Modeling Class December 8-10, 2004 (Wednesday - Friday), Boulder, Colorado

Class size is limited, so please register as early as possible. Registration deadline is November 17, 2004. To register, please print the PDF registration form and follow the submission instructions on the form.

Cost for the three day training is \$1,000 per person (\$750 for RiverWare sponsoring agencies: USBR and TVA). For more information, contact Kaye Barrett, RiverWare Technology Transfer Coordinator, 303-492-4132, bkaye@colorado.edu .

Rulebased Simulation Modeling is a course for users who have already taken the Introduction to Simulation Modeling course and wish to begin learning rulebased simulation. It is taught by the CADSWES engineers and researchers who develop the RiverWare software. This course teaches the user how to incorporate policy as data into their RiverWare models. In this training, you will learn to construct rules and rulesets, and will gain experience in converting written policy into rules, implementing rulesets, testing, and debugging models. The course includes both lectures and self-guided tutorials as well as interactive group projects.

Meeting briefs

2004 Colorado Water Workshop Examines the Science and Politics of Water

by Robert C. Ward, Director
CWRRI

More than 200 people participated in the 2004 Colorado Water Workshop hosted by Western State College in Gunnison, Colorado, on July 28-30, 2004. The 2004 Workshop examined the interface of science and politics in the development of water resources in the 21st century.

George Sibley, Workshop Coordinator, set the stage for the 2004 Workshop by noting that for most of the 20th century, water development in the West was driven by a generally unified political vision and accomplished by unprecedented engineering and technological feats. But that unified political vision began to fragment in the last third of the century due to growing national concerns about deterioration and change in the natural environment, and also due to changes in western regional economies, from utilitarian resource-based economies toward a more amenity-based tourism and resort economy.

The sciences have played a major role in these changes – especially environmental sciences that were little known or noted early in the 20th century, but which both nurtured and were nurtured by an epic wave of environmental legislation in the 1970s. Under the scrutiny of environmental analysis and changing priorities about free and flowing waters, many traditional approaches to water development were no longer appropriate, resulting in a period of political confrontation and contention.

But the demand for water has continued to grow, and scientists, engineers and water managers are starting to collaborate in numerous situations to develop new strategies for meeting growing needs with finite supplies. Collaboration is building around enhanced scientific understanding in conjunction with enhanced political dialogue. Examples of

such collaboration, presented at the Workshop, included the Colorado Water Conservation Board's Statewide Water Supply Initiative (presented by CWCB staff member, Rick Brown); Northern Integrated Supply Project (Nicole Seltzer, NCWCD); City of Aurora efforts to stretch urban water supplies (Peter Binney, Aurora Utilities); dual water system development to meet urban landscape and agricultural water demands (Don Magnuson, Cache la Poudre Irrigating Company); and efforts to coordinate ground and surface water management in the San Luis Valley (Cathy McNeill, Rio Grande Watershed Association of Conservation Districts).

Additional topics addressed during the 2004 Colorado Water Workshop included a comparison of the importance of science versus the role of politics in western water management (politics wins!); an overview of water development strategies in the

21st century (new technology mixed with new institutional arrangements); the need for Colorado to explore alternatives for water right development and administration (see Steve Sims article on page 27 of this issue of *Colorado Water*); and an examination of potential problems that might occur if the Colorado River's 'bank account' in Lake Powell continues to diminish. In addition, there



Aung Hla (CSU Cooperative Extension), visits with Dan Crabtree and Mike Baker (Bureau of Reclamation) between presentations.



Ray Wright (Rio Grande Water Conservation District) watches as George Sibley sets up the computer for presentations.

was a special session recognizing the 125th anniversary of creation of the position of Water Commissioner in Colorado. Dick Stenzel, as part of the special session, described the evolution of the job of Water Commissioner 'from saddle to satellite' (see Dick's talk on page 29 of this issue of *Colorado Water*).

The Colorado Water Workshop is an innovative, informative, and provocative annual conversation about water management issues of importance to Colorado – don't miss the 2005 Colorado Water Workshop, to be held July 27-29, 2005, in Gunnison. Mark your calendars now!

Should Colorado Explore Alternatives For Water Right Development and Administration?

*By Steven O. Sims, Senior Water Counsel
Colorado Attorney General's Office*

Presented at the 2004 Colorado Water Workshop

Note: This article only reflects the views of the author and is not the position of the Attorney General, State Engineer or any other state agency. The article was proposed to stimulate discussion on potential reforms to the Water Court system and was not intended as a personal attack on any water court judge or referee.

Colorado's court centered water law system is basically sound but needs to be reformed to address problems that have occurred since the creation of the water courts 35 years ago.

The General Assembly in the 1969 Water Right Determination and Administration Act created seven specialty courts to have exclusive jurisdiction of water matters. These courts are located in the seven major water basins in the state. Prior to the creation of the specialized water court, district court judges in the county of the proposed point of diversion heard these matters. The 1969 act was designed to create a greater judicial expertise in water matters as well as to expedite the handling of water matters.

During the last 35 years the water courts have fallen short of expectations. The water court process has become too expensive, takes too long, the judges have not come to the water court with expertise in water matters and there is a perceived bias by water judges in favor of local interests. The court, the General Assembly and the water bar must collaborate to solve these problems or water users will continue to lobby the General Assembly to create administrative tools to bypass the water courts.



Steve Sims and Ed Quillen philosophize about water.

Timelines and the 2003 Legislative Changes

In a recent law review article Melinda Kassen concluded:

“...empowering the State Engineer to determine material injury, and not just during drought or emergency situations, recognizes that the court system is not flexible enough to address all of the legitimate water rights transactions that arise in today's fast-pasted world. The next question for the legislature is whether the State Engineer's new authority is sufficient, or whether the times demand an even broader transfer of power from the courts to the administrator.

It will be interesting to watch and see whether the legislature continues to vest more power in the state agencies to solve Colorado's water future, or whether, decades from now, the 2003 legislative session will stand out as an anomaly in its aggrandizement of state agency power.”

I agree with Kassen that the 2003 legislative reaction to the drought showed that many in the water user community believe that the water court system is not flexible enough “to address all of the legitimate water rights transactions that arise in today's fast-pasted world.” The General Assembly approved statutory measures that enabled water users to address pressing needs on a temporary basis while the water court considered a permanent solution. Although the General Assembly's actions created a

solution to the timeliness problems, the other water court problems remain to be resolved.

Expense and trial procedures

In the last 15 years the time to try simple change of water rights cases has grown from three days to nearly seven days. The more complex augmentation cases and transbasin diversions now take many weeks if not months to try. It is no exaggeration to state that it takes less time to try a first degree murder case than the average water case. Obviously the longer the trial the greater the expense.

In addition to the length of trial of water court trials, the other major source of expense is long drawn out pre-trial procedures. Mandatory pretrial disclosures can be tens of thousands of pages. In the 2002 South Platte Well use case, the State Engineer was prepared to make a disclosure of over 300,000 pages of documents. Dozens of depositions usually precede every water court trial. Every applicant and most opposers must retain expert engineering consultants as part of the legal team at the cost of thousands of dollars.

Much of the disclosure, discovery and trial preparation expenses are not necessary and could be avoided with more precise legal theories by both the applicants and the opposers. There are solutions to this problem, but the solutions will require changes to statute, court rules and judges conduct in managing their trials.

A streamlined trial process needs to be adopted for less complex cases. The streamlined process would limit the initial disclosures required, limit the witnesses that could be called in the trial, limit the discovery that could be utilized in the trial and limit the time for argument, direct examination and cross-examination.

Even more complex cases could benefit from active case management that looked at each of these issues in planning trials. Active trial management should be conducted by the referee/magistrate.

Role of the Water Referee

During the debate on the 1969 act the General Assembly wanted a party to review the application and make recommendations to the Water Judge. A great debate took place surrounding this concept. Some wanted the recommendations to have presumptive effect and for the division engineer to make the recommendations. Eventually the General Assembly settled on the present system where a court appointed referee investigated the application and ruled on the application. Instead of giving that ruling presumptive effect, the General Assembly decided that any ruling of the referee could be reviewed by the water judge de novo.

Because of the de novo review aspect, most seriously contested matters eventually bypass the referee and take the dispute directly to the water judge. This has greatly reduced

the role and importance of the water referee. While the referee has taken on some case management duties in some divisions, the effectiveness of this function varies because the referee is not always legally trained. The function of the referee should be changed away from the original investigator role to that of a trial management magistrate. The statute should also be changed to eliminate the referral to the referee for ruling, instead all cases should stay with the water judge, but be managed by the referee.

Additional reforms.

Water judges are selected from the existing group of district court judges. Most district court judges are selected due to criminal or civil trial experience. I am not aware of any district court judges appointed in the last 15 years that came from the water bar. As a result it has been rare to find any new water court judge with any exposure to water law prior to their first trial. While water judges eventually obtain experience by handling cases, on the job training was not what was envisioned when the specialized water court was created.

Some divisions, namely divisions 6 and 7 have few, if any, water trials. Judges in these jurisdictions don't even have the benefit of on the job training to prepare them for handling water cases. Divisions 2, 3, 4 and 5 have very few trials that actually go to trial. Colorado does not need 7 judges and 7 referees to handle the case load on the statewide water docket.

In addition to lack of water law experience many water users perceive that water judges are biased towards the positions taken by the water interests in their communities. One recent water judge upon his retirement commented in a newspaper interview that the proudest moment in his 30 year judicial career was when he denied a water court application that could have resulted in a large transbasin diversion from his water division. Although some may argue that Union Park, AWDI, Park County Sportsman Ranch and the recent Hi-Plains A&M application were just bad applications that would have been denied by any judge, the perception remains that transbasin appropriators are not getting a fair trial.

This perception is reinforced by the fact that the judges ruling on these cases must stand for retention in their judicial districts. When the western slope, San Luis Valley and Arkansas Valley voted nearly 90% against Referendum A, it is realistic to believe that the anti-transbasin sentiment would sweep from office any local judge that approved a transbasin diversions. It is not just transbasin diverters that question the partiality of local judges dealing with statewide water questions. Recently communities have looked to the RICD as a poison pill that can further protect them from transbasin diversions by tying up most of the yield of a river basin without actually diverting water from the

stream. These applications have all been approved by local in-basin judges.

Is it any wonder that the City of Aurora favors non-water court tools to change irrigation water to municipal use when the administrative path to approve the change of the Highland 9 mile water took 3 months while the water court process to change a similar amount of water from the Rocky Ford system has been ongoing for nearly 20 years.

Both of these systemic water court problems can be resolved by abolishing the water court in the seven water divisions. The seven water courts could then be replaced by two water only judges, assisted by two referee/magistrates that would handle all water matters in the state. These judges would only handle water cases and should be recruited from the water bar. Trials would still be held in the locality of the diversion if requested by the parties, but retention would be statewide and cases would be rotated

so no judge handled cases from just one basin. It may make sense to term limit these judges so there would be a regular change of the guard so no one judicial philosophy became dominant.

Conclusion

- Streamlining the disclosure, discovery and trial process.
- Reforming the role of the water referee as a case manager.
- Creating a statewide water court.

These ideas will fix the shortcomings of the water court system and silence the call for additional transfers of power from the water court to the State Engineer.

References

Melinda Kassen, *Statutory Expansion of State Agencies' Authority to Administer and Develop Water Resources in Response to Colorado's Drought*. 7 University of Denver Water Law Review, 48, 66, 91 (2003).

Water Commissioner Position Celebrates 125th Anniversary

by Dick Stenzel, Senior Water Resources Technical Advisor
Applegate Group, Inc.

Presented at the 2004 Colorado Water Workshop

The first Colorado law that provided for the regulation of streams was enacted by the first Territorial legislature in 1861. They enacted a statute that provided:

“That in case the volume of water in said stream or river shall not be sufficient to supply the continual wants of the entire country through which it passes, then the nearest justice of the peace shall appoint three commissioners...whose duty it shall be to apportion, in a just and equitable proportion, a certain amount of said water upon certain or alternate weekly days to different localities, as they may, in their judgment, think best for the interests of all parties concerned, and with a due regard to the legal rights of all...”

However, the earliest pioneer irrigators had little need for a law of this character. At that time ditches were small and the water in the rivers was sufficient to meet their needs.

By 1876 when the Colorado constitutional convention was held its delegates were aware of the need to resolve existing and potential disputes among irrigators. It was not a question of what doctrine was to be used but of how the doctrine was to be administered. Actually the clauses in the State Constitution did little more than officially recognize what was already the law of the land. The new document laid the foundations for state control by declaring the “the water of every natural stream, not heretofore appropriated, within the state of Colo-

rado, is hereby declared to be the property of the public.” Drawing on customs evolved in farming communities and in the mining districts, where water was diverted for placer operations, the constitution also stated a new doctrine of prior appropriation:

“The right to divert the unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using water for the same purpose...those using the water for domestic purposes shall have preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.”

The greater part of the flows of the South Platte River and tributaries had been appropriated prior to 1879. Controversies resulted in physical encounters and often bloodshed. The difficulties had grown so significant that by the time the second General Assembly of the state was to meet in 1879, an effort was made to provide a means for adjudicating the rights of the different appropriators.

A statewide convention was called by Greeley irrigators to be held in December of 1878 in Denver. They realized that

the courts were too slow to offer protection to growing crops. As a result of that convention it was recommended the following changes be made to the existing laws. First, they recommended dividing the State into water districts corresponding with the natural drainage basins; second, the appointment by the Governor of a water commissioner in each district whose duty it would be to divide the water on the basis of prior appropriations; third, a plan for securing a record of priorities through referees' hearings in each district plus recommended the position of State Hydraulic Engineer.

The Legislature responded by creating ten water districts, all but one in the South Platte River system, and also provided for the appointment of ten water commissioners. It empowered the District courts to appoint referees to determine the priority of rights on each stream in the ten districts. The legislature refused to provide for a State engineer or for the gauging stations. To economize, the supervision over irrigation was given to the State Board of Agriculture.

The Water Commissioners were to be appointed by the governor upon the recommendation of the County Commissioners located in each water district that was created. Their duties were "to divide the waters of the public streams in times of scarcity among the several ditches and canals, according to prior rights of each. The first water commissioners were put in an unenviable position of not knowing how much water was in each stream and in most cases they did not know how to measure how much water was being diverted by the irrigators.

In the beginning water commissioners were allowed to work a maximum of 80 days a year. They were paid by the county commissioners that they served, if there was more than one county being administered during a specific period of time the counties split cost equally. The water commissioners pay was \$5 per day and their assistants were paid \$3 per day for a maximum of 25 days. The Water Commissioners could only begin working when they were requested to deliver water according to the priority system due to water shortages.

The Colorado System had been defined but not completed as the Second General Assembly left it; the legislation satisfied no one – not the lawyers, the ditch owners, or the farmers. Early in January of 1881, another irrigation convention was called by farmers who felt that further changes to the existing administrative system had to be made. They listened to a talk given by B. S. LaGrange, who was the water commissioner in District 3, which is the Cache la Poudre River basin, on the need for additional irrigation legislation. Those in attendance to the convention then chose him chairman of a committee to write the irrigation bill for presentation to the legislature.

Water Commissioner LaGrange spent most of the 1881 legislative session in Denver and helped in many ways to father this legislation. The previous legislature had refused to

provide the irrigators with a State commissioner of irrigation and with some legislation for the measurement of the streams. The second bill sought to supply these important elements. It provided for a State hydraulic engineer to measure the irrigable streams. The proposed legislation was influenced by the experience of California, where the office of State engineer had been created three years earlier. Colorado's proposal had one feature, however, which was a considerable improvement over the California law; it provided that prior to the taking of testimony in an adjudication suit, the State engineer should measure the capacities of the stream and the ditches, and present his measurements as evidence in the application for a water right. This bill had another new feature; it provided for the creation of three water divisions which were based on the South Platte, Arkansas, and Rio Grande basins.

The statute that was passed by the General Assembly stated the office of State Hydraulic Engineer "was to be appointed by the governor for a two-year term." The principal task was the making of "careful measurements and calculations of the maximum and minimum flow in cubic feet per second of water in each stream from which water shall be drawn for irrigation." The state engineer also supervised the water commissioners in each water district and supervised equitable distribution. As Elwood Mead later wrote: "To Colorado belongs the credit of having been the first State to enact a code of laws for the public administration of streams, and these laws have directly influenced more people than those of any other commonwealth."

After the state hydraulic engineer position was created the more fortunate water commissioners had gages placed in their water district. At that time gage stations were located near the homes where observers lived. Thus the locations changed whenever new observers were hired. Channel cross section changed because of poor site locations and constantly had to be remeasured in order to develop new rating curves. The observers were paid at rate of \$5 to \$10 month to make 3 readings per day based upon the distance traveled and the amount of work needed to update rating curves. The small pay and the work effort needed resulted in questionable accuracy occurring. Even though the gages were read three times daily most water commissioners only obtained the flow data twice a week. Based upon that data the water commissioners administered the water rights during periods of water shortages and headgates were adjusted accordingly if they existed. The State Engineer was mailed the readings on a monthly basis.

In 1887, the state statutes created the position of Superintendent of Irrigation, today known as Division Engineer. The Division Engineer was to supervise the water commissioners within each division. The expenses and salary of the superintendent of irrigation was to be paid pro rata by the number of counties that were seeking to have their water

rights administered at any one time. In 1911 the office of superintendent of irrigation was abolished and the governor was empowered to appoint five irrigation division engineers.

Water commissioners had to obtain a list of water rights in their water district from the courts but very seldom did the list give the owners names or where to contact them. Another thing making it difficult for the water commissioners was that many ditches had no headgates or measuring flumes, even though the statutes stated that ditches were to install these structures.

Water Commissioners and the superintendent of irrigation had water users seek injunctions against the administration of water rights. They were also sued for attempting to deliver water out of their water districts to meet the needs of downstream senior water rights which had placed river call for water. The expense of defending themselves against litigation was up to the water commissioners and superintendents. Many times the injunctions were dropped as soon as the irrigation season was over. The water users did not necessarily want to know the courts opinion in regards to river administration. They used the injunctions to allow them to continue diverting during the irrigation season.

Many water commissioners did not believe that they had to curtail diversions in their water district in order to meet calls from water rights located in downstream water districts. In fact in District 23 the Water commissioner talked to his own attorney and then based upon those conversations he declined to shut down ditches in his water district even though he had been ordered to do so by the Superintendent of Irrigation in order to meet a river call from a senior water right that came from Water District 2. Finally in 1887 the Colorado Supreme Court ruled on the issue of calls originating from downstream water Districts and the legislature also passed an act that the "enforcement of the right to the use of water without regard to the water district within which the ditches or canals may be located, may be carried into effect by the superintendent of irrigation or the state engineer, and they will not be enjoined from so doing...."

Keeping water users informed of the call and river administration was also very difficult considering the mode of travel and communication methods available to them. They needed to use assistants in order to spread the word and help administer ditches.

A great many headgates were so constructed that it was impossible to regulate the flow of water into the ditches or to lock them when they should be regulated. Water commissioners would make adjustments and return in a few hours to find them tampered with. The water commissioner

would find the locks removed on those ditches that had locks during dry seasons. Even though headgates and rating flumes were required by law, there was no penalty to those who ignored the law and they continued to take water to the detriment of senior water users. The water commissioners found themselves without power or authority. When a rating flume was installed the State Engineer was supposed to be called by the irrigation ditch systems to rate the flume at various flow rates but more specifically their decreed rate. Ditch companies were to pay the cost of his making measurements. Because of the expense, they were unwilling to pay especially since it only enabled the water commissioner to administer water more accurately.

One State Engineer wrote the following reason why rating flumes were not being installed: "No one will have a ditch rated when it is carrying a greater amount than it should, nor does the owner of a ditch that is not carrying the full decree care to have that fact made a matter of record., as it might prevent future enlargements."

The statutes were later revised to state – "each ditch must have a gate and measuring box. If the ditch owner refuses or neglects to put in properly constructed headgates and measuring boxes, it becomes the duty of the water commissioner to construct the same himself or have it done", if the ditch owner refused to pay the water commissioner then the water commissioner was to take the water right owner to court to get paid. Most commissioners were slow to carry out the provisions of this law because they had insufficient means to pay in advance for the gates and measuring boxes or to employ an attorney to represent them in recovering any funds expended.

Because of the lack of gates and flumes the distribution by water commissioner was a matter of guess work. The water commissioners were not capable of making the calculations necessary to determine the amount of water diverted. In fact State engineer J.P. Maxwell, the fourth State Engineer, stated

"the commissioners may possess general intelligence and honesty, but these alone would not suffice, and unless they were well versed in higher mathematics, the intricate formula furnished them by his department for estimating the velocity and volume of flowing water will be fill of mysteries and surprises as a bucking bronco will develop to the tenderfoot who attempts to elucidate his motions while on its back. It is not every man of good horse sense who can ride a cavorting bronco. Nor can it be expected that a person who has spent his life in whacking bulls, or engaged in some other manual pursuit will take Kutter's formula, determine

there from the coefficient of mean velocity, ratio of fall to distance, area of the cross section, wetted perimeter, hydraulic mean depth, then guess at the coefficient of roughness, extract the square root of one factor and raise another to the powers to be, and evolve from this labyrinth of Greek literature the velocity of water per second –without at least indulging in a degree of profanity that should not be encouraged. If well constructed measuring devices were constructed and properly rated by the State Engineer an intimate acquaintance with Mr. Kutter would not be necessary.”

If a water commissioner failed to perform any duties imposed on him by law, he was deemed guilty of a misdemeanor and upon conviction by a court subject to no less than \$50 and no more than \$500 fine. The \$500 fine exceeded the yearly salary of the water commissioners.

In 1896 the water commissioner for District 40 which administered the North Fork of the Gunnison, out of frustration wrote to State Engineer “In the absence of iron headgates, and locks & keys, about the only thing that suggests itself to me would be for an act that put a ball & chain on the majority of ditch owners at the opening of the irrigation season. All laws and customs have been indecently and repeatedly violated.”

The water commissioner in District 41 which administered the Uncompahgre River wrote

“We found the water thieves very shrewd and it is almost impossible for the water commissioner engaged in distributing the water to detect the average gate lifter. In watching of the headgates, we frequently found that instead of going directly to the gates, the would-be thief would search carefully through the undergrowth surrounding nearly every headgate for deputies and be assured no one was present before opening the gates. It frequently happens that several will engage in this work, one watching for commissioners while others opened the gates. A commissioner should not be obliged to station a guard on every headgate in order to distribute water.”

His solution was legislation which would impose an adequate penalty on every ditch receiving or allowing water to flow in the ditch after its gate had been duly closed or the

flow rates adjusted by the water commissioner under the priority system.

He stated “We find strong circumstantial evidence of companies employing men for the very purpose of unlawfully keeping the headgates opened, and make it their exclusive occupation to watch the water commissioner and deputies and steal as much water as possible.”

Again, the same water commissioner stated:

“Locks and headgates, as constructed, are but feeble barriers against picks and crowbars, and few ditch companies care much for their headgate in case they can get a few extra days use of the water. Locks and headgates are frequently smashed presumably by their owners; in some instances carried off bodily or floated down the river. Water commissioners are forced to then dam up the ditch with dirt and rocks which is easily removed by the thieves.”

In another instance during the summer of 1896, some 40 farmers took control of the Handy Ditch headgate near Loveland, Colorado. They accused the local water commissioner of diverting water into another canal that served the farmlands he owned. The farmers hung the commissioner in effigy and drove away the assistant commissioner at gunpoint. Denver newspapers issued special editions with bold headlines declaring it an armed rebellion. There was talk of calling out the state militia, but a crisis was averted when the local deputy sheriff was finally able to negotiate a compromise. The claims of the farmers was investigated later by the State Engineer and not found to be warranted. In either event the water commissioner resigned at the end of that irrigation season.

Despite all these historic problems, ultimately the water commissioners succeeded in getting the water users’ respect. The water users also fully recognized and accepted the need for such an administrative system even if it did occasionally take a Supreme Court ruling to clarify what was meant by the statutes.

Thinking back over time and seeing what the first water commissioners had as information to base their decisions upon when compared to the information system that is available today, it is truly amazing the changes that have occurred.

Request For Proposals

(Denver, CO)-The AWWA Research Foundation, a non-profit organization dedicated to advancing the science of drinking water, announced today that proposals are being requested for five new research projects. The projects, with more than \$1.5 million in funding available, are being sponsored by the Foundation with one or more partner research organizations.

Requests for proposals (RFPs) for the projects will be available on the Foundation's Web site on September 30 at www.awwarf.org.

Guidelines for submitting a proposal are also available on the site.

The following descriptions outline the objective of each proposed project:

"Reservoir Control and Maintenance" (RFP 3037) - Will identify and prioritize reservoir control and maintenance issues. The maximum funding available from the Foundation and the United Kingdom Water Industry Research (UKWIR) is \$437,500.

"Assessment of Physical Security Technologies for Water and Wastewater Utilities" (RFP 3044) - Will provide detailed information on commercially available security technologies and products to help utilities make sound buying decisions. The maximum funding available from the Foundation, the United Kingdom Drinking Water Inspectorate (UKDWI), and the Water Environment Research Foundation (WERF) for this project is \$250,000.

"Thermodynamic Evaluation of Advanced Water and Wastewater Treatment Technologies" (RFP 3056) - Will document the energy consumption and efficiencies of water and wastewater unit operations. The maximum funding

available from the Foundation and the California Energy Commission (CEC) for this project is \$250,000.

"Risk Assessment of Water Utility Energy Management Practices" (RFP 3058) - Will identify risks and benefits associated with energy management or energy conservation practices used by drinking water utilities and risk-mitigation approaches. The maximum funding available from the Foundation and the California Energy Commission (CEC) for this project is \$350,000.

"Water Consumption Forecasting to Improve Energy Efficiency of Pumping Operations" (RFP 3066) - Will identify, test, and evaluate available methods and tools for making short-term water consumption forecasts, necessary for optimizing pumping schedules and energy use, to support the implementation of an Energy and Water Quality Management System (EWQMS). The maximum funding available from AwwaRF and the California Energy Commission (CEC) for this project is \$250,000.

The proposals must be received by the Foundation no later than December 15, 2004, except for RFPs 3037 and 3056, for which proposals will be due January 15, 2004. All projects, unless otherwise indicated, must include 25 percent of the total project budget as in-kind or cash contribution. In-kind contributions can be in the form of labor, materials, or laboratory and other services, and may come from project participants such as water utilities, consulting firms, and universities. For each project, an appointed project advisory committee will evaluate proposals based on responsiveness to the RFP, scientific and technical merit, and qualifications of the researchers.

The AWWA Research Foundation is a member-supported, international, nonprofit organization that sponsors research to enable water utilities, public health agencies, and other professionals to provide safe and affordable drinking water to consumers. With close to 900 subscriber members in the U.S. and abroad, the Foundation has funded and managed more than 800 projects valued at more than \$340 million. More information on the AWWA Research Foundation is available at www.awwarf.org.

American Water Resources Association Upcoming Conferences

For more information and registration materials, go to <http://www.awra.org/>

2004 Annual Conference

November 1-4, 2004 -- Sheraton World Resort, Orlando, Florida

2nd National Water Resources Policy Dialogue

February 14-15, 2005 -- Loews Ventana Canyon Resort, Tucson, AZ

2005 Summer Specialty Conference

Institutions for Sustainable Watershed Management: Reconciling Physical and Management Ecology in the Asia-Pacific

June 27-29, 2005 -- Hyatt Regency Waikiki Resort & Spa, Honolulu, HI

CU water news**Lewis Receives USEPA Grant For Nitrogen and Phosphorus Study**

The USEPA Region 8 has awarded \$120,000 to William Lewis of the Center for Limnology, Cooperative Institute for Research in Environmental Sciences, University of Colorado - Boulder for a one-year project involving collection of field data and statistical analyses intended to produce a framework for regulation of nitrogen and phosphorus concentrations in Colorado waters. The regulations, which will be drafted under USEPA requirements by the Colorado Department of Public Health and Environment, may affect wastewater discharges throughout the state through the wastewater permitting process. The project will assist the CDPHE in finding a rational basis relevant to Colorado for specific degrees of limitation on nutrient disposal in Colorado waters. A pilot project leading to the USEPA proposal was funded by CWRRI.

Short Courses

For more information regarding course schedules, fees, and instructors, visit the website at www.cudenver.edu/engineer/cont. If you have any questions or would like to register over the phone, contact the Continuing Education Program at 303/556-4907 or toll free 800/859-7304.

Street/Inlet Hydraulics and Storm Sewer System Design (NCES 8223)
Thursday and Friday
November 11 and 12, 2004.
8:30 to 4:30 p.m.

The Storm Water Hydrologist Certification Program consists of four courses:
Urban Storm Water Modeling Using CUHP/SWMM Computer Models
Street/Inlet Hydraulics and Storm Sewer System Design
Storm Water Detention System Design
Urban Flood Channel Design and Culvert Hydraulics

Each course is a two-day, fourteen-hour seminar with hands-on computer operations. Students receive course notes and computer software compliant with Urban Storm Water Drainage Design Criteria Manuals for each of the four courses.

Other Courses
NCES 8180: Geometric Dimensioning and Tolerancing
Thursday and Friday, November 18 and 19, 2004; 8:00 a.m. - 5:00 p.m.; \$495

Quality Education Engineered for you!

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Colleen Anderson
Voice: 303-556-4907
Fax: 303-556-6688
E-Mail csanders@carbon.cudenver.edu

**Navigating the Future
Water Supplies in the South Platte**

15th Annual South Platte Forum

October 27-28, 2004
Raintree Plaza Conference Center
Longmont, Colorado

For more information go to www.southplatteforum.org
or contact Jennifer Brown at 402-426-0362 or jennifer@jjbrown.com

*CSM water news***Short Courses**

The International Ground Water Modeling Center is proud to present the following courses for the fall of 2004.

For more information, go to <http://typhoon.mines.edu/short-course/>

Less Than Obvious: Statistical Methods For Data Below Detection Limits

Course Instructor(s): Dennis Helsel

Course Date: October 28-29, 8 a.m. to 5 p.m.

Location: Colorado School of Mines, Berthoud Hall Room 201, Golden

Course Cost: \$895, \$995 after October 15th

Description: Values below detection or reporting limits result from measuring trace amounts of a variety of organic and inorganic chemicals. This course presents up-to-date methods for computing summary statistics, hypothesis test, and regression for data with one or more detection limits.

MODLOW: Introduction to Numerical Modeling

Course Instructor(s): Eileen Poeter

Course Date: November 4-6, 8 a.m. to 5 p.m.

Location: Colorado School of Mines, Berthoud Hall Room 201, Golden

Course Cost: \$995, \$115 after October 21st

Description: Introduces ground water professionals to numerical modeling. Basic modeling concepts: conceptual model development, definition of boundary and initial conditions, parameter specification, finite differencing, gridding, time stepping, and solution control using MODLOW-2000 and UCODE, concepts explained and reinforced with hands on exercises.

Polishing Your Ground-Water Modeling Skills

Course Instructor(s): Peter Andersen and Robert Greenwald

Course Date: November 4-6, 8:30 a.m. to 5:30 p.m.

Location: Colorado School of Mines, Green Center Room 297, Golden

Course Cost: \$995, \$1195 after October 21st

Description: Designed to provide significant detail on practical ground-water flow modeling concepts and techniques. Takes the user beyond topics covered in introductory modeling courses and beyond courses that teach the

mechanics of applying various pre-and post-processing software. Revolves around a series of realistic problem sets to highlight and compare alternative methods of ground water flow modeling.

Modeling Water Flow and Contaminant Transport in Soils and Groundwater Using the HYDRUS Computer Software Packages

Course Instructor(s): Rien van Genuchten and Jirka Simunek

Course Date: November 5-6, 8 a.m. to 5 p.m.

Location: Colorado School of Mines, Green Center Room 257, Golden

Course Cost: \$495, \$595 after October 21st

Description: Most subsurface pollution problems stem from activities involving the unsaturated (vadose) zone between the soil surface and the groundwater table. This course is designed to familiarize participants with the principles and mathematical analysis of variably saturated flow and transport processes and application of state of the art numerical codes to site specific subsurface flow and transport problems.

UCODE: Universal Inversion Code for Automated Calibration

Course Instructor(s): Eileen Poeter

Course Date: November 11-12, 8 a.m. to 5 p.m.

Location: Colorado School of Mines, Berthoud Hall Room 201

Course Cost: \$795, \$995 after October 28th

Description: We begin with a brief review of calibration concepts and introduction to inversion theory and description of inputs, outputs, and special topics associated with UCODE. Soon we move on to hands-on exercises demonstrating the application of UCODE. Each exercise involves more complex issues such that the attendees will be exposed to all available features of UCODE.

Please join us as we explore and expand the use of established technologies and methodologies for understanding and evaluating our ground water resources.

Colorado Water Resources Research Institute Publications Now Available

SR 12 – ORGANIZING FOR ENDANGERED AND THREATENED SPECIES HABITAT IN THE PLATTE RIVER BASIN by David M. Freeman, September 2003. For a paper copy, contact Gloria.Blumanhourst@research.colostate.edu

SR 13 - Stretching Urban Water supplies in Colorado, Strategies for Landscape Water Conservation by Rachel Barta, Robert Ward, Reagan Waskom, and Dan Smith, February 2004. A draft version is available at <http://cwrr.colostate.edu/pubs/series/specialreport/Landscape%20Water%20Conservation%20Draft%20Report%2002-15-04.doc> . For a paper copy of the final version, contact Gloria.Blumanhourst@research.colostate.edu.

CSU water seminars

Oct. 12 4:10 pm C-142 Clark Bldg	Larry Brazil, CEO Riverside Technology	Decision Support Systems: Role in Planning and Management
Oct. 26 4:10 pm C-142 Clark Bldg	Brian Person, Area Manager Eastern Colorado Area Office, Bureau of Reclamation	Water 2025: Preventing Crisis and Conflict in the West
Nov. 2 4:10 pm C-142 Clark Bldg	Peter Binney, Director City of Aurora Utilities Department	Water Resources Planning for a System that Needs a Quick Fix and Double Capacity
Nov. 30 4:10 pm C-142 Clark Bldg	Rick Brown Colorado Water Conservation Bd	Colorado Statewide Water Supply Investigation Results
Dec. 9 12:10 p.m. to 1:00 p.m. W9 Plant Science Bldg	Yaling Qian Dept. of Horticulture and Landscape Architecture	Urban Landscape Irrigation with Recycled Wastewater: Soil and Plant Responses

RESEARCH AWARDS

COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO
Awards for July 24, 2004 to August 29, 2004

PI	Dept	Sponsor	Title
Barbarick,Kenneth	Soil Crop Sci	City of Littleton	Land Application of Sewage Biosolids
Baron,Jill	Nat Res Eco Lab	DOI-NPS	Modeling the timeline for acidification from excess nitrogen deposition in Rocky Mountain National Park
Bestgen,Kevin	Fish Wildlife Bio	Colorado DOW	Inventory of Stream Fishes in Colorado
Bestgen,Kevin	Fish Wildlife Bio	DOI-Bureau of Reclamation	Development & Execution of a Biological Study Plan for Evaluation of Injury to Young Life States of Fish
Bestgen,Kevin	Fish Wildlife Bio	DOI-Bureau of Reclamation	Development of tools to assess effects of regulated flow and temperature regimes on ecology of flannelmouth a...
Bestgen,Kevin	Fish Wildlife Bio	DOI-Bureau of Reclamation	Population estimate of humpback chub in Black Rocks
Binkley,Daniel	Frst Rnglnd Wtrshd Stwr	USDA-USFS-Rocky Mtn. Rsrch Station - CO	Impact of Restoration Treatments on Soil Nitrogen Supply
Binkley,Daniel	Frst Rnglnd Wtrshd Stwr	USDA-USFS-Rocky Mtn. Rsrch Station - CO	Evaluation of the long-term dynamics of slash treatments in lodgepole pine
Bringi,Viswanathan	Elect Comp Eng	NSF	Field Studies of Raindrop Axis Ratio & Orientation Distributions Using an Improved 2D-video Disdrometer & ...
Brockwell,Peter	Statistics	NSF	Applied Probability & Time Series Modelling
Culver,Denise	Fish Wildlife Bio	DOI-BLM	Survey of Critical Wetlands in Fremont County on BLM Lands
Denning,A Scott	CIRA	DOC-NOAA	Impact of Interactive Vegetation on Predictions of North American Monsoons
Denning,A Scott	CIRA	DOC-NOAA	Data Fusion to Determine North American Sources and Sinks of Carbon Dioxide at High Spatial and Temporal Resolution
Dijkstra,Hendrik	Atmos Sci	NSF	Collaborative Research: Adjustment of the Antarctic Circumpolar Current to Variability in Southern Ocean Wind...

Dijkstra,Hendrik	Atmos Sci	NSF	Collaborative Research: Physical Mechanisms of (inter)Decadal Variability of the North Atlantic Ocean Circulation
Dijkstra,Hendrik	Atmos Sci	NSF	CMG Collaborative Training: Modern Mathematical Methods in Physical Oceanography
Douglas,Marlis	Fish Wildlife Bio	Colorado DOW	Rio Grande Cutthroat Trout Genetics
Duda,Joseph	CSFS	USDA-USFS-Forest Research	04CPG S Platte Watershed S. Platte Watershed
Fassnacht,Steven	Frst Rnglnd Wtrshd Stwrdr	NASA	Quantifying Scale Relationships in Snow Redistribution: A Systems Approach
Fausch,Kurt	Fish Wildlife Bio	Colorado DOW	Tools to Increase Translocation Success in Colorado River Cutthroat Trout
Fausch,Kurt	Fish Wildlife Bio	DOI-NPS-	Tools to increase translocation success of Colorado River cutthroat trout
Garcia,Luis	Civil Engineering	DOI-Bureau of Reclamation	HYDROSS Improvements
Hawkins,John	Fish Wildlife Bio	DOI-Bureau of Reclamation	Yampa River Nonnative Fish Control: Translocation of Northern Pike from the Yampa River
Johnson,Brett	Fish Wildlife Bio	DOI-Bureau of Reclamation	Provenance & Trophic Roles of Non-Native Fishes
Johnson,Richard	CIRA	NOAA	Coupling between Monsoon Convection & Subtropical Highs in the PACS Region on Subseasonal to Interannual Time Scales
Konor,Celal S	Atmos Sci	DOE	Formulation of Moist Dynamics and Physics for Future Climate Models
Kreidenweis-Dandy,Sonia M	Atmos Sci	NASA	Laboratory Investigations of the Links between Mineral Dust & Cloud Formation (Fellowship for Kirsten Koehler)
Kummerow,Christian D	Atmos Sci	NASA	Risk Mitigation Studies for Evolving Data & Information Systems Related to Rainfall Missions
Kummerow,Christian D	Atmos Sci	NASA	A Next Generation Microwave Rainfall Retrieval Algorithm for Use by Tropical Rainfall Measuring Mission & Global ...
Kummerow,Christian D	Atmos Sci	NASA	A Next Generation Microwave Rainfall Retrieval Algorithm for Use by Tropical Rainfall Measuring Mission & Global ...
Kummerow,Christian D	Atmos Sci	NASA	A Cooperative Climate Rainfall Data Center
Labadie,John W	Civil Engineering	DOI-Bureau of Reclamation	MODSIM Enhancement and Manintenance
Landon,Melissa	Fish Wildlife Bio	NatureServe	NatureServe TaskOrder CO-001-FY05 (Data Access Requirements Workshop)
Noon,Barry R	Fish Wildlife Bio	DOI-USGS-Geological Survey	Assessment of the status and distribution of amphibian populations in the Kawuneeche Valley of Rocky Mountain ...
Norton,Andrew P	BSPM	DOI-NPS	Monitoring Saltcedar (Tamarix) Biological Control (Diorhabda elongata) Insectary Establishment in Echo Park, Dinosaur...
Pielke,Roger A	CIRA	DOC-NOAA	The Response of North American Monsoon to Boundary & Regional Forcing
Poff,N LeRoy	Biology	NSF	Workshops on River Ecology & Flow Regimes
Poff,N LeRoy	Biology	EPA	Linking Watershed Characteristics with Flow Regime & Geomorphic Context to Diagnose Water Quality Impairment at Multi.....
Randall,David A	Atmos Sci	NASA	Large Ensemble Evaluation of Cloud Models and Super Parameterization Using EOS Satellite Data
Randall,David A	Atmos Sci	NASA	Large Ensemble Evaluation of Cloud Models and Super Parameterization Using EOS Satellite Data
Randall,David A	Atmos Sci	NSF	Cloud Parameterization Frameworks
Randall,David A	Atmos Sci	DOE	A Geodesic Climate Model with Quasi-Lagrangian Vertical Coordinates
Rutledge,Steven A	CIRA	DOC-NOAA	Ship-Based Observations of Precipitating Convection and Environmental Conditions in Support of N
Rutledge,Steven A	Atmos Sci	NASA	Physically-based Observational Studies for Tropical Rainfall Measuring Mission & Concept Development for ...
Shaw,Robert B	CEMML	USDA-USFS-Rocky Mtn. Rsrch Station - CO	Cultural Resources, Archaeological Surveys & Wetlands Monitoring For SOW 04-24
Shaw,Robert B	CEMML	USDA-USFS-Rocky Mtn. Rsrch Station - CO	Cultural Resources, Archaeological Surveys & Wetlands Monitoring For SOW 04-24
Venkatachalam,Chan drasekaran	Elect Comp Eng	NASA	Tropical Rainfall Measuring Mission Observations & Precipitation Microphysics: Interpretation, Precipitation ...
Venkatachalam,Chan drasekaran	Elect Comp Eng	NSF-GEO-Geosciences	Polarimetric Radar Observations of Precipitation: Measurements, analysis, Modeling & Retrievals
Venkatachalam,Chan drasekaran	Elect Comp Eng	UMASS-	ERC: The Center for Collaborative Adapative Sensing of the Atmosphere

Waskom,Reagan M	Soil Crop Sci	Colorado Department of Agriculture	Training & Education for Agricultural Chemicals & Groundwater
White,Gary C	Fish Wildlife Bio	Colorado DOW	Modeling, Design, & Analysis
Wilson,Kenneth R	Fish Wild-life Bio	USDA-USFS-Rocky Mtn. Rsrch Station - CO	Effects of design, scale, and error on biodiversity assessment methods

UNIVERSITY OF COLORADO, BOULDER COLORADO
Awards for July 1 to July 31, 2004

Pampel, Fred	USGS	Provide Research and Research Support Services in Area of Hydrology and Water Resources
Pampel, Fred	USGS	Provide Research and Research Support Services in Area of Hydrology and Water Resources
Jenkins, Chris	USGS	Database and 3D mapping techniques

WATER NEWS DIGEST

The summaries of articles on this page were compiled from the Water-Related Newspaper Article links page maintained by Loretta Lohman. For a complete version of any of these articles, and to see other articles, go to <http://www.npscolorado.com/news.html>.

Sterling -- water conservation rewarded

The Lower South Platte Water conservancy District is the first recipient in eastern Colorado of Water 2025 Challenge Grants (U.S. DOI) in recognition of its program to give customers incentive and assistance for the purchase and installation of water measurement equipment.
Denver Post Community Notes, Wednesday, Sept. 29

Pact over damage to wetlands awaits judge

A consent decree between the Justice Department and two companies accused of polluting wetlands while building Green Valley Ranch Golf Course now awaits a judge's approval and a 30-day public comment period. The companies are accused of putting dredge and fill materials into a nearby creek and adjacent wetlands. The proposal calls for \$98,500 in civil penalties and a donation of 25 acres of land for new wetlands.
Denver Post, September 29, 2004

Wells planned to gauge extent of underground contamination

Lakewood - Eight wells will be drilled next month to determine how far two underground plumes of contaminants extend east of the Denver Federal Center. The monitoring of migrating solvents and other substances will continue for at least five years.
Denver Post, September 15, 2004

Central City loses battle to deny water-storage rights to rival city

The Colorado Supreme Court said Monday that the city of Black Hawk can have conditional water-storage rights in Chase Gulch Reservoir, something the rival gaming town of Central City had strongly opposed.
Denver Post, September 14, 2004

Experts propose cities use ag water on rotational -- not permanent -- basis

To meet Colorado's water needs through 2030, a plan for rotational removal of agricultural water -- as opposed to permanent -- is an alternative a group of experts is proposing.
LaJunta Tribune Democrat, September 8, 2004

Reservoir worries spill over

The federal government should slash water releases from Lake Powell if the ongoing drought extends through the winter, officials from Colorado and neighboring states said last week. The states' request for the Bureau of Reclamation to make a midyear correction to Lake Powell's operation is an unprecedented reaction to dwindling water supplies, officials with the Upper Colorado River Commission said. The river commission could receive a response as soon as Sept. 24, when federal and state officials next meet to continue finalizing the annual operating plan for Powell and its giant downstream sister reservoir, Lake Mead.
Denver Post, September 06, 2004

CALENDAR

Oct. 10-13	Conference on Tailings and Mine Waste '04. Fort Collins, CO. For more information contact: Linda Hinshaw, Dept of Civil Engr., CSU, phone 970-491-6081, fax 970/491-3584, email lhinshaw@enr.colostate.edu .
Oct. 13	Workshop on Water Quality. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Oct.13-16	Water Rights and Related Water Supply Issues. Salt Lake City, UT. For more information go to: www.uscid.org/oridcall.html .
Oct. 14	Endangered Species Conference. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Oct. 17-20	2004 American Institute of Hydrology 2004 Annual Meeting and International Conference: Integrated Water Resources Management. Las Vegas, NV. For more information go to: www.aihydro.org or email AIHdro@aol.com .
Oct. 20	A Review of Federal Environmental Laws. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Oct. 26	Centennial WSD's Water Use Rate Structure. Denver, CO. For more information go to: http://www.awra.org/state/colorado/ .
Oct. 27-28	Navigating the Future: Water Supplies in the South Platte. Longmont, CO. For more information go to: www.southplatteforum.org or email jennifer@jbbrown.com .
Oct. 28-29	Less Than Obvious: Statistical Methods for Data Below Detection Limits. Colorado School of Mines, Berthoud Hall Room 201, Golden, CO. For more information go to: http://typhoon.mines.edu/short-course/
Oct. 27	Workshop on the Initiative Process. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Oct. 29	Leadership Workshop for Board Members of Water Conservancy and Conservation Districts. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Nov. 1-4	American Water Resources Association 2004 Annual Conference. Orlando, FL. For more information go to: http://www.awra.org/ .
Nov. 1	What You Should Know About The Legislative Process: The Law, The Rules, And The Practices. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Nov. 3	Legal Ethics In Water and Environmental Law. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Nov. 4-6	MODLOW: Introduction to Numerical Modeling with Eileen Poeter. Colorado School of Mines. For more information go to http://typhoon.mines.edu/short-course/ or email igwmc@mines.edu .
Nov 4-6	Polishing Your Ground-Water Modeling Skills with Peter Andersen and Robert Greenwald. Colorado School of Mines. More information in this newsletter or go to: http://typhoon.mines.edu/short-course/ or email igwmc@mines.edu .
Nov. 4	New Irrigation Technology: Benefits and Challenges. Denver, CO. For more information contact: Laurie D'Audney at ldaudney@fcgov.com .
Nov. 5-6	Modeling Water Flow and Contaminant Transport in Soils and Groundwater using the HYDRUS Computer Software Packages with Rien van Genuchten and Jirka Simunek. Colorado School of Mines. For more information go to: http://typhoon.mines.edu/short-course/ or email igwmc@mines.edu .
Nov. 6-8	MODLOW: Introduction to Numerical Modeling. Colorado School of Mines, Berthoud Hall Room 201. For more information go to: http://typhoon.mines.edu/short-course/
Nov 11-12	Street/Inlet Hydraulics and Storm Sewer System Design. University of Colorado at Denver Continuing Engineering Education Program. For more information go to: www.cudenver.edu/engineering/cont .

Nov. 10	What You Should Know About the Nine Interstate Compacts that Colorado Is A Signatory. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Nov. 11-12	UCODE: Universal Inversion Code for Automated Calibration. Colorado School of Mines. For more information go to: http://typhoon.mines.edu/short-course/ or email igwmc@mines.edu .
Nov. 18-19	Geometric Dimensioning and Tolerancing. University of Colorado at Denver Continuing Engineering Education Program. For more information go to: www.cudenver.edu/engineering/cont .
Nov. 30	SWSI. Denver, CO. For more information go to: http://www.awra.org/state/colorado/ .
2005	2005
Jan. 18	Endangered Species / Three State Agreement. Denver, CO. For more information go to: http://www.awra.org/state/colorado/ .
Jan. 27-28	Colorado Water Congress 47th Annual Convention. Denver, CO. For more information go to: www.cowatercongress.org , or phone 303/837-0812, or email macravey@cowatercongress.org .
Feb. 11-12	Storm Water Detention System Design. University of Colorado at Denver Continuing Engineering Education Program. For more information go to: www.cudenver.edu/engineering/cont .
Feb. 17-15	2nd National Water Resources Policy Dialogue. Tucson, AZ. For more information go to: http://www.awra.org .
Feb. 22	Bureau of Rec. Projects in Colorado. Denver, CO. For more information go to http://www.awra.org/state/colorado/ .
Mar. 29	Fountain Creek USACE Watershed Study. Denver, CO. For more information go to: http://www.awra.org/state/colorado/ .
April	Annual Symposium of American Water Resources Association Colorado State Section. For more information go to: http://www.awra.org/state/colorado/ .