

COLORADO WATER RESOURCES RESEARCH INSTITUTE

Fostering research to address Colorado's water information needs

I. Research as a water management tool

Colorado water managers are provided a number of 'management' tools by our constitution, legislation and institutional arrangements. These include water rights and administration (the State Engineer's Office, CWCB, and Water Quality Control Commission), physical infrastructure developments (the CWCB Construction Fund and the Colorado Water Resources and Power Development Authority State Revolving Loan Program), water quality criteria, water quality standards, financial aid (i.e. grants and loans), planning (Statewide Water Supply Initiative and Northern Integrated Supply Project), measurement systems (stream gauging and water quality monitoring), education (e.g. 319 Program, Cooperative Extension, and Colorado Foundation for Water Education) and research. When water conflicts emerge, research-based information can help inform the debate, and in some cases, assist decision makers as they attempt to reconcile the legal, historic, management and scientific basis for a particular water problem.

Water research is conducted by a number of entities and agencies, but perhaps the CWRRI is unique in that research is its primary function, specifically research conducted by state's higher education faculty.

II. History of water research in Colorado

To understand water in CO, must understand history. Water research also has rich tradition in CO.

- Elwood Mead (1880 First ever Ag Exp Sta Bulletin 1886.) and Ralph Parshall (1920) to current scientists Luis Garcia, Tim Gates, Kurt Fausch
- Key – tight connection between those who create new knowledge and those who use.
- CWRRI – 40 years and over 450 research reports.

Examples of water research areas include:

- Water Law and Policy
- Watershed Sciences
- Fishery and Wildlife Biology
- Sociology and Water
- Political Science and Water
- Economics and Water
- Recreation and Tourism
- History of Water in Colorado and the West
- Water Resources Archives

III. Current research expertise in higher education spread across CU, CSU, CSM, UNC, et al

- More than 180 faculty in all Colorado institutions of higher education apply disciplines to water.
- At CSU, the 100 faculty, in 22 departments, teach over 150 courses related to water.
- CWRRI facilitates collaborative water projects funded by private, local, regional, state and federal organizations. Approach is to find faculty that are interested in these connections and to know who is doing what kind of research.

IV. Purpose of CWRRI

To connect the water expertise of Colorado's higher education system with the water education and research needs of Colorado's water managers and users.

The Colorado Water Resources Research Institute (CWRRI) is a Congressionally and Legislatively authorized, university-based, water research institution.

CWRRI is one of 54 water institutes that exist in each state and several territories under Congressional authorization and funding. Each water institute is located on the land-grant university campus, but serves 'water' faculty on all campuses of higher education in the state or territory.

Under The Water Resources Research Act authorized by P.L. 101-397, these institutes are to:

- "1) plan, conduct, or otherwise arrange for competent research that fosters (A) the entry of new research scientists into the water resources fields, (B) the training and education of future water scientists, engineers, and technicians, (C) the preliminary exploration of new ideas that address water problems or expand understanding of water and water-related phenomena, and (D) the dissemination of research results to water managers and the public.
- 2) cooperate closely with other colleges and universities in the State that have demonstrated capabilities for research, information dissemination, and graduate training in order to develop a statewide program designed to resolve State and regional water and related land problems."

CWRRI has been in existence since 1965 and operates a modest, state-based water research program funded, cooperatively, by Congress, Colorado State University (CSU) and Colorado water management organizations.

V. Federal and Colorado authorization for CWRRI

- Congressional reauthorization in 2000.

- Colorado legislative reauthorization in 2006.

VI. CWRRI Operations

- Federal funding administered by USGS (must be appropriated by Congress each year)
- CSU provides state 2:1 match for federal funds
- CWRRI received \$500,000 in FY07 state funds for water research
- Advisory Committee on Water Research Policy guides research program (membership attached)

VII. Example Research Projects that have impacted Colorado water management

1. One of the CWRRI sponsored research projects, the South Platte Mapping and Analysis Program is currently being enhanced to establish well augmentation plans for consideration in Water Court. The Integrated Decision System Alluvial Water Accounting System (IDS AWAS), developed by a CSU research team lead by Luis Garcia (in collaboration with the Northern Colorado Water Conservancy District, South Platte Lower River Group, Inc., Central Colorado Water Conservancy District, Colorado State Engineer's Office, and the Lower South Platte Water Conservancy District), has been adopted by the State Engineers office. On May 6, 2006, Hal D. Simpson, the State Engineer issued Procedures Memorandum 2006-1 to all Division of Water Resources Staff announcing *"In an effort to modernize the software used to model stream depletion caused by well pumping, the Division of Water Resources has selected the IDS AWAS software as the standard software to be used by all."* Furthermore, the memorandum stated, *"Evaluators and Engineering staff must use the IDS AWAS Stream Depletion Model, and the Records staff must direct customers to use this software in conjunction with our data."*

The IDS Alluvial Water Accounting System (IDS AWAS) developed by the Integrated Decision Support Group (IDS) at Colorado State University (www.ids.colostate.edu) is a tool that responds to the need for augmentation plans to accurately account for groundwater withdrawals and depletions. The science behind conjunctive management of ground and surface water has received renewed interest in recent years as court approved augmentation plans must be in place to insure that well pumping does not injure senior water rights.

IDS AWAS helps water managers meet the challenges posed by new court decrees and legislation related to the South Platte by providing them with an accurate accounting tool. IDS AWAS provides users with the option of calculating river depletions using The Analytical Stream Depletion method developed in 1987 by Dewayne R. Schroeder. This method uses analytical equations described by Glover (Glover 1977) and others. The model allows users to calculate depletions using daily or monthly time steps. The user may evaluate a number of different boundary conditions (alluvial, infinite, no flow and effective SDF). IDS AWAS can create model input in two ways: 1) each well can have a list of pumping records consisting of a pumping rate and duration (original mode), or 2)

input records consisting of net consumptive use or recharge in a daily or monthly time step can be used. Year type can be set to calendar, irrigation, or USGS.

Data can be projected into the future or past based on historical data, and the effect of turning off the well by specifying an end date beyond the period of record can be simulated. This software can be downloaded from:

<http://www.ids.colostate.edu/projects/idsawas>. IDS AWAS is one component in a suite of tools called the South Platte Mapping and Analysis Program that was initiated with funding from the Colorado Water Resources Research Institute (CWRI) in 1995. Since that time, the user-centered tools have garnered support and funding from numerous other sources including several water users organizations, the state engineers office, Colorado Cooperative Extension Service, and the Colorado Agricultural Experiment.

The South Platte Mapping and Analysis Program (SPMAP) tools are developed by the Integrated Decision Support (IDS) Group at Colorado State University (www.ids.colostate.edu) with the active participation of area water users and staff from the Division One State Engineer's Office. The primary function of these tools is to accurately determine the timing and amounts of tributary groundwater withdrawals used for irrigated agriculture and resulting river depletions in a region where ground and surface water are conjunctively used. The tools have confirmed their worth by easing disputes during Colorado's recent unprecedented drought.

IDS AWAS and the other SPMAP tools were developed in a collaborative manner which involved water user groups, the state engineer's office and university researchers. The SPMAP project is an excellent example of how a number of diverse stake holders can contribute to the development and use of common computer tools which can benefit all.

2. Understanding and documenting the state-of-the art relationship between forest management practices and water yield for policy making purposes (Dr. Lee MacDonald's work with Denver Water, the Northern Colorado Water Conservancy District, and the Colorado River Water Conservation District). Lee MacDonald's forest-water study was a well received overview of the state-of-the-art science that greatly informed a political debate regarding logging for water. Not everyone was happy with the findings, but the good science in the report informed the debated properly and effectively

In the two above studies a key factor in the success of the research has been the involvement of stakeholders from the beginning. In other words, the users of the research are involved in planning the research and guiding its conduct, thus they embrace the findings and quickly make use of them. Other research projects that have influenced water managers include:

3. Colorado River Severe Sustained Drought Study (funded by all seven water institutes in the Colorado River Basin. The CRWCD and others have used this study in their examination of the firm yield of the Colorado River basin.

4. The Drought Study authored by Nolan Doesken was the most popular publication CWRRI ever had - it was published right before the 2002 drought began, so timing was a key factor in its success, but also it was well written and conveyed considerable new insight into Colorado's climate related to drought.

5. Agricultural Water Conservation Study led by Dan Smith was another study that used input from key water leaders to produce new insight and understanding on a critical issue.

6. Dr. Ramchand Oad's work on urban lawn watering return flows was supported by Colorado Springs and the State Engineer to resolve a key conflict on issues related to return flow from irrigation of urban landscapes. Municipalities in Colorado with rights to transmountain water and other "use to extinction" water rights have examined lawn irrigation as a possible source to augment their supplies. They claim that a significant percentage of water applied to lawns is not used by the turf grass, and eventually returns to the streams and ground water systems. In accordance with their water rights, this deep percolation water can be reused by the municipalities. Return flow credits, therefore, involve significant amounts of additional water supply and financial benefits to municipalities. To quantify irrigation-deep percolation relationship, municipalities have used small lysimeters whose accuracy in estimating turf grass consumptive use and deep percolation was not well established. To provide an independent analysis, research was conducted at the Colorado State University, CSU (1992-96) on the accuracy of methodologies used by various cities to estimate deep percolation as a function of applied water. It also analyzes how these methodologies were evaluated by the Water Courts in their decisions concerning credits for return flows.

7. Helping define, in a scientifically sound manner, the life cycle water needs of threatened fish species so that water managers and Colorado legislators can adjust water management practices to protect aquatic ecosystems while not damaging the profitability of Colorado agriculture (Dr. Kurt Fausch's work with the Brassy Minnow);

8. Urban Landscape Irrigation with Reclaimed Wastewater: Tracking Soil and Plant Impacts. Documenting and understanding the limitations of using recycled wastewater on urban landscapes thus insuring this use for recycled water for many years to come Yaling Qian, CSU, Project Director (in collaboration with Denver Water and the City of Denver).

VIII. Water management topics being addressed by current research projects

- Developing improved scientific projections of firm yield in the Colorado River Basin (Dr. Jose Salas's work with the Colorado River Water Conservation District and CWRRI Graduate Fellow Julia Keedy, Civil Engineering, Colorado State University)

- Colorado's Evolving Irrigated Agriculture: Economic Accounting and Impact Analysis. (Dr. James Pritchett with CWRRI Graduate Fellow Jennifer Thorvaldson, Agriculture and Resource Economics, Colorado State University)
- Occurrence and Fate of Organic Wastewater Contaminants in Wastewater Systems and Implications for Water Quality Management. (Dr. Robert Siegrist with CWRRI Graduate Fellow Kathleen DeJong, Environmental Science and Engineering, Colorado School of Mines)
- Provide strong scientific backup for installation and long-term operation of the new large weighing lysimeter at the Rocky Ford Experiment Station which is part of the Arkansas River Compact Settlement (CWRRI coordinated the peer review of the design for the lysimeter)

VIII. Water Research Challenges

- **Interdisciplinary studies** are increasingly being sought by funding agencies.
- **Stakeholder involvement** is increasingly sought for inclusion in major water research projects.
- The public increasingly seeks a stronger connection between **science and policy**.
- **Scale** of water research must be connected to global climate research.
- Fed investment in water resources research has been static for 30 years, meanwhile issues have only increased – water quality, endangered species, growth impacts, homeland security...

IX. Communication of results to water users and managers

- Completion reports and 'information' bulletins
- Newsletter
- Home pages on the internet: <http://cwrr.colostate.edu/>
- Co-sponsor water meetings

CWRRI's technology transfer efforts include the CWRRI newsletter, *Colorado Water*, which serves as a conduit of information between Colorado's higher education 'water' faculty and Colorado water managers and users. The newsletter, published six times a year, is distributed to over 1800 water users, managers, faculty, legislators and Congressional representatives. CWRRI also publishes research reports in a variety of formats designed to meet the information needs of various audiences. CWRRI maintains two web sites on the internet: (1) the CWRRI home page that describes the water-related activities, water expertise, water research results and water educational programs of Colorado's universities in detail: <http://cwrr.colostate.edu> and (2) the Colorado Water Knowledge home page that provides the public with basic information about Colorado's water resources: <http://waterknowledge.colostate.edu>.

CWRRI

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Web Pages:

CWRRI Web Page: <http://cwrri.colostate.edu>
CSU Water Center: <http://watercenter.colostate.edu>
Water Knowledge Web Page: <http://waterknowledge.colostate.edu>
CSU Student Water Symposium: <http://watersym@lamar.colostate.edu>
Hydrology Days: <http://hydrologydays.colostate.edu>

2006/2007 CWRRI ADVISORY COMMITTEE ON WATER RESEARCH POLICY

Appointed by position

Chair, Senate Agriculture, Natural Resources and Energy Committee
Senator Jim Isgar

Chair, House Agriculture, Livestock and Natural Resources Committee
Representative Kathleen Curry

Executive Director, Department of Natural Resources
Russell George (Frank McNulty)

Executive Director, Department of Public Health and Environment
Steve Gunderson, Director WQCD-CDPHE

Commissioner, Department of Agriculture
Don Ament

Appointed by CWRRI Director

Fred Anderson
Former Pres. Colorado Senate
Loveland, CO

Eric Kuhn, Manager
Colorado River Water
Conservation District
Glenwood Springs, CO

Jim Broderick, Manager
Southeastern Colorado Water
Conservancy District
Pueblo, CO

John Porter, Retired Manager
Dolores Water Conservancy
District
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