

Colorado Water

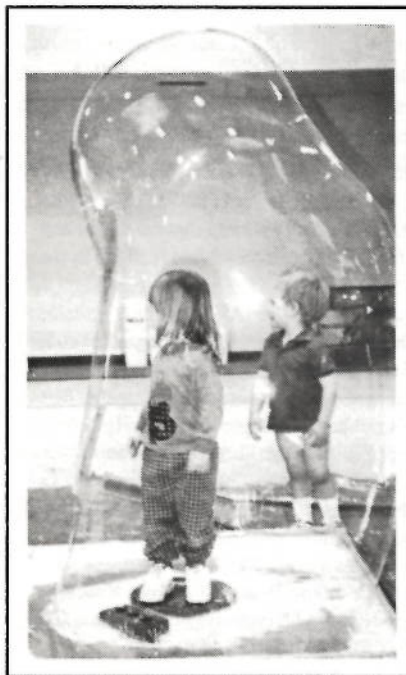
Newsletter of the Colorado Water Resources Research Institute, Fort Collins, Colorado 80523

WATER ITEMS AND ISSUES . . .

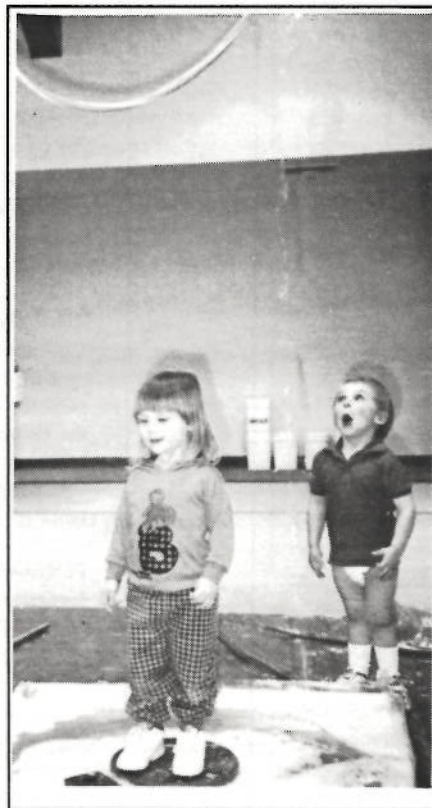
April 1995

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COLORADO CHILDREN LEARN ABOUT WATER ... see page 14



BUBBLEOLOGY IS FUN FOR ALL AGES . . .



. . . WO...OOO...OW !!!

OPEN FORUM

**Agreements Written with Water:
Prospects for Integrated
Watershed Management
for the Cache la Poudre Basin**

**April 26, 5:00 p.m.-8:00 p.m.
Lory Student Center, North Ballroom
Colorado State University**

WHO: Teresa Rice, Natural Resources Law Center; Doug Robotham, Colorado Department of Natural Resources; Skip Underwood, U.S. Forest Service; Kathleen Klein, Colorado Water Resources Research Institute; Eric Wilkinson, Northern Colorado Water Conservancy District. **Moderator:** Robert C. Ward, Director, Colorado Water Resources Research Institute. *Sponsored by CSU Chapter of AWRA and ASCSU. Call David Graf, 491-6308/5661.*

BAD NEWS/GOOD NEWS!

by Robert C. Ward

The Bad News First

As in 1994, the Administration has proposed elimination of funding for the U.S. Geological Survey's Water Research Institute program. The text of the Interior's FY 1996 Briefing Book contains the following quote:

The program has yielded productive research and education; USGS has made a difficult decision to eliminate the program in order to maintain in-house research and investigations efforts which address national priorities and needs.

As noted in this quote, the Water Institute program, nationally, has been a productive program. In fact, as a federal/state cooperative effort to assist state and local water managers in addressing state and local water problems, it has been a tremendous success.

Why has it been so successful and yet receives so little funding (and has to struggle to keep the funding it does receive)? The National Water Institute Program was established with passage of the Water Resources Research Act in 1964 -- just before passage of major new environmental legislation in the late 1960s and 1970s. With passage of new environmental legislation, that included a major legal "hammer," came the need on the part of state and local water users and managers to solve problems defined for them in Washington, D.C. The nature of the problems shifted regularly as federal programs were litigated, with cases pushing concern first here, and then there. Over time, the focus of many of the federal regulatory programs drifted away from what was actually happening to state and local water users and focused almost exclusively on federal law and policy and national regulations. Where does a state-based, federally funded water institute fit in here?

CWRRI has struggled to keep Colorado water users and managers informed about the science and technology of new changes, new requirements, new demands, and new concerns. At the same time, CWRRI's budget held constant or was reduced.

Today there is considerable support for reducing many of the federal mandates and carefully examining the "takings" associated with, as some perceive, an overly aggressive environmental enforcement policy. How can CWRRI play a role? A state-based, federally-funded, water research effort to assist state and local water users and managers is an alternative that could meet the needs of many sides in the debate. By reauthorizing and increasing funding for the National Water Institute Program, Congress could balance what some see as a heavy-handed federal approach to water management with the research, education and outreach model that is best represented, in Colorado, by the Colorado Water Resources Research Institute. Since Federal water regulations and programs have

their primary impact at the state and local level, there is need for a federal program that is state-based and carefully directed toward solving problems that the state water users and managers deem critical. CWRRI has served that role in Colorado for 30 years.

The 28 members of CWRRI's Research Planning Advisory Committee annually determine the top water research needs for Colorado. They then rank the proposals submitted by faculty to address these problems. This sharp focus on local problems using local water users, managers, and university researchers is a hallmark of the water institute program.

The success of the highly regarded National Water Institute Program, I believe, stands as a very strong argument for not only reauthorizing and restoring federal funding for CWRRI, but also for increasing its funding in an attempt to better balance

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Robert C. Ward, Director

large "in-house" federal water research activities with efforts that are more strongly oriented to meeting state and local water needs using state and local water expertise. I would go so far as to suggest that the National Water Institute Program should serve as a model for future federal assistance to states to solve their natural resource and environmental problems.

I greatly appreciate past support for CWRRI from Colorado water users, managers and the readers of *COLORADO WATER*, and any guidance and support you may be able to provide now would, again, be appreciated.

Now the Good News!

This newsletter lists, on page 4, the FY 1995/96 CWRRI projects. I want to briefly comment on them, as I think they reflect the essence of what I've discussed above. Again, CWRRI is funding basic and applied (knowledge synthesis) projects.

First, looking at the more basic research, Colorado's river compacts are increasingly being called upon to buttress Colorado's claim to its "fair share" of each river's water. Dan Tyler, who is currently writing a biography of Delph Carpenter, will undertake an assessment of Carpenter's thoughts and opinions of the LaPlata, North Platte, Laramie, South Platte Arkansas and Rio Grande compacts. This understanding should help all water users better understand how the framers of these compacts foresaw future water management in the basins mentioned.

Wendy Harrison and Donald Macalady, with the Colorado School of Mines, will assess acid mine drainage impacts to ground water systems, using the Tennessee Park as a case study. As a followup to past work, Ramchand Oad and his colleagues at CSU will move beyond comparing measurements from different lysimeters to estimating return flows from urban water use. This work, which has been matched by the State

Engineer's Office and the City of Colorado Springs, will help Front Range cities evaluate and interpret the data from their own efforts to measure return flows from urban lawn watering.

Jim Heaney's work at CU proposes to move urban water conservation beyond coarse measurements into much more refined considerations. Jorge Ramirez will develop a GIS, physically-based methodology to obtain independent estimates of regional actual and potential evapotranspiration.

Now turning to the more applied work that is being conducted in concert with Colorado water users and managers, John Stednick, with cooperation and support from the Farmers Reservoir and Irrigation Company, will be examining the potential for water quality degradation as a result of water exchanges, using the Burlington Ditch as a case study.

David Getches and Teresa Rice with CU and Dan Smith with CSU will, together, be assisting the Yampa River Basin Partnership as they examine their legal and agronomic options for accomplishing locally derived goals through incentives.

Luis Garcia will be evaluating the SAMSON model for use within a Decision Support Context. Luis will be working closely with the State Engineer's Office and the Northern Colorado Water Conservancy District.

Many additional proposals were received this year that warranted support, and, with over 180 "water" faculty in Colorado's higher education system, there are many more projects that could be undertaken.

I want to thank CWRRI's Research Planning Advisory Committee and Technical Advisory Committee for their time and effort in carefully reviewing this year's proposals. It takes considerable support and cooperation to accurately match higher education's water expertise to the research needs of Colorado's water users and managers.

INTERAGENCY ANNOUNCEMENT OF OPPORTUNITY -- NSF/EPA Partnership for Environmental Research

The National Science Foundation (NSF) and the Environmental Protection Agency (EPA) will support a special awards competition in FY1995 based on a Memorandum of Understanding signed on December 8, 1994 which establishes a partnership between the two agencies emphasizing the support and merit review of fundamental, extramural environmental research. The three research areas targeted by this Announcement of Opportunity are:

- At least \$10.0 million for **Water and Watersheds**, with a projected award range of from \$75,000 to \$500,000 per award per year, and an approximate duration of 2 to 3 years.
- Up to \$6.5 million for **Technology for a Sustainable**

Environment, with a projected award range of from \$75,000 to \$150,000 per award per year, and an approximate duration of 2 to 3 years.

- At least \$2.5 million for **Valuation and Environmental Policy**, with a projected award range of from \$60,000 to \$100,000 per award per year, and an approximate duration of 2 to 3 years.

Proposals submitted should be prepared and submitted in accordance with the guidelines provided in the NSF brochure, Grant Proposal Guide (GPG), NSF 94-2 (contact your contract and grant or sponsored programs office).

EPA REGION VIII ROCKY MOUNTAIN HEADQUARTERS MINING WASTE INITIATIVE

EPA Region VIII has limited funding (available to qualified recipients through a competitive process) to help meet the objectives of the Rocky Mountain Headwaters Mining Waste Initiative. Grants or cooperative agreements will be awarded to the respondents whose proposals are

judged most qualified by a panel of EPA Region VIII reviewers. **Deadline: May 1, 1995.** For information contact your Sponsored Programs or Contracts and Grants Office or Jim Dunn, Region VIII EPA, Phone 303/293-7030, FAX 303/391-6957.

NEW WATER RESEARCH -- 1995-96 CWRRI RESEARCH PROJECTS

Delph E. Carpenter and Colorado's Interstate Compacts...

Delph E. Carpenter, Colorado's first interstate streams commissioner, is remembered as the "Father of Colorado River Treaties." Less well-known is the fact that Carpenter used similar principles in drawing up other interstate compacts. This research will focus on: Colorado's other interstate river compacts and the origins and application of the compact idea; the impact of two significant Supreme Court decisions on Colorado's assumption that the state owned all of its waters; the decision by Colorado officials to stress the doctrine of "equitable apportionment" of interstate rivers rather than the doctrine of "prior appropriation" in making agreements with other states; an analysis of the state-vs-federal battle for control of western waters; the problems of faster-growing lower basin states considered against the desire of upper basin states to preserve their water rights for future development, including early views on reservoir storage, return flows and conservation; and the origins and intended meanings of the compacts in light of the current demands by the federal government and by Colorado's neighboring states to buy, lease or exchange water. *Principal Investigator: Dan Tyler, History Department, Colorado State University.*

Estimating Return Flows in Urban Lawn Water Use

An estimated 55 to 70 percent of summer water use along the Front Range goes for lawn watering. With projected urban growth along the Front Range corridor, lawn water use emerges as an area where water savings could be considerable. The goal of this continuing research is to estimate the amount of water lost as deep percolation during lawn watering. Using 24 small drainage and weighing lysimeters and two standard lysimeters (one drainage and one weighing), researchers will investigate: the amount of deep percolation based on the amount of water applied; the amount of deep percolation based on the frequency of the water applications; and the amount of deep percolation as a function of soil type for various frequencies and amounts of water applied.

The site for field research is the Agricultural Engineering Research Center at Colorado State University, which has a large, one meter square weighing lysimeter, 24 small weighing and drainage lysimeters, and a complete weather station. The two types of small lysimeters represent those used by the City of Colorado Springs (drainage) and the City of Denver (weighing). The State Engineer's Office and the City of Colorado Springs have provided supplemental funds for the research. *Principal Investigators: Ramchand Oad and Terry Podmore, Department of Chemical and Bioresource Engineering, Colorado State University.*

Characterization of Metal Transport Between an Alluvial Aquifer and a Natural Wetland Impacted by Acid Mine Drainage

For the past seven years, the Upper Arkansas River Toxic Substances Hydrology Program of the U.S. Geological Survey, in cooperation with the Colorado District of the USGS Water Resources Division, has conducted a variety of geochemical studies at the St. Kevin Gulch site, located in the upstream reaches of the St. Kevin Gulch tributary to Tennessee Creek. St. Kevin Gulch receives acidic mine drainage from the mining district and contributes acidic water to Tennessee Creek, the Arkansas River, and ultimately Pueblo Reservoir. Most studies have focused on surface water impacts to St. Kevin Gulch, and limited groundwater data were available. This project will characterize metal transport from the acid mine drainage source of St. Kevin Gulch to the groundwater system of Tennessee Park, an intermontane valley at the northern headwaters of the Arkansas River. The nature and extent of low-pH, metal-rich water in groundwater as well as the physical and chemical processes which dominate the subsurface fate and transport of acid mine drainage will be assessed. *Principal Investigators: Wendy Harrison, Department of Geology and Geological Engineering, Colorado School of Mines, and Donald Macalady, Department of Chemistry and Biochemistry, Colorado School of Mines.*

Urban Water Conservation -- Current Status and New, Process-Oriented Approach

Demand Side Management -- showing that existing water supplies are used effectively -- is being pursued aggressively in Colorado. This research will provide a reliable method to estimate the expected benefits, costs, and reliability of various water conservation practices. The research goals are threefold: to inventory and summarize the state-of-the-art in urban water conservation in Colorado and elsewhere; to develop a database on the effectiveness of urban water conservation practices, directly measuring urban water use patterns using a new method that permits water use to be measured continuously for individual customers; and to develop a reliability-based model for evaluating the expected benefits, costs and reliability of water conservation programs using a spreadsheet-based model called CIRCE.

The resulting software should be of direct value to public water providers in Colorado who must submit water conservation plans to the Colorado Water Conservation Board by July 1, 1996 and also benefit the CWCB, which must review conservation plans. *Principal Investigator: James P. Heaney, Department of Civil, Environmental and Architectural Engineering, The University of Colorado.*

Implementation of the Complementary Relationship for Estimation of Actual and Potential Evapotranspiration in Colorado

At the heart of most water issues is the problem of accurately estimating both water available for optimal allocation and the demands imposed on the water resource system. Thus, accurate water balances are essential. One of the most difficult terms to describe and estimate is actual evapotranspiration (ET). ET controls watershed response through its effects on water storage and distribution in space and time, thus determining net available water supply. This research will develop actual and potential evapotranspiration (AET and PET) maps at spatial scales ranging from 1 km² to 1000 km² for the State of Colorado. A computer-based, physically-based methodology will be implemented to obtain independent estimates of regional

AET and PET. This methodology will be implemented in a GIS environment so that estimates of AET and PET, as well as other water budget components, can be easily obtained on a spatially-distributed basis, at local and regional scales. A database of point measurements of hydrometeorological variables (precipitation, maximum and minimum temperatures, dew point temperature, solar radiation and wind speed) will be implemented. The proposed methodology will yield estimates based on physical relationships that do not require calibration and that are functions of physical parameters *readily measurable*. *Principal Investigator: Jorge A. Ramirez, Department of Civil Engineering, Colorado State University.*

1995-96 CWRRI KNOWLEDGE SYNTHESIS PROJECTS

YAMPA BASIN LEGAL/AGRONOMIC SUPPORT

The Yampa Basin as a Model for Watershed Problem Solving

Jim Lochhead, Director of Colorado's Department of Natural Resources, recently noted that watershed efforts in Colorado offer the opportunity for the state to develop, with local leaders, a shared vision of what a watershed should be. This project will assist one such group, the Yampa River Basin Task Force, by providing an understanding of relevant state and federal laws that might affect its ability to address identified resource goals and objectives. The Yampa River Basin currently is being evaluated for the role it might play in the recovery program for the Colorado squawfish. Also, segments of the river are being studied for possible designation under the federal Wild and Scenic Rivers Act. This research will identify and examine state and federal laws affecting the ability of local stakeholders to develop and implement solutions to resource management problems. *Principal Investigators: David H. Getches and Teresa Rice, Natural Resources Law Center, The University of Colorado.*

Watershed Problem Solving in the Yampa Basin: Agricultural Issues

The Yampa River Basin Task Force has identified the protection and enhancement of agricultural interests, water quality, and water rights as priority issues. With the existing pattern of basin water use heavily weighted toward agricultural interests, there is potential for conflict between these stated goals and other priorities within the basin. Agricultural water users could be significantly impacted by economic development decisions or public agency initiatives. This research, conducted in collaboration with David A. Getches and Teresa Rice, will provide the task force with better information on the nature of agricultural water use in the basin in relation to agricultural output -- the geographical distribution of use, the magnitude of consumptive use in relation to diversions, the timing of use, and the potential impact of water transfers on agricultural productivity in the basin. *Principal Investigator: Dan Smith, Department of Soil and Crop Sciences, Colorado State University.*

SOUTH PLATTE WATER QUALITY

Design of a Water Quality Monitoring Program to Assess Potential Water Quality Changes Under Hydrologic Modification

Colorado's prior appropriation doctrine allows trans-basin diversion of waters, where water may be moved from outside the basin-of-origin and used wherever the right holder desires. Snowmelt runoff, captured in mountain reservoirs, often is released later in the summer when water demands are high and natural streamflows are low. This hydrologic modification has the potential to significantly modify fish habitat and sediment transport as well as other physical channel characteristics. Additionally, water exchanges allow upstream water rights holders to use water and return other waters to the stream

segment, even when the upstream user is junior to the downstream users. In the Burlington Ditch-Barr Lake system, upstream exchanges are proposed that would use South Platte River water which would be replaced by treated wastewaters from treatment plants. This research, conducted in cooperation with FRICO, will define potential water quality changes from existing water exchanges in the Barr Lake system. *Principal Investigator: John D. Stednick, Department of Earth Resources, Colorado State University.*

SOUTH PLATTE MODEL EVALUATION

Evaluating the SAMSON Model For Use Within a Decision Support Context

The original version of the SAMSON Model (Stream-Aquifer Model for Management by Simulation) was completed in 1987. It was developed over a 15-year period as a river basin model, specifically for the South Platte, to provide daily management information and guidance for long-term strategic planning. This included developing the conjunctive use of water to the fullest extent and understanding how to recharge the aquifer -- even with the complex interactions of water rights, irrigation, pumping, diversions, and water reuse. The South Platte aquifer provides 25 million acre-feet of storage. SAMSON should be able to measure the amount of "active" storage and how it can be used conjunctively with surface flow needs. The model depicts stream aquifer interactions and the effects of pumping for the reach of the South Platte River from Balzac to Julesburg.

This evaluation of the SAMSON model will be done within a Decision Support context, problems will be addressed, and the role that SAMSON might be able to play will be identified. Initially, major issues that users have with respect to use of the model will be identified. To maintain close links with the user community, a working group will be formed, initially of one or two representatives each from the Northern Colorado Water Conservancy District and the State Engineer's Office. The current computer code will be assessed, and the working group will develop a plan of action to study the model in the context of the concerns users have as well as to determine the role it could play in any DSS effort for the South Platte River System. *Principal Investigator: Luis Garcia, Department of Chemical and Bioresource Engineering, Colorado State University.*

WATER RESEARCH UPDATE -- State Water Institute Program

CONSUMPTIVE USE AND RETURN FLOWS IN URBAN LAWN WATER USE

by

*Ramchand Oad, Associate Professor and Michael DiSpigno, Research Assistant
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Colorado State University*

The results reported are based on preliminary analyses of data, and as such, should be considered only preliminary at this time.

Background

The western United States is experiencing rapid population growth which places increased demands on the limited natural resources of the region, most notably, water. It therefore becomes crucial for both agricultural and urban water users to protect their water rights and resources by careful accounting and planning processes. One such source of which the cities desire to take advantage is the return flow from urban lawn irrigation. The return flow -- water applied in excess of grass consumptive use -- is significant, and many cities want to increase their water supply by claiming credit for return flows in water exchanges (Wheeler, 1987; Gronning, 1989).

Several cities have used small lysimeters to estimate turf grass consumptive use and return flows. The accuracy of small lysimeters is not well known, and the practice has been questioned by some who believe that small lysimeters predict inaccurate consumptive use and return flows. Also, what is measured in these lysimeters is deep percolation (water draining out of the rootzone) and not return flow (portion of applied water returning to streams from surface and subsurface flow). In response to these concerns, this research was sponsored by the Office of the State Engineer and the Colorado Water Resources Research Institute.

Research Objectives, Procedures, and Data Collection

The overall goal of the research project is to develop a methodology for estimating return flow from urban lawn water use. The first phase of the research project (1992-93) was to evaluate the accuracy of the small lysimeters in estimating grass consumptive use. The project phases that follow (1994-95 summers) provide data to evaluate the lysimeter accuracy for estimating deep percolation. Accuracy of the lysimeters is evaluated by comparing evapotranspiration results obtained from the small lysimeters to those obtained from the standard lysimeter and from using the Penman Equation. The results of deep percolation using small lysimeters are compared to some previous estimates (Wheeler, 1987; Gronning, 1989).

The study was conducted at the Agricultural Engineering Research Center (AERC) located north west of Fort Collins, Colorado. This facility has an automated weather station which collects weather data needed to estimate potential evapotranspiration using a modified Penman equation (Buchleiter et al., 1988). A large lysimeter is also located on the plot, and this lysimeter is used as the reference to which 24 small lysimeters are compared. The study utilized two types of small lysimeters, a weighing type (Wheeler, 1987) and a drainage type (used by the City of Colorado Springs; Gronning, 1989). The lawn was managed in such a way as to be representative of a typical urban lawn situation. The lawn was watered twice each week by means of a permanently installed sprinkler system. The amount of water application, deep percolation and the change in soil moisture content were

measured for the 1992, 1993 and 1994 summer seasons. Daily evapotranspiration (Et) was calculated from a volume balance equation,

$$Et = I + P - D - DSM$$

where I is irrigation, P is precipitation, D is drainage and DSM is the change in soil moisture. Amount of water applied is the summation of irrigation and precipitation.

Results -- Accuracy of Small Lysimeters in Estimating ET

Presently, we are consolidating the three years (1992-94) of data and standardizing the values over equal season durations. The following results are based on a preliminary analysis of the data, and as such, the findings should be considered only preliminary at this time.

Figures 1 and 2 present three years (1992-94) of seasonal ET data for the weighing and drainage type lysimeters, respectively. The seasonal mean ET values were 387 mm for the weighing type lysimeters and 432 mm for the drainage type lysimeters. These values bracket the evapotranspiration measured by the large lysimeter (reference ET,ET_r), which was 428 mm. In general, the weighing lysimeters underestimated evapotranspiration and the drainage lysimeters overestimated it compared to the large lysimeter.

The standard deviation from the mean for the weighing type lysimeters was 85 compared to 168 for the drainage type lysimeters. These results imply that the weighing lysimeters individually are more consistent in their estimation of evapotranspiration. The drainage lysimeters, however, appear to have a mean which estimates evapotranspiration closer to the standard, yet with much variation among the individual lysimeters.

One possible reason for the difference in the evapotranspiration values measured by the two types of lysimeters is that the drainage lysimeters assume no change in soil moisture storage. The weight measurements recorded for the weighing type lysimeter, however, show significant fluctuations in the soil moisture storage. It can be assumed that similar fluctuations occurred in the drainage lysimeters, since both types were subject to the same conditions and location. Another possible reason relates to the construction of the lysimeter rim. The literature states that small lysimeters may gain heat from solar radiation absorbed by the lysimeter rim (Howell et al., 1991). The drainage lysimeters are constructed of steel pipe, which is dark in color and a good conductor of heat. The weighing lysimeters, though, are made of white plastic pipe, which is reflective of solar radiation and a poor heat conductor. This

Figure 1: Grass Actual ET (ET_a) by Weighing Lysimeters

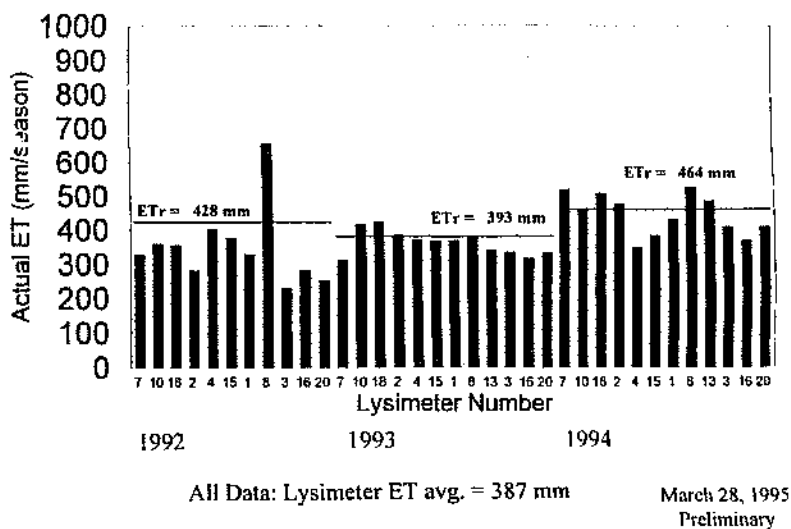
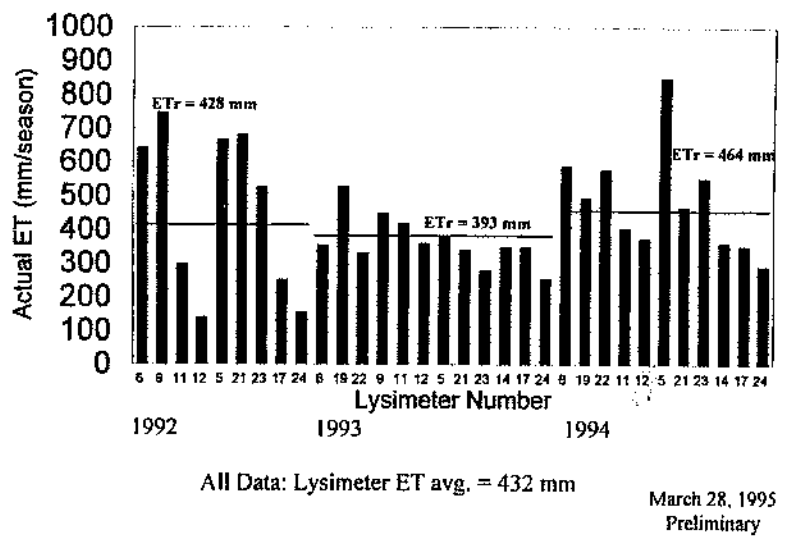


Figure 2: Grass Actual ET (ET_a) by Drainage Lysimeters



would indicate that the drainage lysimeters would absorb more heat than the weighing lysimeters and therefore be able to use that heat for increased evapotranspiration.

Results--Estimating Return Flow by Using Small Lysimeters

While evapotranspiration can be assumed to be independent of application within the range of applications that this study is concerned with (that is, a well watered condition), deep percolation, on the other hand, is very closely related to application. Analysis of return flow, therefore, is meaningful in the context of water application. Knowing the amount of water application and drainage for the small lysimeters, relationship for return flow (R) was derived as a function of water application (A).

Figures 3 and 4 show this relationship for the weighing and drainage type lysimeters, respectively based on the three years

(1992-94) data. The regression equations for these curves are,

Figure No.	Lysimeter type	Best Fit Curve
3	Weighing	$R = 0.83 A - 0.089$
4	Drainage	$R = 0.68 A - 0.080$

These results can be compared to the Gronning Curve developed for the City of Colorado Springs (also shown in Figures 3 and 4, reproduced from Gronning, 1989). The Gronning Curve is a linear regression of the form,

$$R = 0.546 A - 0.019$$

where R is return flow in inches per day and A is application in inches per day. The negative intercept value implies that a certain amount of application must take place before there is any deep percolation. The lysimeter equations, particularly the one for drainage-type lysimeters, compare well with the one developed for Colorado Springs, which was developed by using drainage-type lysimeters.

The mean value for drainage (deep percolation) was 331 mm for the weighing type lysimeters which is about 40 percent of the applied water amount. For the drainage type lysimeter, the deep percolation was 227 mm which is about 30 percent of the applied water amount. The Cottonwood Water and Sanitation District estimated return flows based on the Cottonwood Curve (Wheeler, W. 1987) developed by using weighing type small lysimeters. The curve is a relationship between the ratio return flow/application and the ratio application/consumptive use, and its regression equation is

$$R/A = 0.357 (A/ET - 55) \text{ for } A/ET = 55 \text{ to } 160, \text{ and}$$

$$R/A = 100 (A/ET - 100) / A/ET \text{ for } A/ET > 160.$$

Figures 5 and 6 (next page) show the three years (1992-94) of return flow data compared to the Cottonwood Curve for the weighing type and for the drainage type lysimeters, respectively. The linear fit regression equations for the two types of small lysimeters are as follows.

Figure No.	Lysimeter Type	Best Linear Fit
5	Weighing	$R/A = 0.354 (A/ET) - 15.4$
6	Drainage	$R/A = 0.304 (A/ET) - 17.4$

The research results agree well with the linear part of the Cottonwood Curve for both types of small lysimeters. The linear part of the curve is of real significance because it curves

the range of application/consumptive use from 100 to 200 percent which more than adequately represents the amounts of water applied by urban residents.

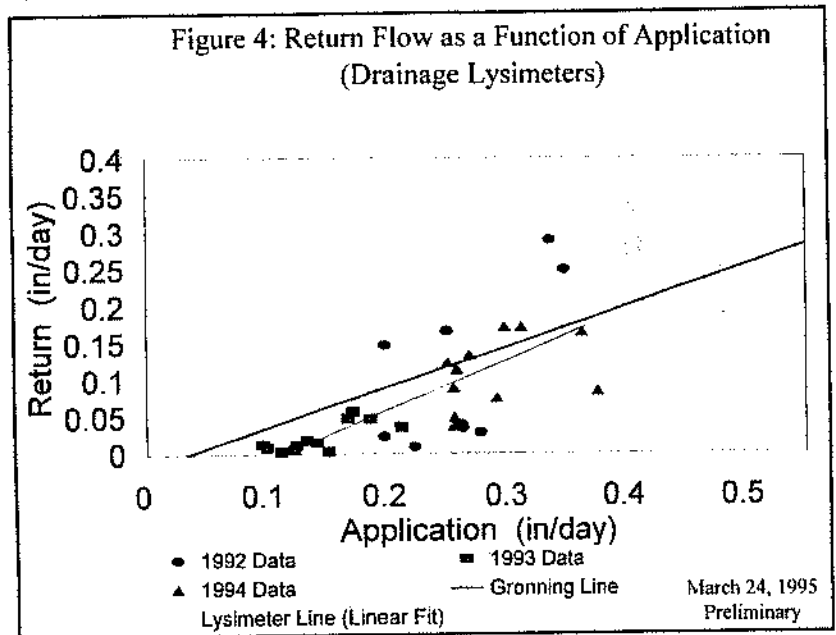
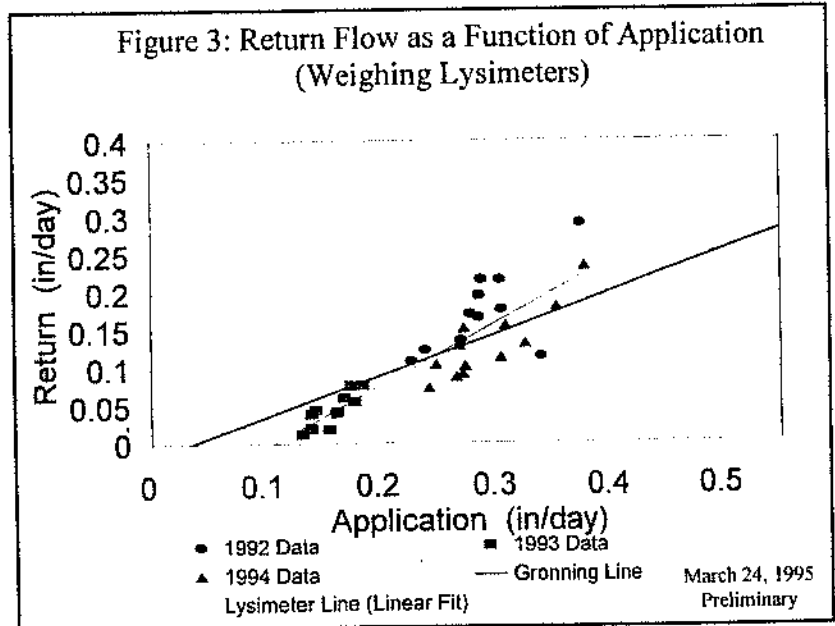


Figure 5: Return Flow as a Function of Application and Consumptive Use
(Weighing Lysimeters)

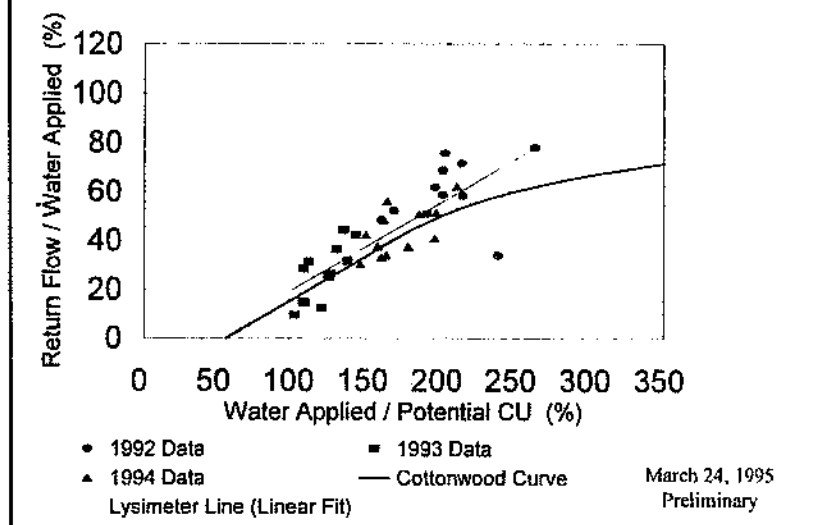
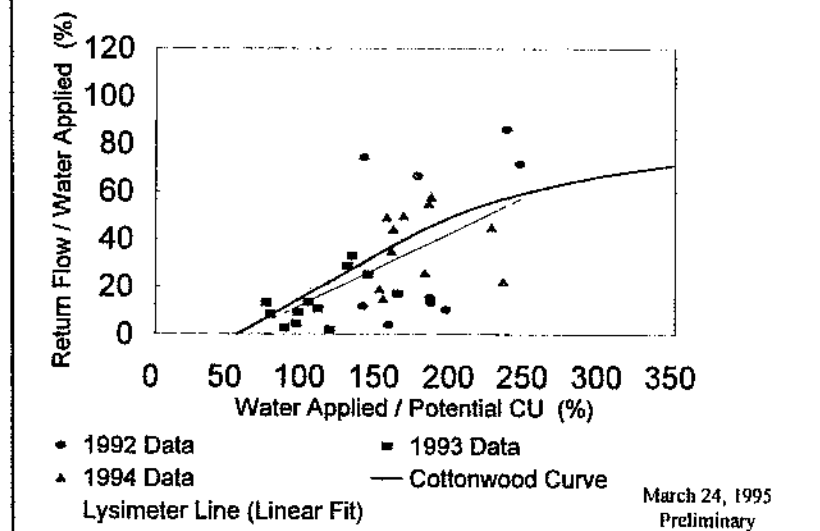


Figure 6: Return Flow as a Function of Application and Consumptive Use
(Drainage Lysimeters)



It may be desirable to repeat that we have measured deep percolation, and not return flow, up to this time in this research. This is why we get high numbers for deep percolation -- 30 to 40 percent of applied water amount. A significant portion of this deep percolation is consumptively used by deep-rooted bushes and trees. As such, return flow would be significantly lower than deep percolation.

Preliminary Conclusions

The research results so far show that the two types of small lysimeters -- weighing type and drainage type -- compare well with the standard methods of estimating grass consumptive use -- a large lysimeter and the Modified Penman Equation. Also,

small lysimeters are not statistically different from each other. In relation to the reference (Penman Equation and large lysimeter), the weighing type lysimeters had a smaller range of values but underestimated evapotranspiration while the drainage lysimeters had a larger range of values and overestimated ET.

The research up to this time has not provided enough data to draw conclusions about deep percolation and return flow in urban lawn water use. Further research is necessary to evaluate deep percolation issues and beginning in summer 1995, this research will now focus on the issues of deep percolation and return flow. Preliminary indications are that the two types of small lysimeters appear to be statistically similar in measuring deep percolation. Also, the research results seem to support the previous studies of deep percolation using small lysimeters (Wheeler, 1987; Gronning, 1989).

The results imply that the small lysimeters are of acceptable accuracy for estimating grass consumptive use and deep percolation. However, the large range of individual estimates suggests caution in the use of these lysimeters. In this context, a primary concern would be that if the small lysimeters are placed in locations with different conditions, it may be difficult to separate differences in evapotranspiration due to locational factors from the inherent variability of the lysimeters. With this in mind, the following recommendations are made:

- * The drainage type small lysimeter should be used only if a sufficient number of them are installed to ensure that the mean of the desired measurement, either evapotranspiration or return flow, is representative of the reference value.
- * The weighing type small lysimeter should be used preferably if a correlation is performed to adjust the desired measurement to the reference value.

Future Research Program

In future research efforts, it would be desirable to estimate return flow from the knowledge of deep percolation measured in small lysimeters. One way to accomplish this objective would be to evaluate consumptive use of trees and bushes present in the urban landscape. The knowledge of return flow as influenced by water application in urban areas would be highly useful for future water management.

Also, the research needs to evaluate return flow as a function of different water application practices of the city residents. For example, it can be hypothesized that the amount of deep percolation would vary with the frequency of water application for the same amount of water applied.

Acknowledgments

The authors would like to acknowledge the financial support of the State Engineer's Office, Denver, Colorado; City of Colorado Springs; and the Colorado Water Resources Research Institute, Fort Collins, Colorado.

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- Gronning Engineering Company, 1989. Ground water development augmentation and exchange plans for the City of Colorado Springs, Denver, Colorado.
- Howell, T. A., A. D. Schnieder, and M. E. Jensen, 1991. History of lysimeter design and use for evapotranspiration measurements, Proc. of the International Symposium on Lysimetry, p. 1-9, ASCE, New York, N.Y. 10017-2398.
- Wheeler, W.W and Associates, 1987. Lysimetry Study, Englewood, Colorado.

WATER RESEARCH AWARDS

A summary of water research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigator c/o indicated department and university.

Colorado State University, Fort Collins, CO 80523

- *Russell Lakes SWA Wetlands Study, David J. Cooper, Cooperative Fish & Wildlife Research. Sponsor: Colorado Division of Wildlife (CDOW).
- *Embankment Overtopping, James F. Ruff, Civil Engineering. Sponsor: Bureau of Reclamation (USBR).
- *Incremental Assessment of Habitat, Discharge & Modification for Low Flow, Steve Abt, Civil Engineering. Sponsor: Corps of Engrs.
- *Spatial Trends in Surface Water Quality, Noatak National Preserve, Daniel E. Binkley, Forest Sciences. Sponsor: US Forest Service.
- Alternative Landfill Cover Design -- Capillary Barrier, Charles Shackelford, Civil Engineering. Sponsor: Sandia Corporation.
- Long-Term Ecological Research - Luquillo Experimental Forest, Alan P. Covich, Fishery & Wildlife Biology. Sponsor: Puerto Rico Resource Center.
- *Flaming Gorge Studies: Annual Assessment of Mainstem Razorback Sucker Production, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- *Assessment of Drifting Larval Fishes in the Yampa and Green Rivers, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- *Water Management Research, Jim C. Loftis, Chemical & Bioresource Engineering. Sponsor: USDA/ARS.
- Extreme Precipitation Data Study, Thomas B. McKee, Atmospheric Science. Sponsor: Colorado Department of Natural Resources.
- Preparation of Reference Series of Endangered Fish Larvae, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: National Park Service (NPS).
- Interim Management Objectives for Endangered Fishes of the Upper Colorado River Basin, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- Assessment of Electrofishing Injury on Colorado Squawfish, John A. Hawkins, Fishery & Wildlife Biology. Sponsor: USBR.
- *Evaluation of Restoration Potential of Green River Above Confluence With Yampa River, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- *Larval Fish Laboratory Involvement in Implementing Recovery Actions..., Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- Individual-Base Model: Colorado Squawfish, Kevin R. Bestgen, Fishery & Wildlife Biology. Sponsor: NPS.
- Little Snake River: Management Action Plan and Work Plan, John A. Hawkins, Fishery & Wildlife Biology. Sponsor: USBR.
- Little Snake River: Fish Composition, John A. Hawkins, Fishery & Wildlife Biology. Sponsor: USBR.
- Flaming Gorge Studies: Technical Integration and Synthesis, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- Effects of Two Different Electrofishing Fields on Fertility of Mature Razorback Sucker, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
- Gas Supersaturation Dynamics in the Middle Park Reach of the Colorado River, Eric P. Bergersen, Cooperative Fish and Wildlife Research. Sponsor: CDOW.

Flaming Gorge Studies: Green River Nonnative Fish Management, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: USBR.
 Effects of Winter and Spring Flows on Colorado Squawfish, Daniel W. Beyers, Fishery & Wildlife Biology. Sponsor: USBR.
 Genetic Analysis of Colorado Native Fishes, Robert T. Muth, Fishery & Wildlife Biology. Sponsor: CDOW.
 Modeling the Effects of Channel Perturbations on Flow Patterns, Ellen E. Wohl, Earth Resources. Sponsor: NPS.
 Rocky Flats OU2 Groundwater Model Review, James W. Warner, Civil Engineering. Sponsor: Colorado School of Mines.
 Organic Pollutants in Soils, as Studied by Nuclear Magnetic Resonance, Gary E. Maciel. Sponsor: US Air Force.

University of Colorado, Boulder, CO 80309

- *Incorporating Tracers in the Hydrologic Cycle of the Genesis Earth System Model, Robert Webb, Institute of Arctic and Alpine Research (IAAR). Sponsor: Tulane University.
 - Land Use and Cover Change in Developing Mountain Valleys, William Riebsame, Geography. Sponsor: State of Colorado.
 - *Design and Development of the Power and Reservoir System Model (PRSYM), Edith Zagona, CADSWES. Sponsor: Electric Power Research Institute.
 - Modeling of the Vadose Zone in Soil of Rocky Flats Environmental Technology Site, Tissa Illangasekare, Civil Engineering. Sponsor: Colorado School of Mines.
 - *Measuring the Subjective Benefits and Costs of Environmental Programs, William Schulze, Center for Economic Analysis. Sponsor: EPA.
 - *Rotating Hydraulic Channel Flow with Friction, Daniel Ohlsen, Program in Atmospheric and Oceanic Sciences (PAOS). Sponsor: Dept. of the Navy.
 - *Modeling and Monitoring the Circulation in the Gulf of Mexico, Robert Leben, Center for Astrodynamics Research. Sponsor: Science Applications International Corporation.
 - Validation of Flow and Transport Models, Tissa Illangasekare, Civil Engineering. Sponsor: Los Alamos National Laboratory.
 - *Correlative MF Radar Studies of Large-Scale Middle Atmospheric Dynamics in the Antarctic, Ben Balsley, Cooperative Institute for Research in Environmental Sciences (CIRES). Sponsor: National Science Foundation (NSF).
 - Geostatistical Methods for Determination of Roughness, Topography, and Changes of Antarctic Ice Streams From SAR and Radar Altimeter Data, Ute Herzfeld, IAAR. Sponsor: National Aeronautics and Space Administration (NASA).
- *Supplement to existing award.

WATER SUPPLY

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the USDA/SCS is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on snow pack, reservoir storage, and precipitation for the winter period (Nov.-April). During the winter period snow pack is

the primary component in all basins except the South Platte, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven basins on March 1, 1995 and reflect conditions during the month of February.

<u>Basin</u>	<u>March 1, 1995 SWSI Value</u>	<u>Change From Previous Mo.</u>	<u>Change From Previous Yr.</u>
South Platte	+0.6	+1.3	-1.3
Arkansas	+0.9	+1.8	+1.7
Rio Grande	+3.1	+0.8	+3.4
Gunnison	+1.8	+1.9	+3.6
Colorado	+1.1	+2.7	+0.9
Yampa/White	0.0	+1.9	+1.7
San Juan/Dolores	+2.2	+0.9	+3.5

SCALE									
-4	-3	-2	-1	0	+1	+2	+3	+4	
Severe Drought	Moderate Drought	Near Normal Supply	Near Normal Supply	Near Normal Supply	Above Normal Supply	Above Normal Supply	Above Normal Supply	Abundant Supply	Abundant Supply

FEATURES

DELPH E. CARPENTER AND THE COLORADO RIVER COMPACT

by

Daniel Tyler, History Department
Colorado State University*

A recent article in The Colorado Lawyer presents a crisp and accurate snapshot of Delph Carpenter, a man whose legacy to Colorado "is an abiding faith that negotiation, not litigation, is the more civilized means of resolving differences with neighboring states over the protection and use of the waters that are Colorado's most precious natural endowment." The article, written by Peter A. Fahmy of the Colorado Attorney General's Office, describes Carpenter as a visionary whose implementation of the compact idea to settle interstate water disputes qualifies him as one of Colorado's preeminent water lawyers.

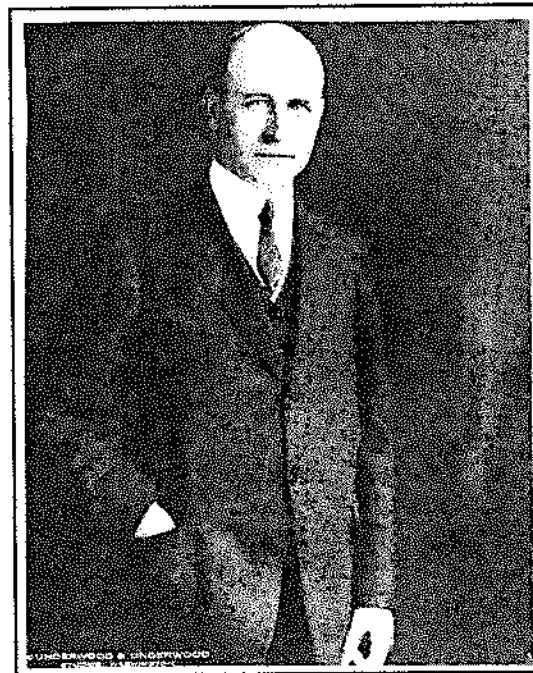
Carpenter was a key person in the development of the Colorado River Compact, a document that constitutes one part of "the law of the river." He wrote the first compact draft; he proposed the basic element of dividing the river into two basins; and he was the one who before, during and after the 1922 signing had the experience, patience and diplomacy to find common ground amongst negotiators with conflicting priorities.

Sixty years of judicial decisions and administrative procedures, however, have substantially altered Carpenter's goal of equitable apportionment. Specifically, a 1963 Supreme Court ruling granted Arizona and Nevada exclusive use of their Colorado River tributaries, exceeding compact authorization. In a 1988 paper (Contrary Views of the Colorado River) written by two Colorado water lawyers, the late John U. Carlson and Alan E. Boles, Jr., the authors refer to the Supreme Court's decision as "judicial dyslexia." In addition to the court decision, the Upper Basin states feel threatened by the possibility of having to provide more water to the Lower Basin than the river is likely to contain if a serious drought cycle returns to the Colorado Plateau. The present Compact obligation is 75 million acre-feet (maf) every ten years and one-half of 1.5 maf (or 0.75 maf) annually promised to Mexico by a 1944 treaty.

Using legal cases, congressional hearings and printed source materials, Carlson and Boles studied "the law of the river" in great detail and decided that the Upper Basin states were left with three possible avenues of recourse:

- utilize Article VI of the Compact to convene a new Colorado River Commission that would address existing inequities;
- seek federal legislation to modify the Compact; or
- ask the Supreme Court for a reinterpretation of the Compact based on a "mistake of fact" stemming from erroneous information regarding historic flows of the Colorado River.

Carlson and Boles suggest that a legal theory which might be presented in litigation is a return to the "plain language and intent" of the Compact itself. If this course is followed, the words of Carpenter would have to be carefully examined. To date, no study of the Colorado River Compact has focused on Delph Carpenter's interpretations of the intent and meaning of Compact articles. Fortunately, however, a great deal of discussion took place in the decade following the signing of the Compact in November 1922.



Delph Carpenter, the Father of Colorado River Treaties

In letters to state legislators, interested partisans, Washington bureaucrats and President Herbert Hoover, Carpenter wrote extensively about what the Compact's articles meant in practical terms. Many of his letters have been preserved at the Hoover Presidential Library in Iowa, in the Carpenter Papers in Colorado, and in the archives and records centers of the seven Colorado River Basin states. A preliminary overview of what can be found in these materials constitutes the remainder of this essay.

Carpenter's decision to divide the waters of the Colorado River between the Upper Basin and Lower Basin resulted from his discussions with Arthur Powell Davis, Director of the Reclamation Service. Carpenter was significantly influenced by

an Egyptian government report on the Nile River, which stated the need to view the Nile as a single entity and as a public resource to be administered with regard for the rights of future generations and without prejudice against less densely populated areas. Water allocation on the Colorado River, Carpenter concluded, should not be based on 1922 population densities but on the growth expectations of all regions. Because Lees Ferry was a natural dividing point between the basin-of-origin states and the more developed regions below the Grand Canyon, it could serve as a boundary line between the two basins. In 1921, a Colorado River Commission (CRC) was organized under Congressional mandate to divide the waters of the Colorado River. In 27 meetings of the CRC, Carpenter adhered to the following principles that he felt should govern the seven-state compact:

- to allow the Upper Basin states to develop and utilize their 50 percent of the river through in-basin development and transmountain diversion;
- to provide flood control and hydroelectric power through construction of dams but without attached rights of prior appropriation in excess of a basin's 50 percent allocation;
- to equally share between the two basins any future responsibility to Mexico;
- to guarantee equality among the seven states entitled to negotiate a treaty under Article VI of the United States Constitution, recognizing local control of navigable and nonnavigable waters within their borders; and
- to equitably distribute water in the Colorado River for all present and future needs of the seven states and Mexico.

Most conflict surrounding the Compact has resulted from a perceived clash in meaning between paragraphs (a) and (d) of Article III.

Paragraph (a) allocates 7.5 maf to each basin in perpetuity.

Paragraph (d) appears to give the Lower Basin a prior guarantee of 75 maf over a 10-year period.

In other words, the consumptive right that the Upper Basin has in paragraph (a) clashes with the wet water obligation of paragraph (d). In an extended drought, it might be impossible for the Upper Basin to implement both its right to consume water and its obligation to deliver wet water to the Lower Basin.

Carpenter, however, distinguished between the Upper Basin's allocation and its guarantee to the lower river. In several letters to California's special legal counsel Northcut Ely, Carpenter stated that

Paragraph (d) ...bears no direct relation to the allocation of 7,500,000 acre feet per annum to the Lower basin under paragraph (a)... [P]aragraph (d) originated solely out of fear entertained by Commissioners for California

and Arizona, that the Upper States would exceed their allocation and would unduly deplete the supply to the Lower basin in periods of extreme drought...the Upper States do not guarantee to deliver 7,500,000 acre-feet in any one year. They may deliver no water at all in one year, 10,000,000 in another year, 7,000,000 in another year, etc., so long as the aggregate for ten years is 75,000,000 acre feet.

Clearly Carpenter saw that the river's yield could vary dramatically from year-to-year. He also noted that

...the necessity for a minimum...comes from a drought that strikes at the roots of agriculture in the upper section...the minimum being of such a quantity that the penalty of the drought will be equally distributed over the whole river system...[T]he idea in fixing the minimum should not be to guarantee that the lower division will have enough in low years [but] to allocate the drought...among people of the entire basin, much the same as we allocate the waters in fat years.

Carpenter also foresaw the needs of Denver and East Slope agriculture when he calculated Colorado's future needs. A 1922 Supreme Court decision (Wyoming v. Colorado, 259 U.S. 419) made it clear that among states utilizing the prior appropriation doctrine, water disputes left to the Supreme Court would be settled on the basis of first-in-time, first-in-right. Under this ruling, California's early appropriation of Colorado River water meant that the Upper Basin states would have very little leverage in a litigated settlement based on prior appropriation.

Carpenter believed it was incumbent upon Colorado to seek a negotiated Compact in which Upper Basin states could utilize a portion of their 50 percent allocation by means of transmountain diversion. At the same time, he insisted that because a small percentage of Colorado River water would be diverted out of its basin of origin, the Upper Basin states could, in theory, divert 15 maf for beneficial use because from 40 percent to 60 percent of this water would return to the river as return flow to satisfy Article III obligations. He thus distinguished between unlimited diversion and limited consumption.

Carpenter elaborated on many other compact issues in his extensive correspondence. He clearly managed to rise above the parochiality of the state he represented to become spokesman for the entire river basin. His personal qualities, immense knowledge and noteworthy determination brought accolades from many quarters as he continued to work on compacts with New Mexico (La Plata River, Rio Grande) and Nebraska (South Platte River). Delph Carpenter's wisdom was continually sought by those who came to believe that negotiation of interstate water rivalries was far more productive than litigation.

*Author's note: Quoted comments in this article are taken from Carpenter correspondence located in the Hoover Presidential Library or from materials owned by the late Judge Donald Carpenter of Greeley, Colorado.

WATER EDUCATION

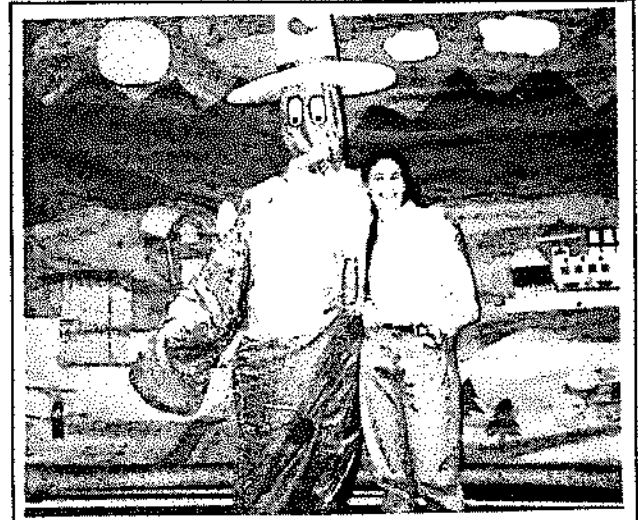
CHILDREN'S WATER FESTIVALS -- WATER EDUCATION IS FUN (AND GROOVY)!

by David Williams

On March 14 in Brighton about 500 fifth-graders from surrounding elementary schools engaged in the first ever Brighton Children's Water Festival. The festival follows a long tradition of Children's Water Festivals started in Greeley five years ago by Tom Cech of Central Colorado Water Conservancy District. The Greeley Children's Water Festival spawned many similar festivals around the state. There are now festivals in Sterling, Aurora, Montrose, Boulder, Fort Collins, and Loveland, to name a few.



Dress for Success: Students from the Brighton area dressed for their favorite Career in Water.



Cindy Brady of CWRRI poses with Metro-Meba, from the Metro Wastewater Reclamation District.

Water festivals celebrate the gift of water through workshops and exhibits for fifth graders. The workshops and exhibits are presented by utilities, conservancy districts, federal and state agencies, private industries, and educational institutions.

There are three main areas that students visit. Each class goes to a classroom activity, aimed at education in a specific area in water resources. Activities include learning about wetlands, utilities, water rights, groundwater, water projects, water supply, recycling, water quality, and many other topics.

Students also attend a session with the "Water Wizard." In this area, teams from two classes compete with each other to answer questions about water knowledge. Nearly all teams demonstrate an incredible knowledge of water. The competition is usually heated, with schools heartily cheering their teams.

The third area that students visit is the exhibition hall. This is a bustling area with a lot of energy and many educational opportunities. Students have a chance to learn about Careers in Water at CWRRI's interactive display. They learn the secret of what it takes to "Get paid to get wet!" Then they choose their favorite career in water and dress the part.



Donna Nelson of the Natural Resources Conservation Service explains the basics of nonpoint source pollution to a group of Brighton-area fifth-graders.

Among the other exhibits in the hall are Bubbleology (as shown on cover), and education on how Metro Wastewater Reclamation District uses microbes to clean wastewater, including an opportunity to meet Metro-McBa. Students also learn about panning for gold, water conservation, snow measurement with "snow pillows," fish hatching, and water sports.

For teachers, there is a teachers resource room. Presenters are encouraged to bring materials that could be incorporated into classroom curricula. Teachers have a chance to visit the resource area and collect materials. This is an excellent opportunity for presenters to get their name out to teachers and for teachers to gather valuable resources.

"Puddle pictures" is an activity offering students an opportunity to compete against other schools and to show off their artistic talent. A student is given a "water word," and then he or she draws a picture explaining the word. Students compete to have their class guess their word first. The competition is tense, and the artwork is fabulous.

Water festivals are fun for students and for presenters. To take an interest in the future through the education of our youth is also rewarding, and for a water resources professional, this can be especially fun.



Rick Stephenson of the Natural Resources Conservation Service demonstrates how water and contaminants flow through a simulated aquifer.



Cindy Brady of CWRRRI listens as students explain their Career in Water.



David Williams of CWRRRI offers students a chance to select a Career in Water.



Tony Tolsdorf (Top Right) of the Natural Resources Conservation Service checks the runoff potential of a group of students on the Snow Survey "Snow Pillow."

YOUTH AND THE ENVIRONMENTAL INDUSTRY -- PARTNERSHIPS FOR EDUCATION AND EMPLOYMENT

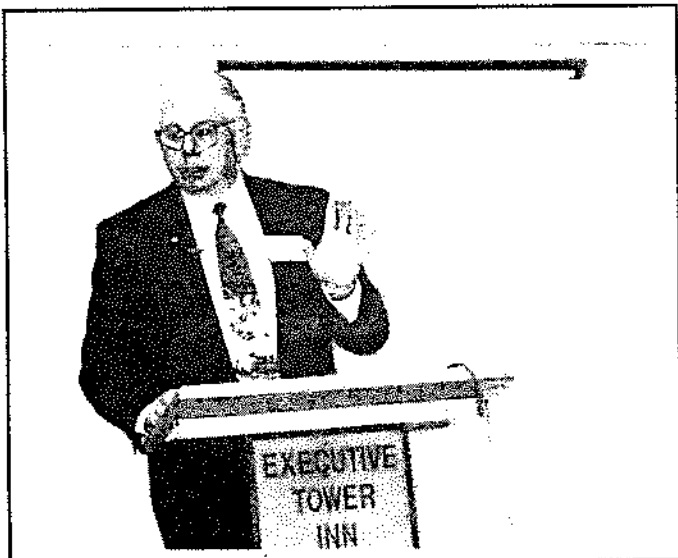
March 30-31, 1995, Executive Tower Inn, Denver

by David Williams

On March 30 and 31, Colorado State University's Civil Engineering Department, under the leadership of Dr. Neil Grigg and Janet Montera, hosted Colorado's first ever conference on Youth and the Environmental Industry. The conference attracted people from all parts of the environmental industry: federal and state agencies, private industries, non-profit youth organizations, public service organizations, local school districts, and alternative schools. The group was treated to an extremely beneficial sharing of ideas and information on creating opportunities for youth of all cultural backgrounds, economic abilities, and previous experiences.

Bill Yellowtail, Region VIII EPA Administrator, helped set a course for the meeting by speaking on the importance both of the environment in determining our future and of environmental-related jobs for youth. He stated that in the 21st century, the environment will be the engine driving public policy and education. He also posed the question, "Have we only scratched the surface of environmental science and technology?" He spoke of the role that justice and accountability will play in how EPA addresses the environment in the 21st century. Apparently alluding to the structure of current environmental legislation, he noted that we separate the basic components, soil, air and water, when we address environmental concerns. He summed up his talk by saying that the greatest opportunities for the youth of our country will be increasingly in environmental careers.

Yellowtail was followed in the opening general session by James Abbott, past president of the Water Environment Federation (WEF), and David Rockland of the National Environmental Education and Training Foundation (NEETF). Abbott spoke on some of the ways that the WEF is bringing innovative environmental education curricula to teachers. Curriculum topics offered by the WEF include: conservation, groundwater, surface water, waste-water treatment, nonpoint source pollution, biosolids



Bill Yellowtail explains that opportunities for youth will be increasingly found in environmental careers.



Mike Way of the Colorado Alliance for Environmental Education uses sophisticated equipment to explain a blueprint for environmental education.

recycling, and household hazardous waste. He also elaborated on the WEF program that provides youth mentoring by pairing students with water resources and environmental professionals.

Rockland provided the group with the results of a highly informative study comparing the environmental perceptions and knowledge of disadvantaged and non-disadvantaged students. The results, of great interest to teachers and environmental education providers in urban, suburban, and rural settings, indicated that students living at or near the poverty line are more concerned with environmental problems that affect them in the "here and now," such as clean drinking water and lead poisoning, and are less likely to be concerned with altruistic concerns such as rainforest destruction. As a reality check, he mentioned that the percentage of students saying they receive little or no environmental education in school increases from 30 percent in grades 4-5 to 71 percent in grades 11-12. Providing strong evidence for outdoor, experience-based, education, one of the most important findings in his study showed that getting students closer to nature does the most to improve their knowledge and perceptions of the environment. Both talks held information that teachers and environmental education providers would find most beneficial.

Following the general session, attendees had three tracks of quality speakers from which to choose. Many speakers mentioned the need to bring together the different agencies providing environmental education in a unified front. Mike Way, of the

Colorado Alliance for Environmental Education, spoke of the need to reevaluate our blueprint for environmental education, to create order out of chaos and strengthen every agency's program through cooperation. Jeff Rucks, of the Division of Wildlife, provided evidence that this is possible and effective, citing the success of combining Project Wild with Project Learning Tree and other environmental education materials. Glen Hinshaw, of the Division of Wildlife, echoed Rucks, discussing the success of having teachers work together with multiple agencies to create environmental education programs and curricula. Hinshaw summed up the basis of cooperation in any situation by saying, "What we can accomplish is unlimited if we don't care who gets the credit."

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**Glen Hinshaw,
DOW**

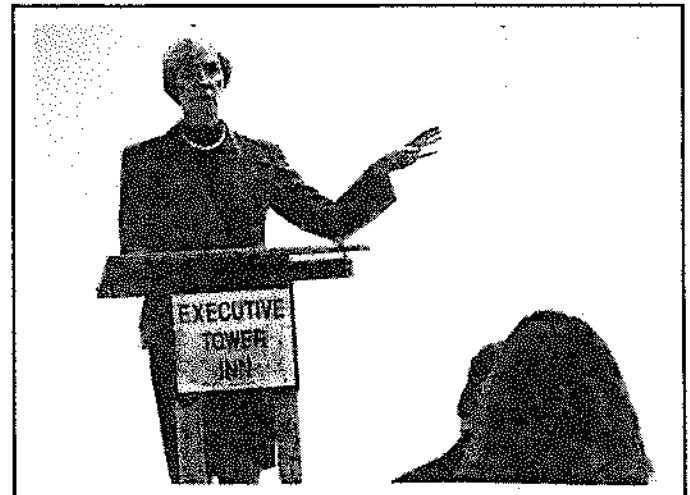
There were many presentations by different groups on how their programs have brought students closer to understanding their environment and entering environmental careers. Herbert Fain, of the City of Houston, Department of Public Works and Engineering, presented an overview of the city's School to Work Program. The program involves six high schools in Houston and numerous higher education institutions. Students work as interns with the Department of Public Works and Engineering, earning a wage or stipend and credit at their institution. They also get a taste of the flavor of working in engineering.

Omnia El-Hakim of Colorado State University and Fort Lewis College provided information on her program to bring Native American students to engineering. Her program provides opportunities for Native American students to work at Navajo Agricultural Products Industry (NAPI) in Farmington, New Mexico. Students gain hands-on experience in science and engineering, understanding of problem-solving techniques, and skills in teamwork and presentation.

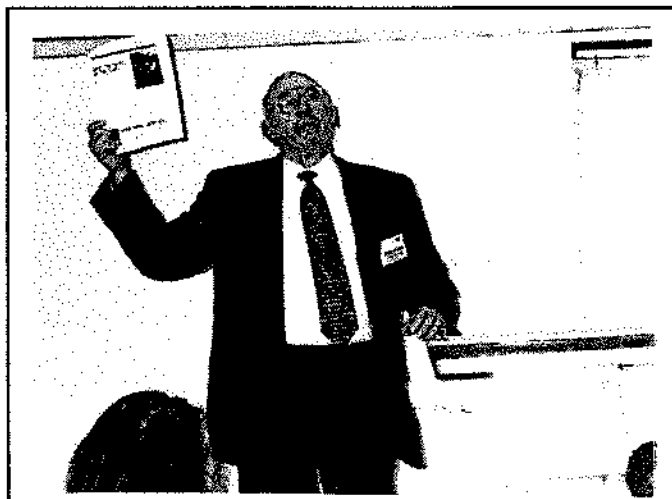
Kelly Weiler, of Miami Valley Earth Central in Spring Valley, Ohio, spoke about a program spawned out of a 20th anniversary Earth Day celebration. The Miami Valley Environmental Youth Congress (EYC) provides intensive environmental awareness and

training for junior high school students involved in community projects. The students participate in field trips, brainstorming sessions, and decision making process aimed at completing community projects for the environment. In four years, the EYC has completed over 1500 community environment projects.

In addition to many excellent presentations on specific programs and agency resources, attendees were treated to two very insightful luncheon speakers. On the first day, Lt. Governor Gail Schoettler shared some of her recent experiences in South America and how they relate to Colorado. She echoed previous assertions that the underprivileged in the world are more concerned with the "here and now," and less with what will be in the very distant future. She stated that sensitivity to this concern is important in administering environmental improvement and education programs. Schoettler stated that Colorado is viewed as a world leader in environmental research and called for the state to maintain that role.



Lt. Governor Gail Schoettler reflects on environmental concerns in foreign countries and how they relate to those in Colorado.



Alfred McLaren of Science Service, Inc. shares his insights on how science fairs are a powerful educational experience.

The second-day luncheon speaker was Alfred McLaren, president of Science Service, Inc. He shared his experience with local, regional, national, and international science fairs. McLaren observed that science fairs bring many students together to share ideas and create partnerships between schools and private industry. He offered examples of students who, at the age of 15 or 16, have advanced private industry research and development by leaps and bounds in a short time and with budgets of only a few hundred dollars.

Considering the many excellent presenters (not all mentioned here), the conference on Youth and the Environmental Industry was an excellent time for agencies, private industries, teachers, and many others to share ideas and form partnerships for environmental education. For more information on the conference, including proceedings, contact Neil Grigg or Janet Montera at (303) 491-5048.

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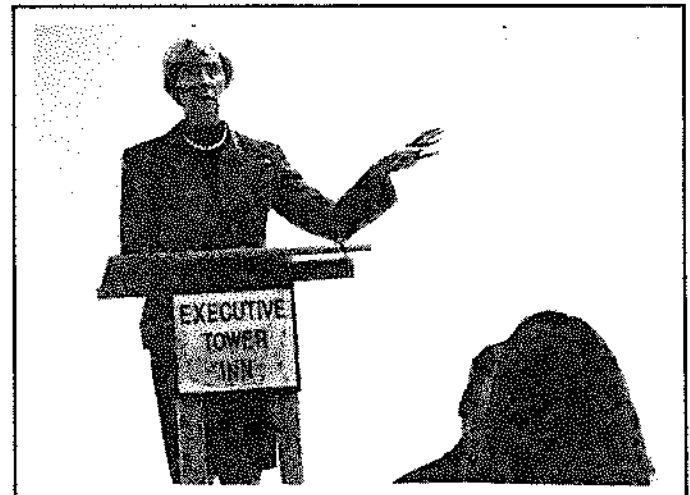
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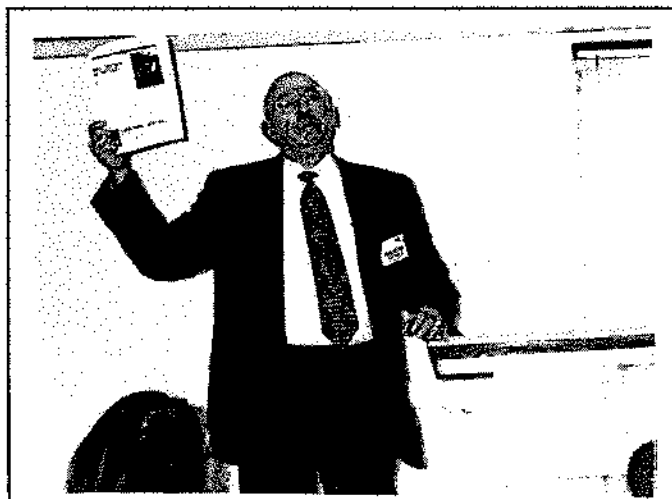
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UNIVERSITY WATER NEWS

**UNIVERSITY OF WYOMING
and
COLORADO STATE UNIVERSITY
NSF Graduate Research Traineeships in
Water Resources/Environmental
Sciences and Engineering**

The National Science Foundation has granted five graduate traineeships in water resources/environmental sciences and engineering for research leading to a Ph.D degree in Civil Engineering or Earth Resources with specialization in water quality. The traineeships include up to five years of support including a competitive stipend and tuition and fees. The program is open to U.S. citizens or permanent citizens holding Bachelor's or Masters degrees in relevant disciplines. Individuals with strong interest in any of the following or related research areas are invited to apply:

**Riparian Hydrology and Water Quality
Wetland Hydrology and Water Quality
Landscape Elements Affecting Soil Erosion
Wind Erosion and Water Quality
Water Balance and Water Quality Modeling
Passive Treatment of Acid Mine Drainage
Water-Sediment Chemistries**

Successful applicants will have opportunities to conduct innovative research in the above areas with faculty from University of Wyoming and Colorado State University and scientists from federal agencies that include USDA Agricultural Research Service, Forest Service, and USDI National Park Service. Women, minorities, and persons seeking retraining are encouraged to apply. For information please contact either:

**Dr. Jim Smith
Dept. of Civil Engineering
University of Wyoming
P.O. Box 3295
Laramie, WY 82071
307/766-4970**

**Dr. John D. Stednick
Watershed Science Program
Dept. of Earth Resources
Colorado State University
Fort Collins, CO 80523
303/491-7248 e-mail: jds@cnr.colostate.edu**

Preapplication materials should be sent to Dr. Smith.

University of Wyoming and Colorado State University are equal opportunity/affirmative action employers and comply with all federal, Wyoming and Colorado state laws, regulations, and executive orders regarding affirmative action requirements. In order to meet affirmative action responsibilities, ethnic minorities, women and other protected class members are encouraged to apply and to so identify themselves.

**1995 STUDENT PAPER COMPETITION
Sponsored by
Hydrolab Corporation
American Water Resources Association
Universities Council on Water Resources**

Three awards will be given -- one sponsored by Hydrolab Corporation of Austin, Texas, and the other two by the American Water Resources Association (AWRA) and the Universities Council on Water Resources (UCOWR). Final selections will be made by a subcommittee of the AWRA Student Activities Committee, the Editor of the *Water Resources Bulletin* and the Chairperson of the Education and Public Service Committee of the Universities Council on Water Resources (UCOWR). For more information and instructions for submission of papers for Award #2 and Award #3 contact:

**EARL SPANGENBERG
713/346-2372**

AWARD #1 -- Given by Hydrolab Corporation for the Best Student Paper Presentation at the Annual AWRA meeting November 5-9, 1995 in Houston, Texas. Cash prize of \$300. One year's membership in AWRA. This award will be presented at the annual meeting.

AWARDS #2 & #3 -- Given by UCOWR and AWRA to the students who submit the best technical paper. One award is given for the best undergraduate paper and one award is given for the best graduate paper. Cash prize of \$250 for each award. One year's membership in AWRA for each award. Publication in the *Water Resources Bulletin* for each award.

**WATER RESOURCES RESEARCH
SELECTED AS PROGRAM OF
RESEARCH AND SCHOLARLY EXCELLENCE**

President Albert C. Yates has named Water Resources Research as a 1995 Program of Research and Scholarly Excellence at Colorado State. The water resources programs in the Colleges of Engineering and Natural Resources include research into issues such as managing water during drought, providing safe drinking water, monitoring hazardous waste, providing adequate water for fisheries and recreation, protecting groundwater, managing irrigation water for food production, and river research. Measured by the number of graduate students and the volume of research activity, in combination the programs offer what may be the nation's most extensive graduate program in water resources engineering. The program is also a CCHE Center of Excellence.

FOURTH COLORADO ENVIRONMENTAL POLL PLANNED

The Human Dimensions in Natural Resources Unit (HDNRU) at CSU is planning the fourth Colorado Environmental Poll (CEP). The poll is designed to obtain information about timely natural resource issues that affect Colorado citizens.

In February, preparatory to conducting its fourth poll, HDNRU distributed executive summaries for polls taken in 1992, 1993 and 1994. Responses to selected water issues are itemized below.

1992: Endangered Species Act--Do you agree all endangered species of plants, animals and insects should be saved regardless of the costs or do you think the policy should be changed to take cost into consideration?

Agree all species should be saved	33%
Policy should be changed to consider cost	54%
Depends on the species	7%
Undecided/Don't know	6%

1992: Water Uses--...Given the increasing scarcity of water resources, which of the following do you give the highest priority for water use?

Growth of cities	10%
Sustaining agriculture	73%
Undecided/Don't know	17%

1992: Recreation--...Would you pay \$5 per vehicle per day per visit to help maintain parks and enhance recreation?

Yes	79%
No	18%
Undecided/Don't know	3%

1993: Should Colorado increase, decrease or maintain the same spending on:

	<u>Increase</u>	<u>Same</u>	<u>Decrease</u>
Water conservation activities...	44%	47%	9%
Pollution control...	53%	39%	8%
Managing fish and wildlife...	23%	61%	16%
Protect endangered species...	28%	53%	19%
Protect ag land from development	37%	48%	15%

1994: Survey participants were provided background information concerning the proposed resort at Seven Utes along with arguments both for and against the development. Two thirds (66%) of the study participants were against the proposed resort, 21% supported it, and 13% were undecided.

The lead person for the 1995 poll is Dr. Jerry Vaske, Department of Natural Resource Recreation and Tourism. He can be reached at: Phone: 970/491-2360; FAX: 970/491-2255.

PEOPLE

GLEN CANYON ENVIRONMENTAL STUDIES

William M. Lewis, Jr. of the University of Colorado at Boulder chairs the Water Science and Technology Board's Committee to Review the Glen Canyon Environmental Studies. The committee continues to provide advice to the Bureau of Reclamation on scientific applications in the management program for the Colorado River. The committee's last report reviewed the "Draft Environmental Impact Statement on the Operation of Glen Canyon Dam." The committee has been requested to extend its review to assist USBR with long-term monitoring plans for the Colorado River, the experimental flow design for the dam, the multiple-level intake studies for the dam, an annual report required by the Grand Canyon Protection Act, and nonuse value and power reports that USBR plans to issue. It will also assist with developing ecological indices to explain the state of the Grand Canyon ecosystem.

Source: *Water Science and Technology Board*, Jan/Feb 1995.

ALLUVIAL FAN FLOODING

Stanley A. Schumm, Professor Emeritus of Earth Resources at Colorado State University, chairs the WSTB Committee on

Alluvial Fan Flooding, created in response to a request from the Federal Emergency Management Agency (FEMA). The committee will develop an updated definition of alluvial fan flooding, including criteria for determining the potential for and degree of hazard of such flooding.

Source: *Water Science and Technology Board*, Jan/Feb 1995.

STEIN STURE HEADS CIVIL ENGINEERING AT CU

Professor Stein Sture has been named Chair of the Department of Civil, Environmental and Architectural Engineering at The University of Colorado. Sture has been at CU since 1980, and served as Acting Chair in 1990-91. He has been principal or co-investigator for 60 research projects sponsored by numerous federal agencies including the National Science Foundation, the National Aeronautics and Space Administration, the Bureau of Reclamation, and the Air Force Office of Scientific Research. Sture has authored or co-authored 150 papers and chapters in books and 75 research reports, and is a member of numerous professional engineering societies including the American Society of Civil Engineers, American Society for Testing and Materials, American Geophysical Union, American Society for the Advancement of Science, and the American Society for

Engineering Education. Sture has had industrial and consulting experience with over 22 companies, including Shell Development Company, Woodward-Clyde Consultants, Veritec/Veritas, Exxon Production Research, the United Nations, and the Government of India. He is past president of the Colorado Section of the American Society of Civil Engineers; Editor of the *Journal of Engineering Mechanics, ASCE*; in 1990

was recipient of ASCE's Walter Huber Civil Engineering Research Prize; and is Chair of the Organizing Committee for the 1995 ASCE Engineering Mechanics Conference to be held in Boulder in May 1995.

On a personal note, Sture enjoys outdoor activities including cross-country skiing, hiking and sailing.

EDITOR'S IN-BASKET

COLORADO RIVER UPDATE

Glen Canyon Environmental Studies--The Final Environmental Impact Statement (EIS) on the Operation of Glen Canyon Dam is now available as an executive summary report or the complete EIS (see page 24). The process began in July 1989 when then Secretary of the Interior Manuel Lujan directed the Bureau of Reclamation (USBR) to prepare an EIS to assess the impacts of the operation of Glen Canyon Dam on downstream resources and to evaluate alternative operations. Public comment on the Draft EIS resulted in over 33,000 comments with more than 2,300 separate issues involved. The costs and benefits will now be audited by the General Accounting Office as required by the Grand Canyon Protection Act (GCPA). Following the audit, the Secretary of the Interior will complete the Record of Decision (ROD). The audit is expected to take up to one year, with the ROD in 1996. The ROD will implement long-term monitoring and the Adaptive Management Program, as required by the GCPA.

What's Next?--

Biological Opinion--A major component of the EIS is the U.S. Fish and Wildlife Service's biological opinion. Due to concerns for endangered species and their critical habitat, USBR has begun planning for the endangered fish studies, selective withdrawal structures, and critical habitat elements of the biological opinion.

Transition Monitoring--Transition monitoring will begin on October 1, 1995. The Transition Work Group (TWG) will develop a draft of the transition monitoring plan. After approval by the TWG, the final plan will be in effect until the ROD is signed and the formal Adaptive Management Program (AMP) is in full swing.

Long-term Monitoring--A detailed long-term monitoring plan will be developed when a research center (as outlined in the EIS) is operational.

Beach/Habitat-Building Flow--The preferred alternative contains, as a common element to alternatives, a beach/habitat-building flow. These high flows of short duration will be tested prior to long-term implementation. Research will include an evaluation of the impacts of these controlled high releases on the downstream sediment and biological environments.

On December 17, 1994 the GCES program was administratively transferred from Reclamation's Upper Colorado Region to its Denver Technical Service Center. The future role of the GCES will be assisting in transition monitoring and as a consultant to USBR.

Source: *Newsletter, Colorado River Studies Office, Feb. 1995*

ARIZONA STANCE SIMILAR TO COLORADO POSITION ON INTERSTATE WATER TRANSFERS

Owners of water rights to Cibola Valley Irrigation and Drainage District (CVIDD) in southwestern Arizona seek approval to sell or lease about 24,000 acre-feet of federal contract Colorado River water to out-of-state buyers. This proposed transaction represents a challenge to the state of Arizona and its efforts to control interstate water transfers. The Arizona Department of Water Resources (ADWR) thus far has blocked any proposed interstate sales or leases.

Arizona currently has more water than it can use or pay for and there are willing out-of-state buyers, specifically in Nevada and California, who need water and are willing to pay. Officials fear, however, if they allow any of the state's allotment of Colorado River water to be used out-of-state, Arizona may not be able to reclaim it for in-state use when needed. The issue is further complicated because Arizona, by insisting on its authority to regulate interstate water transfers, is standing up to what it perceives to be interference from the federal government. The U.S. Bureau of Reclamation has proposed regulations that would allow the Secretary of the Interior to authorize the interstate leasing of unused water allotments.

Arizona and other lower Colorado River Basin states objected to the proposed plan mainly because the federal government would gain control of how states manage and eventually sell or lease their allotments of Colorado River water. The Colorado River Compact States organized a technical committee to examine options to the federal plan. Arizona has proposed a water banking concept.

Source: Arizona Water Resource, Arizona Water Resources Research Center, Jan. 1995.

WATER PUBLICATIONS, DATABASES, VIDEOS

A NEW CWRRI REPORT -- *QUENCHING THE URBAN GIANT*

The Proceedings of the 19th Colorado Water Workshop, *Quenching the Urban Giant*, is now available from CWRRI. The workshop, held July 20-22, 1994 at Western State College in Gunnison, Colorado, focused on the challenge of providing water for Colorado's growing urban and suburban population and asked the following questions: *Will additional storage be built? Can systems integration and conservation reduce demand for new supplies? Will farms and rural communities dry up to quench the cities? How could bypass requirements, instream flow needs, and public trust issues affect urban supplies?*

Program participants included county commissioners, attorneys, water utilities managers, water engineers, irrigation district managers, farmers, researchers, and federal representatives from the U.S. Geological Survey, the Forest Service, and the Fish & Wildlife Service. Focusing on the challenge of providing water, conference participants for the most part indicated a desire to "walk the extra mile" to achieve genuine, cooperative solutions among opposing interests.

Providing Water to the Front Range

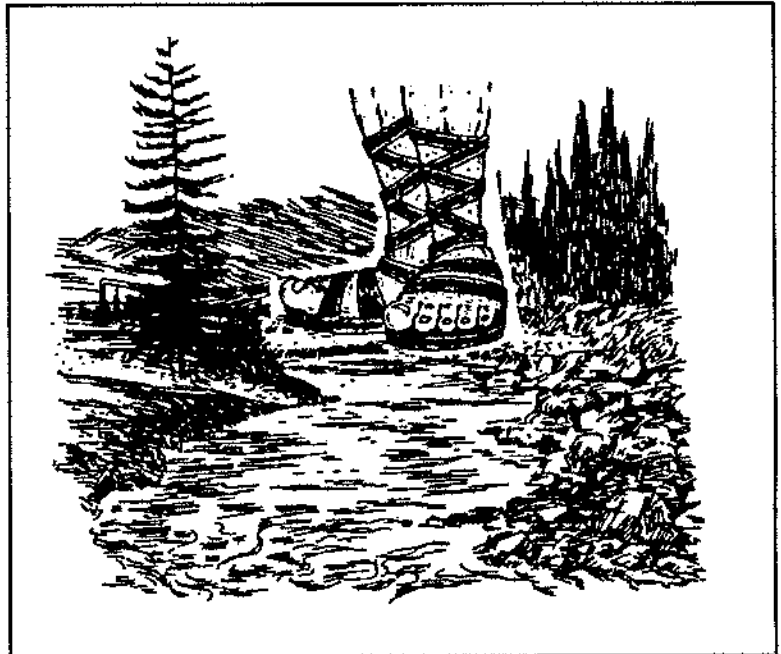
How water users are attempting to cope with growth and meet future municipal water needs, including cooperative Front Range/Metropolitan water supply planning efforts, was characterized by:

Cap Allen, Cap Allen Engineering, Durango
 Gary Bostrom, City of Colorado Springs
 David Little, Denver Water
 Lynn Murray, Huthinson Building Corporation, Lakewood;
 Doug Robotham, Department of Natural Resources
 James R. Sullivan, Commissioner, Dist. II, Douglas County
 Jack E. Holmes, Holy Cross Wilderness Defense Fund
 Ken Salazar, Parcel Mauro Hultin & Spaanstra, P.C., and
 Marcia Hughes, Legal Counsel, Metro Water Providers

Cooperative Efforts

The question, "West Slope-Front Range Cooperation: Can it Work?" brought recounts of ongoing efforts to bring opposing sides together to work at "win-win solutions, not lose-lose compromises," according to Richard L. Gustafson of the Eagle River Assembly. Gustafson described the creation of the Assembly as an effort to "solve our problems through conversation, not litigation."

Rick Hum, Summit County Commissioner, described the work



of the Colorado River Headwaters Forum, formed under a grant from the Department of Local Affairs. Hum said that while problems remain, "Consensus can be reached with divergent interests if the right people are willing to invest the time and energy that agreement requires." Others who described West Slope/East Slope cooperative efforts were Greg Trainor, City of Grand Junction, and Doug Kemper, City of Aurora.

Ag/Urban Water Conservation

The topic, potential for urban and agricultural water conservation, brought a variety of comments and opinions from the following individuals:

Scott Chaplin, Rocky Mountain Institute, Snowmass
 Angela Montoya, Denver Water
 Grant Cardon, Colorado State University
 Bart Woodward, Riverside Irrigation District
 Ruth Hutchins, Fruita, and
 Steve Glazer, High Country Citizens' Alliance

Luncheon speaker Jon Olaf Nelson, of California's North Marin Water District, described the northern California district's efforts to achieve planned, long-term water conservation of 13 percent. Targeted for the "hardcore" conservation programs were turf, toilets and showers. North Marin's program includes a "Cash

for Grass" program that offers a rebate to those who reduce existing irrigated turf areas. "Soft" conservation activities include education programs, targeted promotions, public xeriscape gardens, displays at fairs, contests and "screwdriver maintenance" — a program that allows field service reps to act of their own volition to help customers reduce water loss, for example, through leaks or faulty valves.

Farms/Cities Working Together

Teresa Rice, Senior Attorney at CU's Natural Resources Law Center outlined options for moving water from agriculture to urban uses, including short-term transfers, water banking and dry-year options.

Carol Ellinghouse, Coordinator of Water Resources for the City of Boulder, described the city's Comprehensive Plan, which includes interruptable water supply contracts and an open space program. A voter-approved sales tax allows the city to acquire some of the agricultural lands surrounding the city, with much of the land kept in active agricultural production.

Eric Wilkinson, General Manager of the Northern Colorado Water Conservancy District, described district efforts underway between the agricultural and municipal sectors. Wilkinson noted that rental markets in the Colorado-Big Thompson Project and the Windy Gap Project allow water to be easily moved to any water user for beneficial purposes within district boundaries. He also discussed lease-back agreements and water banking.

Bart Woodward, Superintendent of the Riverside Irrigation District, said municipalities should not look to agriculture to solve their problems. "Agriculture does not have an overabundance of water," he said. Woodward urged a new, inventive look at storage.

Water Quality and the Upper Colorado NAWQA Study

Nancy Driver, Chief of the Geological Survey's Upper Colorado River National Water Quality Assessment Program, gave an overview of the NAWQA program and the major water quality concerns in the Upper Colorado River Basin. She said the NAWQA study will use a holistic viewpoint that includes chemical, biological, and physical conditions including critical habitat designations.

Meeting the Needs of Forest Resources -- Bypass Flows

Skip Underwood, Forest Supervisor of the Arapaho and Roosevelt National Forests and Pawnee Grasslands, described forthcoming cooperative efforts by the Forest Service, the Colorado Department of Natural Resources and the Colorado Water Conservation Board to examine water issues on a larger scale.

Water for Endangered Species

Lee Carlson, Field Supervisor for the U.S. Fish and Wildlife Service, spoke about the requirements of the Endangered

Species Act's Section 7. Again, Carlson advocated a more holistic view versus the current case-by-case issuing of permits. He also stressed that more complete information is needed in biological assessments provided to the agency.

Human Water Supply and Environmental Requirements

Chuck Lile described cooperative accomplishments of the Colorado River basin states, including the work of the Western States Water Council and the Colorado River Salinity Control Forum. Lile is director of the Colorado Water Conservation Board.

Rod Kuharich, City of Colorado Springs, said the "buzzword" for water planners today is "integrated resource planning" — something that really has been around for years, he said, known as "sound planning principles." Kuharich also expressed concern about excessively stringent water quality standards that will be difficult and expensive to enforce.

Nancy Jacques, Colorado Rivers Alliance, spoke of the human element and individual perceptions of social and natural systems. She urged people to look anew at how they have tried to subjugate and control nature.

Frank Stephens, Director of Water and Sewer for the City of Greeley, discussed the city's purchase of Peterson Lake and Barnes Meadow Reservoir in 1947 to augment its direct flow rights in the Poudre River in the fall and winter. To obtain permit renewal of Forest Service special use permits, a proposal was put together with Greeley, the Water Supply & Storage Company, and the City of Fort Collins to accomplish the goals of the Forest Plan without decreasing the yield from existing facilities and without significantly increasing the cost of that yield.

The USBR and Quenching the Urban Giant

Ed Osann, Director of Policy and External Affairs, spoke of the new direction being taken by the Bureau of Reclamation and discussed a wide range of topics: USBR projects in the West including the North Platte and the Colorado-Big Thompson, rules administering the Colorado River, interstate transfers, water spreading and water conservation. Osann said USBR Commissioner Dan Beard has identified water conservation as the Bureau's highest priority.

The Last Oasis

Sandra Postel is Senior Fellow at the Worldwatch Institute and author of *Last Oasis: Facing Water Scarcity*. Referring to her book Postel said, "The overriding message of *Last Oasis* is that in most cases measures to conserve water, to reuse and recycle water, and to use water more efficiently are the most cost-effective and environmentally sound ways of meeting new water needs when we compare supply-side options and demand-management options on an equal footing and level the playing field and look at them as equal alternatives."

The Public Trust Initiative

"Defining the public trust doctrine is a little like trying to nail Jello to the wall," according to Stephen H. Leonhardt. Leonhardt and Brent A. Waite of Fairfield and Woods, P.C. and Jerry Swingle, Colorado Vice President of the Four Corners Action Coalition, presented their views on the public trust initiative in Colorado. Jerry Swingle and Richard Hamilton have proposed a statewide public trust ballot initiative. Swingle said the initiative is intended to be administered as a dual, equal and conjunctive doctrine alongside the Doctrine of Prior Appropriation. He quoted the testimony of cosponsor Richard Hamilton:

The intent of the sponsors is that Public Trust Doctrine and the Doctrine of Prior Appropriation be a conjunctive system of water usage for the protection and utilization of all of Colorado's water interests. The intent here is not to diminish the Doctrine of Prior Appropriation, but to bring the Public Trust Doctrine forward to act as an equal and as legally compelling a doctrine as that of Prior Appropriation.

Leonhardt and Waite, on the other hand, see the public trust doctrine as "...a trump card judges or government officials can play to deny new water rights or abrogate existing water rights in the name of environmental values, while hoping to avoid the constitutional mandate to pay just compensation for those water rights."

If mitigation passes, Leonhardt and Waite say at the very least it "will dramatically increase litigation over Colorado water rights. The proponents intend it to apply not only in determinations of new water rights, but also to force reconsideration of rights previously decreed, as in the Mono Lake case" (involving the City of Los Angeles and the Owens Valley). Leonhardt and Waite also see the proposed initiative as upsetting "the careful, and widely approved, balance the legislature and CWCB have struck between instream and other beneficial uses of water."

Proceedings can be purchased from the Cooperative Extension Resource Center (see below).

OTHER NEW CWRRI REPORTS

To order CWRRI reports contact the Cooperative Extension Resource Center, General Services Building, Colorado State University, Fort Collins, CO 80523. Phone 303/491-6198; FAX 303/491-2961.

Changes in Morphology and Endangered Fish Habitat in the Colorado River, by John Pitlick and Mark Van Steeter. (This research will be summarized in the next edition of *COLORADO WATER*. Completion Report No. 188. Price: \$5.00.

Proceedings: Colorado Water Workshop, Quenching the Urban Giant. Transcribed and edited at CWRRI. Information Series No. 78. Price: \$30.

Proceedings: Workshop on Computer Applications in Water Management, L. Ahuja, J. Leppert and K. Rojas, eds. Information Series No. 79. Available from Great Plains Agricultural Council. Call L. Ahuja at 970/490-8315.

Proceedings, High Altitude Revegetation Workshop No. 11, Warren R. Keammerer and Wendell G. Hassell, eds. Information Series No. 80. Price: TBA.

COOPERATIVE EXTENSION REPORTS

Colorado River Salinity Control Program, Lower Gunnison Units--1994 Surge Irrigation Research and Demonstration Report. Eighty cooperators participated in the surge irrigation research and demonstration project. Irrigation Water Management and surge training workshops were held for the participants in conjunction with field training. Cooperators were provided with management knowledge and equipped with a surge system. The program showed that surge technology, when properly used, reduces deep percolation, runoff, and salt loading to the Colorado River. The uniform application of water, reduction of deep percolation and fertigation through surge cut down the leaching of non-point source pollutants and helped maintain water quality. The program was sponsored by the U.S. Department of Interior, Bureau of Reclamation, and is administered by Colorado State University Cooperative Extension. To obtain a copy of the report contact either Mahbub-ul Alam or Richard W. Antonio, Irrigation Extension Agents, at 303/874-5735 (Delta) or 303/249-8407 (Montrose).

Best Management Practices (BMPs) for Colorado Agriculture--by Reagan M. Waskom, Extension Water Quality Specialist, principal author, in association with the Colorado Department of Agriculture and the Agricultural Chemicals and Groundwater Protection Advisory Committee. This is a compilation of bulletins that provides BMPs for:

Nitrogen Fertilizer
Irrigation Management
Manure Utilization
Phosphorus Fertilization
Pest Management
Pesticide Use in Field Crops
Pesticide and Fertilizer Storage and Handling
Wellhead Protection

Available from the Cooperative Extension Resource Center. See address above.

U.S. GEOLOGICAL SURVEY REPORTS

Physical, Chemical, and Biological Characteristics of Pueblo Reservoir, Colorado, 1985-89, by Michael E. Lewis and Patrick Edelmann. USGS Water-Resources Investigations Report 94-4097.

Reconnaissance Investigation of Water Quality, Bottom Sediment, and Biota Associated With Irrigation Drainage in the Dolores Project Area, Southwestern Colorado and Southeastern Utah, 1990-91, by David L. Butler, U.S. Geological Survey; Richard P. Krueger and Barbara Campbell Osmundson, U.S. Fish and Wildlife Service; and Errol G. Jensen, Bureau of Reclamation. USGS Water-Resources Investigations Report 94-4041.

Irrigation Water Use for the Fort Lyon Canal, Southeastern Colorado, 1989-90, by Russell G. Dash. USGS Water-Resources Investigations Report 94-4051.

Hydrogeology and Simulation of Flow Between the Alluvial and Bedrock Aquifers in the Upper Black Squirrel Creek Basin, El Paso County, Colorado, by Kenneth R. Watts. USGS Water-Resources Investigations Report 94-4238.

Water-Quality Assessment of the Rio Grande Valley Study Unit, Colorado, New Mexico, and Texas--Analysis of Selected Nutrient, Suspended-Sediment, and Pesticides Data, by S.K. Anderholm, M.J. Radell, and S.F. Richey. USGS Water-Resources Investigations Report 94-4061.

Water-Quality Assessment of the South Platte River Basin, Colorado, Nebraska, and Wyoming--Analysis of Available Nutrient, Suspended-Sediment and Pesticide Data, Water Years 1980-92, by Kevin F. Dennehy and others. USGS Water Resources Investigations Report 94-4095.

Maximum-Accumulation Snowpack Chemistry at Selected Sites in Northwestern Colorado During Spring 1994, by George P. Ingersoll. USGS Open-File Report 95-139.

Denver's Urban Groundwater Quality: Nutrients, Pesticides, and Volatile Organic Compounds, by B.W. Bruce. USGS Fact Sheet FS-106-95.

Nutrients in the South Platte River, 1993-95, by D.W. Litke. USGS Fact Sheet FS-105-95.

Are Streams in Agricultural and Urban Areas Contaminated by Pesticides? by R.A. Kimbrough. USGS Fact Sheet FS-104-95.

Some Bacteria Are Beneficial!, by P.B. McMahon. USGS Fact Sheet FS-102-95.6

Contact the U.S. Geological Survey, Earth Science Information Center, Open-File Reports Section, Box 25286, Mail Stop 517, Denver Federal Center, Denver, CO 80225 or call (303) 236-7476.

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Status of Water Quality in Colorado, 1994--Prepared by the Water Quality Control Division in fulfillment of Section 305(b) of the Clean Water Act of 1977 (P.L. 95-217), November 1994. For additional information contact: Water Quality Control Division, Colorado Department of Public Health and Environment, 4300 Cherry Creek Drive South, Denver, CO 80222-1530. Phone 303/692-3508.

VIDEOS

Subdividing the West: Implications of Growth. The fastest growing states are western and the region collectively is filling up at a rate not seen since the early land-rush days. This video examines the societal drives and motivations behind this latest land rush and how the influx of people with different values and perspectives is affecting western communities and cultures. The video is 49 minutes long and can be obtained by sending a \$10 check or purchase order (for duplication, processing and postage) to: Instructional Services, Colorado State University, A71 Clark Building, Fort Collins, Colorado 80523. A second video, called *Saving the West*, will be available this Spring.

INTERNATIONAL DROUGHT INFORMATION CENTER

Proceedings: Drought Management in a Changing West: New Directions for Water Policy--The conference was held in May 1994 in Portland, Oregon. The 250-page proceedings contains papers presented during plenary sessions, including comments from panel members, preconference workshop summaries, an integrated summary report from the working group sessions, and a plan of action for drought management in the West. Available from: International Drought Information Center, 241 L.W. Chase Hall, University of Nebraska, P.O. Box 830728, Lincoln, NE 68583-0728. IDIC Technical Report Series 94-1. Price: \$25.

UNIVERSITIES COUNCIL ON WATER RESOURCES

Proceedings: Environmental Restoration, UCOWR 1994 Annual Meeting. The meeting was held August 2-5, 1994 in Big Sky Montana. For information about the proceedings contact: UCOWR Executive Director's Office, 4543 Faner Hall, Southern Illinois University at Carbondale, Carbondale, IL 62901. Phone: 618/536-7571; FAX: 618/453-2671.

USBR--OPERATION OF GLEN CANYON DAM FINAL EIS

March 1995. Summary or complete final environmental impact statement now available from: Bureau of Reclamation, Attention: Colorado River Studies Office, 125 South State Street, Room 6107, Salt Lake City, UT 84138-1102. Phone: 801/524-5479.

WATER NEWS DIGEST

WATER ALLOCATION

Forest Service Files for Instream Flow Rights -- General Assembly Responds with Resolution

The Forest Service's request in a state water court for a guaranteed minimum flow in East Middle Creek, a tributary of the Rio Grande River, could challenge the state's water rights. State law requires that all instream flow rights in Colorado be held by the Colorado Conservation Board (CWCB). If the state grants the instream flow right to the federal government, it could bypass the CWCB, violating state law. The Colorado Senate, with the concurrence of the Colorado House of Representatives, passed a resolution requesting that the Forest Service withdraw its filing for appropriative water rights in the Rio Grande National Forest. It further resolved that the Forest Service seek any appropriative water right through the Colorado Water Conservation Board, in conformance with Colorado Law.

East Middle Creek is a headwater stream, starting at 11,600 feet. If the Forest Service filing is approved, it could prevent construction of a dam on the creek or water diversions to other drainage basins. The Forest Service, concerned about the CWCB's ability to change its mind about the amount of a flow right if it receives another request for use of that water, says the filing is intended to protect fish habitat in the high mountain stream and to prevent the board from someday reducing the amount of water protected by the right. If the in-stream flow right is granted, it could have far-reaching implications by allowing federal agencies to claim instream flows for endangered species and water quality issues not connected to federal lands. It could also be used to move water out of Colorado to downstream states.

Greeley Tribune 3/13/95; Montrose Daily Press 3/15/95; Senate Joint Resolution 95-15

Three-State Talks on Platte Basin Could be Stalled

Colorado, Nebraska, and Wyoming agreed last year to discuss plans to earmark Platte River water for endangered wildlife in central Nebraska. Since the talks began in July, the states have balked at a U.S. Fish and Wildlife Service plan to help the animals, and in January Wyoming proposed a cap on water project development in the Platte River as an alternative to the USFWS plan. The Colorado Department of Natural Resources, however, has said a cap would violate state law and keep Colorado from meeting the needs of a population expected to grow 37 percent in the next 25 years. Recently, officials in the Department of the Interior suggested that the process is not going well and that it should not be extended in June unless significant progress is made in the interim.

Denver Post 3/10/95; Fort Collins Coloradoan 2/12/95; Greeley Tribune 2/13/95; Montrose Daily Press 2/13/95, 3/13/95

Gunnison Flows to Increase

Responding to water supply outlooks in the Gunnison river Basin, estimated at 106 percent of normal, the Bureau of Reclamation has begun increasing releases from Aspinall Unit reservoirs, Blue Mesa, Morrow Point, and Crystal. The releases will raise Gunnison River Flows through the Black Canyon of the Gunnison National Monument and the Gunnison gorge. Those flows were to be gradually increased from around 650 cubic feet per second (cfs) to 1300 cfs by mid-March. On March 22, the Bureau of Reclamation reported a flow of 1290 cfs at the Gunnison tunnel. Though final spring and summer operation plans will be determined in mid-April, it is anticipated that a peak flow of around 3000 cfs through the monument and gorge will occur in mid- to late-May. For average flows of the Gunnison and several other Western Slope rivers, call Reclamation's toll free number, 1-800-276-4828.

Montrose Daily Press 3/10/95; Grand Junction Daily Sentinel 3/15/95

WATER PROJECTS

Grand Canyon Flows to be More Natural Under New Rules

The Colorado River below Glen Canyon Dam will operate more like Mother Nature intended under new rules announced by the U.S. Bureau of Reclamation, part of a permanent health plan for the Grand Canyon and Colorado River. Flows from the dam above the Grand Canyon will be permanently altered, with the new flows expected to rebuild sandbars, restore backwater channels, and re-create some of the dynamics of a natural river system. The changes are laid out in a final environmental impact statement. An audit under way by the General Accounting Office must be released before the changes can take effect.

Grand Junction Daily Sentinel 3/23/95

Arapahoe County gets Another Chance at Union Park Water

The Colorado Supreme Court announced on February 23 that Arapahoe County will get another chance at conditional water rights from the Gunnison Basin. The high court, in a 4-3 decision, affirmed a water court's dismissal of an application for a water decree that the county bought from the Natural Energy Resources Company. The justices, however, also reversed the water court's dismissal of the county's application because the county had failed to prove water availability and sent the case back to determine if a new trial is necessary. The county applied to the water court for rights to build and develop the Union Park Reservoir project, which would divert water for instream use in the Gunnison River Basin and for use in Arapahoe County. The application requested a conditional right for consumption of 900,000 acre-feet of water. The water

court's dismissal of the application for a conditional decree required the state Supreme Court to construe a law, called the "can and will" statute, to determine the extent to which existing rights decrees should be considered in determining water availability. The "can and will" statute requires a water rights applicant to prove the availability of water under river conditions existing at the time of application.

Denver Post 2/22/95, 2/25/95

Group Renews Gunnison Dam Proposal

Dominguez Hydroelectric Associates Inc. of Aurora is asking the Federal Regulatory Commission for a second three-year feasibility study permit for its proposed hydroelectric project. The first three-year permit expired Jan. 1. The study was delayed early on by uncertainties over the boundary line between the project area and the nearby Dominguez Wilderness Study Area. The Dominguez project calls for a 250-foot-high dam on the Gunnison River just south of Whitewater, which would create a 38,000-acre reservoir and another dam on the rim east of the river, creating a separate reservoir to be filled by pumping water from the lower reservoir. The project would make money by releasing water from the high reservoir to generate electricity at times of peak electrical use, when power is most valuable. The group also envisions leasing water to Las Vegas and California.

Grand Junction Daily Sentinel 3/1/95

Wolford Reservoir in Last Phase of Work Before Completion

A 120-foot high earthen dam on Muddy Creek, five miles north of Kremmling, is being built by the 15-county Colorado River Water Conservation District. The total cost of the project, Wolford Mountain Reservoir, is \$47 million. Though the reservoir will inundate 292 acres of wetlands where Muddy Creek flows through irrigated pastures, included in the project cost is a \$2.8 million mitigation plan to improve 420 acres along five miles of the creek from the dam to Kremmling. The remaining work, including addition of height to the dam and construction of a recreation area at the reservoir's midpoint, is to be wrapped up by October, but it is possible that some of this spring's runoff could be captured in the new reservoir. Holding 60,000 acre-feet of water, releases from the reservoir are earmarked for several users. Denver Water may use 15,000 acre-feet per year, and will pay \$33 million for the permanent right to use that water. The reservoir will also supply 3,000 acre-feet for Middle Park water users, 3,000 acre-feet for endangered fish in the Grand Valley, and 2,000 acre-feet for the new wetlands area. The River District will also reserve 10,000 acre-feet for flatwater recreation.

Grand Junction Daily Sentinel 3/13/95

New Demand Surfaces for Dolores Water

Dolores Project water is suddenly in demand, after farmers

earlier said it cost too much and turned back 1,100 acre-feet of what they had been allocated. Officials said the change is because agriculture has become more economically beneficial because of the Dolores Project. The project serves about 61,500 acres of land, including lands served by the Montezuma Valley Irrigation Company and lands owned by the Ute Mountain Ute Indian tribe. McPhee Reservoir, the source for the water, was finished in 1984 and water distribution began in 1987, currently supplying 90,000 acre-feet each year. Farmers were required to sign up for water allocations before the project was begun, and some later asked to be released from their agreements because of the costs.

Denver Post 1/28/95

WATER QUALITY

National Group Issues Clean Water Data Report

About 432 cases of illness related to drinking water have been detected in Colorado in the past eight years, according to a new report. Clean Water Action, a national environmental organization, in February released new data compiled by the Natural Resources Defense Council. Most of the illnesses linked to drinking water in Colorado were found primarily on the Western Slope and were attributed to giardia, an intestinal infection spread by parasites that causes acute gastrointestinal illness. In 1993 and 1994, 60 Colorado water systems violated either the coliform health standards or the surface water treatment rules.

Colorado Springs Gazette Telegraph 2/9/95; Denver Post 2/11/95; Grand Junction Daily Sentinel 2/9/95; Montrose Daily Press 2/10/95; Pueblo Chieftain 2/10/95

MTBE Polluting Groundwater in Denver

The gasoline additive MTBE, meant to reduce air pollution, has been found in groundwater along the Front Range. A 1993 U.S. Geological Survey study of the South Platte River found MTBE in 23 of 29 wells along Bear, Clear, Cherry, and other Denver-area creeks. The average concentration of the additive was 0.6 parts per billion, or one-eighth the amount considered harmful to human health. During a test conducted after a snowstorm in February, USGS investigators found that MTBE averaged one twelfth the concentration of that found in shallow groundwater. The EPA has said that MTBE, used in about 30 percent of the oxygenated fuels in Denver in winter, is a possible carcinogen.

Colorado Springs Gazette Telegraph 3/17/95; Greeley Tribune 3/16/95; Montrose Daily Press 3/20/95; Pueblo Chieftain 3/17/95

Larimer County Landfill Groundwater Contamination Reported

Volatile chemicals seeping into groundwater at the Larimer County Landfill have migrated offsite, and officials have identified the contamination on the Cathy Fromme Prairie, a

city-owned natural area that abuts the landfill property. Local officials have known about the migrating chemicals since 1990, but it is only since the city purchased the Fromme Prairie in 1993 that they were able to determine the extent of the contamination. Traces of organic compounds -- all of which are ingredients found in common household products as well as industrial waste -- are the remnants of hazardous materials that were dumped at the site three decades ago. Authorities say neither the level of the possible carcinogen, vinyl chloride, nor other chemicals detected pose any immediate threat to human health or to the environment. Most of the contamination is confined along the northern edge of the landfill. County and state officials have decided to begin the cleanup process on their own, without the help of the Environmental Protection Agency.

Fort Collins *Coloradoan* 2/25/95, 3/1/95, 3/10/95, 3/17/95

Water Supplies to be Tested for Cryptosporidiosis

To determine whether a health risk exists, public water systems serving 10,000 or more customers soon will begin testing for the tiny parasite cryptosporidiosis. Waterborne cryptosporidiosis appears to be taking on increased public health importance after several outbreaks in the past few years. The Environmental Protection Agency is expected to require community water systems to collect information on the presence of cryptosporidium before and after water is treated for drinking. Systems serving 10,000 to 100,000 customers will test every other month for a year, and larger systems will test every month for 18 months. In Colorado, 34 communities meet the size requirement. Cryptosporidium eggs are expected to be found in the source water of more than 80 percent of the nation's treatment systems, and chlorine is not very effective against the parasites.

Denver Post 2/16/95

WETLANDS

Fort Collins Wetlands Preserved Under Deal

The Fort Collins' natural areas tax has saved a critical wetland from being boxed in by houses, assuring the 90 bird species and other wildlife that use the area a refuge from development. The area, which the city is in the process of purchasing, includes 229 acres of intermixed wetland and grassland on the southeast side of town. Acquisition of the properties, which is subject to formal approval from the City Council, will push the amount spent on natural areas and open space purchases with natural-areas tax money to more than \$5 million, preserving more than 1,300 acres. The tax -- a quarter cent on a dollar for most purchases -- was approved by city voters in 1992 to fund the purchase of land for natural areas, wildlife habitat, and public trails. The Natural Resources Division is also negotiating to acquire four other parcels, two along the Poudre River, one along the city's Bridges Open Space, and another on the north side of the Cathy Fromme Prairie.

Fort Collins *Coloradoan* 3/14/95

WILDLIFE

Redlands Dam Fish Ladder Planned

The U.S. Bureau of Reclamation is seeking a dredge-and-fill permit from the U.S. Army Corps of Engineers for the \$1 million fish ladder it plans to build for the U.S. Fish and Wildlife Service. The ladder is a C-shaped concrete structure that will swing around the east side of the Redlands Water and Power Company diversion dam on the Gunnison River. Biologists hope that fish will use the ladder to get around the Redlands dam to habitat in the Gunnison River upstream to Delta. Fish will gather in a large holding tank at the top of the ladder for sorting. Non-native fish will return to the river below the bottom of the ladder, and native fish will go into the river above the dam. Project construction will start this fall and be complete by spring 1996. USBR has already made a deal to provide water from Blue Mesa Reservoir to operate the ladder.

Grand Junction *Daily Sentinel* 3/9/95; *Montrose Daily Press* 3/10/95

South Platte's Rare Fish in Trouble

Populations of several rare fish in the South Platte River have plummeted in the past 15 years, increasing the chance that they will be included on the federal list of endangered species -- and add new restrictions to municipal utilities and Eastern Plains farmers. At a recent conference in Denver of more than 100 water managers, irrigators, regulators, and environmentalists, the message was clear that fewer rare fish means problems for water users. Wildlife researchers said that at least 10 South Platte fish could become candidates for protection under the federal Endangered Species Act. State biologists said they suspect that river pollution and water-use policies by cities and farmers have dramatically changed the natural flows of the South Platte. Levels of nitrate pollution have climbed steadily in most of the South Platte, and natural river flows have been changed by intensive farm irrigation. State officials said they hope to persuade utilities, farmers, and environmental groups to work together on behalf of the rare fish to prevent a federal takeover.

Colorado Springs *Gazette Telegraph* 3/17/95; *Denver Post* 3/16/95; *Montrose Daily Press* 3/20/95

State Considers Breeding Endangered Aquatic Species

A small-scale aquatic breeding ground could help keep some species off the federal endangered species list. The proposed Colorado Aquatic Facility, to be operated by the Division of Wildlife, would cost between \$8 and \$12 million and would be located halfway between Alamosa and Monte Vista. The aquatic facility would produce small numbers of specialty aquatic species like mollusks, crustaceans, amphibians, and fish. There is hope among DOW officials that the federal government will hold off declaring some species endangered if they could be grown at the facility.

Pueblo *Chieftain* 2/26/95

PEOPLE

New General Manager for Southeastern Colorado Water Conservancy District

Former state representative Steve Arveschoug has been appointed to head the Southeastern Colorado Water Conservancy District, effective May 1. His appointment as general manager follows the death of Charles "Tommy" Thompson, a longtime state water advocate who headed the district. The district, founded in 1958, encompasses more than 26,000 square miles of land along the Arkansas River Basin from Leadville to Holly.

Colorado Springs *Gazette Telegraph* 3/17/95; *Pueblo Chieftain* 3/17/95

Senator Hank Brown Takes Helm of New Water Caucus

A group of lawmakers at the beginning of March formed a Western Water Caucus and vowed to fight federal efforts to supersede state water laws. Senator Hank Brown, co-chairman of the caucus, said they would balance the needs of urban and agricultural water users and environmentalists. Brown said, however, that he is worried that federal agencies are trying to take water rights in the name of environmental conservation. He said that he supports minimum stream flows and providing water for preservation, but the federal government should obtain water the same way everyone else does.

Denver *Post* 3/2/95; Fort Collins *Coloradoan* 3/2/95, 3/6/95; *Pueblo Chieftain* 3/2/95

WATER RATES

East Larimer County Water District Water Rate Increase

Effective March 1, the East Larimer County Water District will increase its raw water fee from \$1,500 per acre-foot to \$1,750 per acre-foot. The rate will affect any customer purchasing a new tap directly from the District.

Fort Collins *Coloradoan* 2/23/95

Monte Vista Considers Flat Fee to Cover Sewer Compliance

With one of the city sewer lagoons out of compliance and faced with hefty fines and penalties, Monte Vista is considering a flat fee of \$2.50 a month for city residents for water and sewer improvements. If the city council approves the fee, likely in April, buildings outside the city limits using city water and sewer will face a monthly charge of \$7.50.

Pueblo Chieftain 3/25/95

Canon City Council Approves 15% Hike to Fund Repairs

The Canon City Council, on March 6, gave final approval to a 15 percent increase to fund \$1.2 million in repairs to its aging

water treatment plant. The council was forced to pass the increase because voters defeated a \$5.7 million water revenue bond last November. The council plans to proceed with another bond issue election in November to fund an additional \$4 million plant improvement in the form of a new pretreatment facility. If the bond issue should fail again, the council would have to accumulate the \$4 million in funds through another rate increase in the beginning of 1996.

Colorado Springs *Gazette Telegraph* 2/3/95; *Pueblo Chieftain* 2/3/95, 2/9/95, 2/22/95, 3/8/95

LITIGATION

Kansas-Colorado Case Returns to High Court

In 1907 the Supreme Court declined to rule on the case. In 1943 the high court rejected a special master's plan to divide the Arkansas River with five parts for Colorado, one part for Kansas -- and told the two states to negotiate, which led to the 1949 Arkansas River Compact. Now Colorado and Kansas are taking their century old fight over Arkansas River water back to the Supreme Court. Both sides will try to strip away layers of a special master's interpretation of the compact. Unlike most other interstate water agreements, the Arkansas River Compact was preceded by a long history of litigation and no specific amount of water to be delivered to Kansas is stated. Colorado is not prohibited from drilling wells or building dams under the compact.

Denver *Post* 3/22/95; *Montrose Daily Press* 3/13/95; *Pueblo Chieftain* 3/12/95, 3/22/95

CONSERVATION

Researchers Lauded for Helping Farmers Save Energy

Michael Blue, Gerald Buchleiter, Harold Duke, and Dale Heermann, all from the Fort Collins office of the U.S. Department of Agriculture, were recognized for developing a computer program to schedule irrigation to improve efficiency, minimize environmental damage, and save energy. The U.S. Department of Energy recognized the four with a Sustained Exemplary Service award.

The program they developed measures the amount of water used by a farmers irrigation system, then calculates what has been taken out by weather conditions to give a final reading of how much water needs to be applied to replace what has been used. The scientists use 20 to 24 mini-weather stations near several well-irrigated fields around the state to gather information about wind, solar radiation, temperature, and relative humidity. The computer in Fort Collins calls the stations and collects the weather data, then makes recommendations on when to begin irrigation and how long to irrigate.

Fort Collins *Coloradoan* 2/11/95

CALLS FOR PAPERS
**ASCE North American Water
and Environment Congress**

June 22-28, 1996, Anaheim, CA. To receive Call for Papers and program brochure, contact: Headquarters, American Society for Civil Engineers, Attn: Ms. Andrea Simon, Conference and Convention Department, 345 East 47th St., New York, NY 10017. FAX: 212/705-7975. Deadline: August 25, 1995.

Water Quality International '96

June 23-28, 1996, Singapore. For abstract instructions contact: International Association on Water Quality (IAWQ), 1 Queen Anne's Gate, London SW1H 9BT, England. Tel: 44-171-222-3848; FAX 44-171-233-1197; Tlx 9188518 WATAD G. Presenters must pay registration fee and own expenses. Deadline: July 1, 1995.

ANNOUNCEMENT AND CALL FOR PAPERS
ENDANGERED SPECIES MANAGEMENT: PLANNING OUR FUTURE

The 6th Annual South Platte Basin Forum

October 25-26, 1995

The Ramkota Inn, Greeley, Colorado

The South Platte Basin contains diverse ecological and social communities. The link binding these communities together is the South Platte River. Rapid growth has threatened ecological integrity and biological diversity, but legislation designed to protect diversity is perceived as a threat to social and economic prosperity in the basin. Can both communities be protected?

The 1995 South Platte Forum will address threatened, endangered, and state species of special concern in the South Platte Basin. Presentations will identify biological issues of concern, and keeping in mind the integrative framework developed in previous South Platte forums, investigate the political, economic and social implications of sensitive species management. How can protection and recovery of declining, threatened and endangered species be balanced with preserving historic ways of life and planning for inevitable growth? How has our use of water since settlement altered the ecological setting, and what is our vision for the ecology of the future? How will changes in Washington affect our ability to resolve endangered species issues?

You are invited to submit a one-page abstract to the organizing committee for a planned 15-minute presentation. Specific topics to be addressed at the conference include:

- State and federal endangered species legislation
- Current status of federally listed species and state species of special concern
- Habitat requirements of threatened and endangered species
- Threats to endangered species
- Implications of managing for recovery and preservation of sensitive species, with respect to
 - water conservation
 - economic development and regional growth
 - social responsibility and values
 - planning for future change

Abstracts are due by July 1, 1995. Authors whose papers are selected for presentation will be notified by August 1, 1995. The abstracts should be one page or shorter in length, and be submitted both in hard copy and Wordperfect or ASCII format on disk if possible. All submitted abstracts will be published in the conference proceedings.

SUBMIT MATERIALS TO: Colorado Water Resources Research Institute
410 University Services Center
Colorado State University
Fort Collins, CO 80523
Attention: David Graf, Coordinator.
Phone: 970/491-6308 FAX: 970/491-2293

JOSEPH F. POLAND SYMPOSIUM ON LAND SUBSIDENCE

October 4, 1995 -- Sacramento, California

A symposium on land subsidence is planned for the 1995 Annual Meetings of the Association of Engineering Geologists and the Ground Water Resources Association of California, during October 1-7, 1995 at the Hyatt Hotel in Sacramento, California. The symposium is named in honor of the late Joseph F. Poland, a founding charter member of the AEG and world-renowned expert in the field of land subsidence due to subsurface fluid withdrawal.

In honor of Dr. Poland, the Land Subsidence Committee of the AEG invites papers for oral and poster presentation from practitioners, researchers, and planners/decision makers, including legal counsel, who have experience with the study, mitigation, and societal impact of land subsidence.

Each presenter should submit an abstract cover page that contains the following information:

PRESENTATION TITLE (ALL CAPS), LAST NAME, Firstname, M.L., affiliations and addresses. List primary author first and note presenter with (*), Office, home and fax telephone numbers. Indicate if oral or poster presentation is preferred.

Abstracts should be less than 400 words, single spaced, in 10 point, Times font (no figures or references).

Submit to: Julia Turner, Technical Program Manager, AEG Annual Meeting, 3037 Valkyrie Way, Sacramento, California, 95821 (e-mail: jturner@trmx2.dot.ca.gov).

Deadline: May 1, 1995

For information contact:

Jim Borchers, U.S. Geological Survey, at 916/278-3005
FAX 916/278-3013; e-mail: jborcher@usgs.gov

or

C. Dale Elifrits, Manager of the AEG Subsidence Committee, at 314/341-4847
FAX 314/341-6593; e-mail: cdfritz@umr.ed

INTERNATIONAL CONFERENCE ON EVAPOTRANSPIRATION AND IRRIGATION SCHEDULING IN CONJUNCTION WITH THE IRRIGATION ASSOCIATION EXPOSITION NOVEMBER 3-6, 1996 -- SAN ANTONIO, TEXAS

The conference will focus on reporting new technology, providing updates on existing technology, discussing techniques to apply a technology, and identifying and prioritizing future needs.

Obtain submittal forms and abstract instructions from:

Judy Brown
American Society of Agricultural Engineers
e-mail: brown@asae.org
Phone: 616/428-6323
FAX: 616/429-3852

Abstracts should emphasize the rationale, approach, results and significance to ET and/or irrigation scheduling. Author instructions for preparation of manuscripts in camera-ready form will be provided upon acceptance of the abstract. Papers will be limited to six (6) pages. Manuscripts will be reviewed by the Proceedings Committee. Published proceedings of the conference symposium papers will be distributed at the conference. All senior authors will be required to pay an advance registration fee: *Total proceedings cost/number of*

papers (approximately \$75.80). This publication fee will be collected at the time of paper submission in its final version. This amount will be deducted later from final registration fees. Page charges of \$50 per page will be assessed for papers over six pages.

Deadline for abstract: July 1, 1995

Send paper proposal forms to:

Walter C. Bausch
USDA-ARS
AERC-CSU Foothills Campus
Colorado State University
Fort Collins, CO 80523
Phone: 970/491-8264 FAX: 970/491-8247
INTERNET: walter@lily.aerc.colostate.edu
(proposals not accepted by e-mail)

For information about the International Irrigation Exposition contact: Claude Phene, Co-chair, Phone 209/298-0201, FAX 209/298-8068; or Claudio Stockle, Co-chair, Phone 609/335-3826, FAX 509/335-2722.

MEETINGS**15th Annual
Thornton Symposium****Friday, May 5****Managing Our Successes:
Addressing the Pressures of
Growth on Colorado's
Water Resources****Radisson Graystone Castle
I-25 & 120th Avenue**For information contact: City of Thornton,
Utilities Department, 9500 Civic Center Drive,
Thornton, CO 80229.**The Endangered West
August 2-4, 1995****20th Annual Colorado
Water Workshop
Western State College
Gunnison, Colorado**

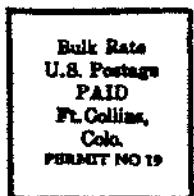
Can the West's finite water resources support a growing population, irrigated agriculture and endangered species? Should farms be sacrificed to provide water for other uses? How could the undeveloped waters of the Colorado River fit into the equation? Join the search for solutions this summer in beautiful Gunnison Valley.

Contact: Lucy High or Jill Corbett
970/943-7156**CALENDAR**1995

- April 17-18 **UPPER ARKANSAS RIVER RESEARCHERS WORKSHOP**, Canon City, CO. Contact: Jeff Keidel, P.O. Box 938, Buena Vista, CO 81211 or call 719/395-6035.
- April 20 **RMWPCA MID-YEAR CONFERENCE**, Northglenn, CO. Contact: Jose Velazquez, Camp Dresser & McKee, Inc., 1331 17th St., Suite 1200, Denver, CO 80202. Voice 303/298-1311; FAX 303/293-8236.
- Apr. 23-26 **WATER IN THE 21ST CENTURY; CONSERVATION, DEMAND & SUPPLY**, Salt Lake City, UT. Contact: American Water Resources Association, Phone 703/904-1225; FAX 703/904-1228.
- May 7-11 **INTEGRATED WATER RESOURCES PLANNING FOR THE 21ST CENTURY**, Cambridge, MA. ASCE 22nd Annual Conference. Contact: Headquarters, American Society for Civil Engineers, Attn: Ms. Andrea Simon, Conference and Convention Department, 345 East 47th St., New York, NY 10017. FAX: 212/705-7975.
- May 14-18 **WATER RESOURCES AT RISK**, Denver, CO. Contact: Helen Klose, Amer. Inst. of Hydrology, 3416 Univ. Ave., SE, Minneapolis, MN 55404, Phone 612/379-1030.
- May 16-19 **EFFECTS OF LAND APPLICATION OF BIOSOLIDS IN ARID AND SEMI-ARID ENVIRONMENTS**, Fort Collins, CO. Contact: Brian Janonis, Phone 970/482-5922, Janonis@aol.com; Bob Brobst, 970/293-1627, Brobst.bob@epamail.epa.gov; or Phil Hegeman, 970/692-3598.
- May 23-25 **WORKSHOP ON COMPUTER APPLICATIONS IN WATER MANAGEMENT**, Fort Collins, CO. Contact L.R. Ahuja, USDA-ARS, Phone 970/490-8300; fax 970/490-8310.
- June 6-8 **GREAT PLAINS AGRICULTURAL COUNCIL 1995 ANNUAL MEETING: AGRICULTURAL/NATURAL RESOURCE POLICIES AND THE GREAT PLAINS**, Albuquerque, NM. Contact: Helen F. McHugh, Program Chair, 970/491-6449, hfmchugh@lamar.colostate.edu.
- June 7-10 **THE 5TH INTERNATIONAL SYMPOSIUM ON SOCIETY AND RESOURCE MANAGEMENT**, Fort Collins, CO. Contact: Jennifer Pate, Phone 970/491-2077; FAX 970/491-2255.

- June 7-11 SOCIETY FOR CONSERVATION BIOLOGY, Fort Collins, CO. Contact: Rick Knight, Dept. of Fishery & Wildlife Biology, Colorado State Univ., Fort Collins, CO 80523, Phone 970/491-6714.
- June 9-11 1ST CONFERENCE, ASSOCIATION FOR THE STUDY OF LITERATURE AND ENVIRONMENT, Fort Collins, CO. Contact: Office of Conference Services, Colorado State University, Phone 970/491-6222 or e-mail at asleconf@vines.colostate.edu.
- June 25-28 AUTOMATING TO IMPROVE WATER QUALITY, Minneapolis, MN. For information call 1-703-684-2400, ext. 7221.
- June 25-28 WATER RESOURCES & ENVIRONMENTAL HAZARDS: EMPHASIS ON HYDROLOGIC & CULTURAL INSIGHT IN THE PACIFIC RIM, Honolulu, Oahu, Hawaii. Contact American Water Resources Association, Phone 703/904-1225; FAX 703/904-1228.
- July 2-14 INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS, Boulder, CO. Contact IUGG XXI General Assembly, c/o American Geophysical Union, Phone 202/462-6900, FAX 202/328-0566, e-mail iugg_xxiga@kosmos.agu.org.
- July 24 FUNDAMENTALS OF COLORADO ENVIRONMENTAL LAW COMPLIANCE, Denver, CO. Phone: 301/921-2345, FAX 301/921-0373.
- Aug 1-4 WHOSE THIRST IS FIRST? A NEW PARADIGM FOR WATER MANAGEMENT? The Universities Council on Water Resources Annual Meeting, Portland, ME.
- Sept. 6-8 SYMPOSIUM ON THE SETTLEMENT OF INDIAN RESERVED WATER RIGHTS CLAIMS, Portland, OR. Contact: Western States Water Council, Phone 801/561-5300; FAX 801/255-9642.
- Sept. 10-13 1995 ANNUAL CONFERENCE, ROCKY MOUNTAIN SECTION OF THE AMERICAN WATER WORKS ASSOCIATION AND THE ROCKY MOUNTAIN WATER POLLUTION CONTROL ASSOCIATION, Sheridan, WY. Contact: Al Kinter, 307/674-9833; or David Hill, 307/235-8213.
- Sept. 17-20 ASDSO ANNUAL CONFERENCE, Atlanta, GA. Association of State Dam Safety Officials. Contact: ASDSO, 450 Old East Vine St., 2nd Floor, Lexington, KY 40507. Phone 606/247-5140; FAX 606/323-1958.
- Sept. 18-20 VERSATILITY OF WETLANDS IN THE AGRICULTURAL LANDSCAPE, Tampa, FL. Contact American Water Resources Association, Phone 703/904-1225; FAX 703/904-1228.
- Oct. 21-25 WATER ENVIRONMENT FEDERATION 68TH ANNUAL CONFERENCE & EXPOSITION, Miami Beach, FL. Contact: Water Environment Federation, 601 Wythe Street, Alexandria, VA 22314-1994. Phone 800/444-2933.
- Nov. 5-9 1995 NATIONAL CONFERENCE OF THE AMERICAN WATER RESOURCES ASSOCIATION, Houston, Texas and Reconvened Conference Nov. 10-12, 1995, Cancun, Mexico, General Chairperson, Bechtel, 3000 Post Oak, Houston, TX 77252-2166, Phone 713/235-4921.

Colorado Water Resources Research Institute
410 University Services Center
Colorado State University
Fort Collins, CO 80523



**OUR AREA CODE IS
CHANGING**
As of April 2, 1995, CWRRI's
new telephone number will be:
970-491-6308
Our fax number will be:
970-491-2293