COLORADO WATER

Newsletter of the Water Center at Colorado State University

OCTOBER 1999

Hear Marc Reisner, author of *Cadillac Desert*, the keynote speaker for the Third Annual Student Water Symposium. The symposium will be held in the Lory Student Center at Colorado State University November 3-5, 1999.

Reisner will speak on Wednesday, November 3 at 7:00 p.m. in the Theatre of the Lory Student Center, CSU.

See page 43 for details about the Student Water Symposium.

Greg Hobbs, Justice, Colorado Supreme Court, and Hubert Morel-Seytoux share a moment at the 19th Annual Hydrology Days held at Colorado State University August 16-20, 1999. *See page 29 for meeting summary.*

10th ANNUAL SOUTH PLATTE FORUM
October 27-28, 1999
Raintree Plaza Conference Center, Longmont, Colorado

See page 42 for the forum program.

WATER ITEMS AND ISSUES . . .

COLORADO WATER

Vol. 16, No. 5 **October 1999**

Editor:
Shirley Miller
Writers:
Dave Bartecchi
Jamie Miller
Cat Shrier

COLORADO WATER is a publication of the Colorado Water Resources Research Institute. The scope of the newsletter is devoted to enhancing communication between Colorado water users and managers and faculty at the research universities in the state. This newsletter is financed in part by the U.S. Department of the Interior, Geological Survey, through the Colorado Water Resources Research Institute. The contents of this publication do not necessarily reflect the views and policies of the U.S. Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement by the United States Government.

Published by the
Colorado Water Resources Research Institute
Colorado State University, Fort Collins, CO 80523
Phone: 970/491-6308 FAX: 970/491-2293
E-mail: CWRRI@ColoState.EDU

INTERNET SITES
Colorado Water Resources Research Institute
http://cwrri.colostate.edu
Colorado Water Center
http://watercenter.colostate.edu
Colorado Water Knowledge Homepage
http://waterknowledge.colostate.edu

EDITORIAL

'WATER' STUDENTS

by Robert Ward, Director

Today, there are many university students in Colorado majoring in a variety of disciplines and studying aspects of water science, technology and management. 'Water' is an area of study that occurs at the interface of disciplines, not a separate discipline unto itself. Thus, students interested in water normally major in a discipline while studying some aspect of water – from basic hydrology and urban water infrastructure to public water information and creative writing about the West's changing relationship with water.

For example, engineering students are examining ways to make our water infrastructure more sensitive to ecological and social constraints while meeting the needs of traditional and new water users. Students in aquatic ecology, by studying the life cycles of threatened fish, are quantifying water and habitat needs that become design constraints for the engineers. Students seeking degrees in economics are examining options to maintain, and where necessary obtain, in a fair and equitable manner, the water and habitat needed. Hydrology students are measuring water quality impacts of water right exchanges. Journalism students examine ways to inform the public about the complexities of western water management. Creative writing students examine the human emotions that surround water management in Colorado. Students in sociology examine the human organization created to manage water. And the list goes on and on.

'Water' students, in all disciplines today, exhibit a strong sense of creativity and practicality as well as commitment to excellence. Nowhere will this be more strongly exhibited than at the Third Annual Student Water Symposium to be held November 3-5, 1999, at the Lory Student Center on the Colorado State University campus. The symposium is organized and managed in all details by students and is designed to help 'water' students improve and perfect their professional presentation skills. A major feature of the symposium is the highly interdisciplinary backgrounds of the students who organize and participate in the meeting.

To keynote the 1999 Student Water Symposium, Mark Reisner has been invited, by the students, to share the evolution of his thinking about western water management. His address will be presented at 7:00pm, November 3, 1999, in the Main Theatre of the Lory Student Center. I encourage water professionals from both on and off campus to join the students November 3-5, 1999, in the Lory Student Center to learn about the research topics being addressed to today; to experience the intellectual energy brought to the topics; and to witness the excellent presentation skills being developed by today's 'water' students.

'Water' faculty in Colorado, under the leadership of Professor Jorge Ramirez at CSU, are organizing the 20th Annual Hydrology Days to be held April 3-6, 2000. A summary of the 1999 Hydrology Days is presented on page 29. A major feature of this annual 'water' meeting is the student paper/poster competitions. Students, again, are displaying their research topics, their findings and their presentation skills in a professional setting and before professionals working in the field.

Water managers seeking new 'water' employees have an excellent opportunity to gain insight into the talents and knowledge of students completing their degrees each year at these two meetings. Please feel free to join these meetings and participate – you may find your next employee!

I might suggest going further than simply checking out the new crop of 'water' graduates each year. Why not get ahead of the competition by supporting an outstanding student in their education and research endeavors. Organizations that employee water professionals may want to consider establishing 'water' scholarships for undergraduates and graduate research assistantships and/or fellowships for graduate students to work on topics that meet specific needs of the sponsoring organization. In this way, water organizations in Colorado can obtain needed research, carefully examine the capabilities of a potential employee and, at the same time, support the development of outstanding future water professionals.

If a water organization is interested in supporting a scholarship, assistantship or fellowship for a promising 'water' student, please contact me at CWRRI [(970) 491-6308 or rcw@lamar.colostate.edu. CWRRI welcomes the opportunity to bring the water education offered by Colorado's higher education system into direct connection with the needs of Colorado's water management organizations in any way we can.

See you at the Student Water Symposium!

RESEARCH

ISSUES AFFECTING IRRIGATION DISTRICTS AND MUTUAL CANAL COMPANIES

by John Wilkins-Wells[1]

This report presents the findings of a three-year study commissioned by the Bureau of Reclamation. The study reports on various issues affecting irrigation districts and mutual canal companies in the intermountain region (Colorado, Idaho, New Mexico, Utah and Wyoming) Thirty-four of these enterprises are represented in the study.

A key issue is the rapid increase in the cost of assessments paid by water users. The study also reports on

- ***various aspects of the daily governance and management of these two principal forms of nonprofit irrigation enterprises, and***
- ***current policy concerns voiced by representatives of these enterprises while conducting fieldwork for the study.***

Finally, as part of the overall study, an additional in-depth analysis was conducted on conservation investments made by irrigators on irrigated farms served by irrigation districts and canal companies.

Western irrigated agriculture is characterized by upwards of 8,500 associations of farmers and ranchers in incorporated or unincorporated mutual organizations, commercial companies or irrigation districts. In this summary, these water delivery or storage organizations are collectively referred to as "irrigation enterprises". The enterprises occupy an important intermediate role in the West's irrigation economy, between the individual farm irrigators and the public agencies historically active in developing multipurpose water development and storage facilities. This role is sometimes misunderstood or overlooked in public water-policy discussions.

Irrigation districts and canal companies in the intermountain region of the western United States appear to be under considerable stress from challenges to their traditional water rights, urbanization of services areas, and environmental requirements in operating an irrigation enterprise. The ability of irrigation enterprises to counter or adapt to these challenges depends in no small way on the soil, water, environmental and project-level conservation investments of the irrigators and their water servicing enterprises.

Thirty-six enterprises participated in this study. The combined effective irrigated acreage served by the sample enterprises amounts to about 1,478,720 acres (1995), or a little over one-tenth of all irrigated lands in the region served by gravity canal systems. The sampled enterprises have service areas ranging in size from 4000 to 200,000 acres. The sample includes only enterprises that are direct water suppliers to irrigated farms. Conservancy districts or other special water districts not providing direct water service to farms were not part of the study. All sampled enterprises operate as nonprofit entities under state irrigation district statutes or nonprofit corporation laws. The sampled enterprises also included irrigation districts under Reclamation projects. Eleven Reclamation project areas are represented in the sample. Data were collected by first obtaining the consent of irrigation district and canal company managers and boards. Participants then provided financial data from 50 years of enterprise financial audits, including balance sheets and revenue and expense statements for every fifth year beginning in 1945 and through 1995. These data were supplemented by personal interviews about present and future concerns. In addition, nearly 22,800 individual conservation records involving farmers in 57 intermountain counties were acquired from the Conservation Reporting and Evaluation System (CRES) database, administered by the Farm Service Agency and covering the seven-year period 1989-1995. Thirty-six of these 57 counties had an irrigation enterprise participating in the study. The water conservation cost-share projects represented in this supplement database reported in a separate volume involved about 3.5 million benefiting acres in farms. The CRES records are a rich and accessible source of information for in-depth agricultural and economic research on conservation and related environmental subjects, going far beyond the immediate needs of the current study.

[1] The research project was assisted by Dr. Raymond L. Anderson, Dr. George A. Pavelis, Mr. Hubert Lagae, Mr. Muhummad Anwer and Mr. Andrew Griguhn.

Irrigation Enterprise Costs[2]

♦For the single year of 1995, combined irrigation enterprise O & M and administrative costs for the sample ranged from $5.00 per irrigated acre to $78.00 per irrigated acre, with an average cost of about $20.68 per irrigated acre. At the same time, there was no strong correlation in the data between the acre size of an irrigation enterprise service area and the cost per irrigated acre by water users. Use of average cost values translated into the cost-per-irrigated-acre, or cost-per-acre-foot of water delivered to the farm headgate, must be used with extreme caution in estimating regional water costs for irrigated agriculture. This is because the cost of operating an irrigation enterprise in the intermountain region varies greatly due to differences in (1) geographical location (rural/urban), (2) canal engineering and design, and (3) administrative requirements (office, employees, legal, etc.).

♦For 1995, the $20.68 per-irrigated-acre average cost of operating an irrigation enterprise can be broken down as follows: $7.75 per irrigated acre for total O & M costs, $11.87 per irrigated acre for administrative costs, $0.88 for debt payment on the irrigation enterprise, and $0.17 for special project costs. An important contributor to increased administrative costs is the legal fees associated with urbanization and environmental regulations.

♦The true level of legal costs borne by irrigation enterprises today is difficult to research and document. Legal costs are often not separated out from other administrative costs in irrigation enterprise expense statements. However, total legal and accounting costs in 1995 were running at about $0.90 per-irrigated-acre for a subset of 14 enterprises in the study sample. These same 14 enterprises showed a dramatic increase in legal costs over the years studied.

♦A major contributor to the rapid rise of administrative costs appears to be employee salaries. Some of this increase is obviously due to incrementally higher pay rates for higher-skilled managers, office secretaries and additional field staff over the years. The cost of employee health and retirement benefits is rapidly growing in importance too. Employee salaries are generally 60 percent higher for enterprises located in urbanizing counties compared to enterprises located in more rural counties.

♦Irrigation districts generally show a higher O & M cost than mutual canal companies, whereas administrative costs for the two types of enterprises are about equal. Part of this difference may be explained by the generally higher level of long-term debt liability carried by irrigation districts, due to their legal status. This legal status allows them to place irrigated lands as collateral for bonds and other forms of long-term debt financing. Therefore, the districts often end up entering into larger annual debt repayment obligations for more canal infrastructure.

♦As of 1995, long-term debt liabilities held by 29 of the sampled enterprises amounted to $34,681,633, or about $25.25 per irrigated acre. Short-term debt liabilities amounted to about $6.78 per irrigated acre. By prorating these values across all irrigated acreage in the intermountain region served by gravity canal systems, this would show about $289 million dollars in long-term and short-term debt liabilities for 1995. Irrigation districts tend to carry somewhat more debt liability than canal companies.

♦Historically, trends show declining assets, or depreciated assets over the years. It is conservatively estimated that the region currently shows $1.4 billion (1995 dollars) in irrigation infrastructure assets (book value). This dollar figure is only for primary canal systems and associated small reservoir storage, diversion, and pumping facilities. This asset value generally does not include the value of large multipurpose reservoir facilities developed through Reclamation's revolving fund or state-financed public water projects. This investment is what must be considered when assessing (1) the effects of reallocation water out of these enterprise service areas to other users, (2) possible replacement costs of these basic canal facilities in the future if required because of loss through urbanization.

♦The decade of the 1970s appears to be a period when costs began to show their most rapid increase. Some of this is undoubtedly due to the general inflation in the economy at this time. However, the trend continues unabated thereafter. Another jump in costs occurs in the 1980s and continues into the present. Much of this later jump in costs appears due to recent urbanization in the intermountain region, plus the overall effects of the general increase in environmental regulations, including the 300-percent increase in irrigation enterprise operational costs (O & M and administrative) between 1975 and 1995.

Urbanization

♦The gradual urbanization of irrigation enterprise service areas appears to have a dramatic affect on the costs of operating an enterprise. Total operational costs (combined O & M and administrative) tend to be about 50 percent higher for enterprises located in urbanizing areas than for those in predominantly rural areas. Some of this is reflective of higher employee salary costs in urbanizing areas, but not all.

[2] All costs reported are per irrigation enterprise service area irrigated acre.

♦Irrigation enterprise board members and managers are almost unanimous in their concern about the unwillingness of municipalities to share in the growing cost of operating an irrigation enterprise in urbanizing areas. Such costs include the burying of ditches, protecting canal crossings, fencing to prevent drowning, protection of enterprise right-of-way or violation of same, canal damage from urban storm runoff, etc.

♦All or most prime irrigation counties in the intermountain region are experiencing rapid urbanization. Urban policies and associated values toward irrigated agriculture are frequently unsupportive toward addressing the increased operational and administrative costs borne by irrigation enterprises as a result of urbanization. Much of the problem appears to be linked to county government land-use policies.

Enterprise Office Management

♦For irrigation enterprises, the five-member board is still the predominant size. Regular, secret-ballot elections for board members are the norm. All but three enterprises in the sample had full-time managers, and at least one full-time office secretary. The three exceptions were either small or had relatively uncomplicated irrigation systems to operate.

♦The number of employees hired by irrigation enterprises tends to increase proportionally with the complexity of the irrigation system. Complexity involves a combination of factors, such as service-area size, the number of individual water accounts served by (and billed by) the enterprise, and physical features.

♦Computerized recordkeeping is the norm in all but the smallest enterprises. However, computerized water-delivery recordkeeping has been adopted somewhat more slowly than computerized financial recordkeeping. Many enterprises do not have effective computerized record keeping for water management (e.g., processing water orders and recording water measurements daily).

♦Operating a continuous flow regime (continuous flow throughout the irrigation season) is still the preferred method of managing an enterprise's main canal in the intermountain region. About 83 percent of the sampled enterprises practice this main-canal regime. Also, the use of " call systems," involving the ordering of water by farmers 12 to 48 hours in advance, and then having ditch riders readjust these continuous flows to meet changes in system-wide water orders, is still the preferred method of managing the main canal throughout the irrigation season.

♦Approximately 50 percent of the sampled irrigation enterprises supervised water deliveries down to the actual farm headgate. The other 50 percent generally only supervised water down to the lateral headgate. This latter finding may suggest that, unless farmers along laterals cooperate fully with each other, about 50 percent of all irrigation enterprises may be understaffed. This should be evaluated on a case-by-case basis; however, it suggests a possible management concern very likely related to irrigation enterprise budgets and the increasing costs of employee salaries, particularly for the field staff (i.e., ditch riders).

Water Rates

♦The cost per acre-foot of water delivered to the farm headgate, as well as the cost-per-irrigated-acre, should be reported together in any analysis of water costs for irrigation districts and canal companies. This is because they reflect different and important dimensions of enterprise operational cost. One cannot fully comprehend the business nature of these nonprofit irrigation enterprises without incorporating these two cost dimensions. This is a weakness of many treatises on water pricing and water rate analysis. The report demonstrates this through examples.

♦The cost of water for irrigated agriculture in the intermountain region varies considerably from one irrigation enterprise to the next. Water cost can vary by $10 per acre-foot or more between irrigation enterprises that are immediately adjacent to each other. The cost per acre-foot delivered to the farm headgate is a function of differing irrigation enterprise operating costs and available supply owned/controlled and managed by the enterprise. Prorating an average cost of $20.68 per irrigated acre reported by the sample, and an effective water supply of approximately three acre-feet per acre for the region, would give an average cost of $6.89 per acre-foot for water supplied by enterprises in the intermountain region. This means that the annual water bill for an average-size farm of 280 acres would be about $5,790. However, it is believed that this is generally a conservative estimate of the cost of water for irrigation in the region.

♦Researchers working in the field generally understate the cost of irrigation water in the intermountain region. This is primarily because of (1) farm irrigation labor costs and (2) farm capitalization costs associated with irrigation that are ignored in the calculation of water cost. Only the cost of gravity surface delivery by irrigation enterprises is generally used, and that is all that is reported in the present study when the value of $20.68 per irrigated acre is indicated for the sample.

♦Attempts to define a marginal price for water in irrigated agriculture for a particular locality, let alone a region, are extremely hazardous. It is extraordinarily difficult to "normalize or standardize" the economics of this business community in any meaningful way for the purpose of determining marginal costs of water. Furthermore, the business community represented by irrigation enterprises has shown remarkable ingenuity in developing methods to equitably apportion out both operational costs and water supply to its water users.

♦Many different types of water rate structures were found in the sample of irrigation enterprises. These include (1) uniform rates based on acres or shares, (2) rates by type of crop, (3) *ad valorem rates*, (4) water tolls, (5) rates by various classes of stock, (6) rates by layered shares, and (7) tiered water rates. The intermountain region shows considerable variation and ingenuity in the design of water rate structures. These are discussed in the report.

In constant 1992 dollars, farmer investments in on-farm water conservation measures in 57 intermountain counties during the seven-year period 1989-1995 were about $12.2 million per year.

Investments in On-Farm Water Conservation

♦In constant 1992 dollars, farmer investments in on-farm water conservation measures in 57 intermountain counties during the seven-year period 1989-1995 were about $12.2 million per year. These were mostly for water quality improvement (47 percent) and water conservation (36 percent). Total water savings were estimated at 71 percent to the water conservation purpose as such, 24 percent to water savings complementary with improving water quality, and 5 percent to water conservation complementary with erosion control. Federal assistance averaged $22.7 million per year. Irrigation water conservation practices were adopted on 630,000 acres over the period, resulting in a 28 percent reduction in total water application for the practices installed.

♦Nearly 54,000 conservation agreements involving 884,000 acres were negotiated with farmers and ranchers in 16 intermountain 'priority' counties between 1989-1995. The adoption of water conservation practices on 282,000 acres resulted in an estimated 24 percent reduction in the quantity of irrigation water applied to crops. Consumptive use efficiencies were increased from an average of 38 percent to 50 percent of the water applied. In two typical counties, investment costs for irrigators per acre-foot conserved ranged from about $55/ac.ft. to $70/ac.ft. Roughly 60 percent of the total investment costs per acre-foot conserved were cost-shared by USDA under the ACP or other programs.

♦In addition to the conservation measures adopted by the individual farmers or ranchers, activities of a group or project nature were also investigated for the study, notably the Public Law 566 small watershed program administered by USDA, and its community-based Resource Development and Conservation Program. Both of these programs require a high degree of local initiative and sponsorship in addition to specified financial or other obligations. The research identified 50 such watershed projects in 27 intermountain counties. Many (180) of the RC&D improvements appeared to involve improvements in the water storage and delivery works of irrigation enterprises. This is not an insignificant contribution to the further capitalization of these irrigation enterprises to improve overall water management. The current replacement cost value in 1997 of all on-farm conservation measures financed by farmers themselves since 1982 in the 16 priority counties can be estimated at nearly $87 million-roughly $45 per acre prorated over the acres of irrigated crops harvested. Another $65 per acre is an approximate measure of the value of federal assistance provided under USDA cost-sharing programs.

♦Geographic coverage and interagency maintenance of databases that track these various water conservation programs should be improved. The study suggests methods for utilizing the extensive information in these databases to maximize the cost-effectiveness of additional conservation investments on irrigated farms and within irrigation enterprises. As resources may allow, the pending availability of annual county-level 1987-97 CRES data for all counties in Colorado, Idaho, Montana, New Mexico, Utah and Wyoming would permit other selective or more complete analyses of conservation activities on farms in at least these six states over the recent decade. More complete capital formation studies involving farm irrigation equipment and conservation measures, as well as the water delivery and other assets of irrigation enterprises and public agencies, would also be expedited by the methods and information outlined in the study.

POLICY OPPORTUNITIES

What do the results of the Irrigation Enterprise Management Practice Study tell us about (1) the future of these irrigation enterprises as businesses, (2) the physical irrigation infrastructure they manage, and (3) the irrigated farms they provide direct water service to? This overall infrastructure represents a "food production platform" upon which a variety of crops not grown in other regions of the nation are grown in the intermountain region. This infrastructure would appear to be as important to the nation's future economy as are highways, bridges, seaports, and other important infrastructure. What can we distill from the study's findings that might help Reclamation craft better policies that help preserve this infrastructure, while at the same time meeting alternative water uses and important environmental goals?

♦In the intermountain region, agriculture still contributes significantly to the region's economy, and the nation's economy, through billions of dollars in gross farm sales. Even though net realized farm income has been declining somewhat over the past few decades, gross farm sales are up, and these sales contribute to a major income stream moving through many local communities and businesses. It is unfortunate that the primary producer cannot realize more net farm income from these gross farm sales. Farm operational costs have tended to increase proportionally with gross farm sales over the years. Nevertheless, irrigation infrastructure still generates enormous wealth for the region.

♦The intermountain region is unique. Not only is water vital to the communities in the region, but also agriculture is almost totally dependent upon water supplied through irrigation facilities. Agriculture represents the only primary economic opportunity for a vast majority of small towns in the region. The region is diverse in its social and economic condition, and the water traditions of the region clearly single it out as unique from other areas of the West. Federal and state policies and programs designed for the West as a whole should be de-emphasized in favor of sub-regional policies and programs that capture this uniqueness.

♦Irrigation systems in the intermountain region tend to be older and less capitalized than irrigation systems in other areas of the West. This may require a careful look at how irrigation enterprises in the region may be expected to access long-term debt financing for upgrading in the intermountain region, given the farm income levels and the level of depreciated irrigation enterprise assets characterizing the region.

♦These canal facilities have been developed through Reclamation's revolving fund and private capital over many years. They are essentially irreplaceable. If they are lost to urban encroachment, it will require enormous re-investment to create similar new facilities for anticipated food production needs in the future. Monies for this re-investment will be difficult to obtain from any source. Most certainly, the current level of farm income generated from the land that is presently being irrigated will most likely not be sufficient to pay for such re-investment. Finally, any newly developed facilities may be expected to service much more marginal lands than those currently developed for irrigated agriculture. Federal and state agencies should work more closely with county and municipal governments to address the common concern of protecting existing irrigated lands.

♦Irrigation enterprises represent an important point of contact for federal and state initiatives to improve water management and to meet alternative demands for water supplies. Working more directly with these enterprises will ensure the utilization of local capabilities, expertise and human capital represented by the management staff and boards of these enterprises. More mechanisms are needed to exchange ideas between these enterprises, and for them to share common experiences, and to communicate these experiences to federal and state agencies. This can be done through various means, such as newsletters, workshops and direct educational services to these enterprises. In doing so, much more focus is needed on problem identification, such as those problems uncovered in this report.

♦While a fairly complete review of soil and water conservation expenditures on irrigated farms in the intermountain region was completed under U.S. Department of Agriculture cost-sharing and other programs, this study only indirectly addressed the extent of conservation activity within water users' organizations and projects with historic or present ties to the Bureau of Reclamation. Irrigators in those areas are fully eligible to participate in USDA programs, and most of their cost-shared investments were probably included in the study. However, those resulting, for example, from the Reclamation's Water Conservation Field Services Program or perhaps other non-USDA arrangements, could not be identified..

♦By quantifying as well as recognizing the importance of conservation capital formation on and off farms in irrigated areas, this study improves our knowledge of economic structure in agriculture. With conservation capital defined, quantified, and included as a component of farm business capital, a better basis is provided for assessing the benefits of continued investments, whether made by farmers, irrigation enterprises or public agencies. The work has identified several promising areas for in-depth research of

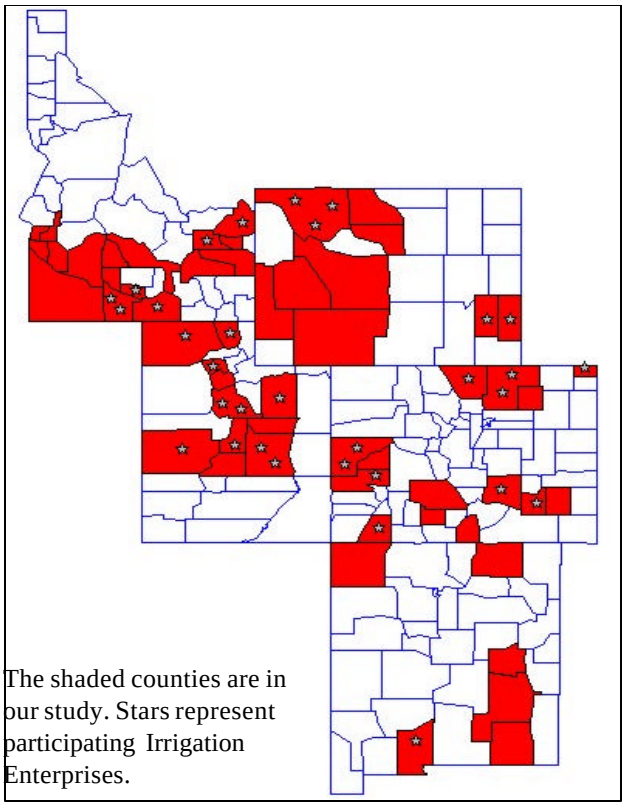
significant potential value to irrigation enterprises and irrigators. The objective would be to develop a procedure for examining the cost effectiveness of additional irrigation water conservation measures for different analytical units or area (states, counties, hydro areas, groups of contracts, etc.) and from a public point of view, the farmers' point of view, an irrigation enterprise point of view and a combined or merged point of view.

An additional in-depth analysis was conducted on conservation investments made by irrigators on irrigated farms served by irrigation districts and canal companies through a cooperative agreement with USDA's Economic Research Service. Colorado State University utilized the personal services of a former ERS natural resource economist to research historical conservation activity in the study area.

John Wilkins-Wells is an Assistant Professor in the Sociology Department at Colorado State. For more information about the Irrigation Enterprise Management Practice Study, contact him at e-mail jwilkins-wells@yines.colostate.edu, or phone 970/491--5635. The Sociology Department number is 970/491-6044.

Federal and state policy must evaluate the degree to which actions taken by an agency are in keeping with maintaining the economic viability of these enterprises, and of irrigated agriculture. Programs and policies directed at water conservation and environmental improvement are costly. These nonprofit entities must weigh the cost of new management programs and activities against the ability of local irrigators to pay for them through annual land taxes and water assessments. Water in the region is already expensive for irrigated agriculture. New cost burdens cannot simply be passed on to these enterprises without these burdens threatening their economic viability, and thus the irrigation infrastructure they support and maintain. Finally, it is unlikely that much-needed environmental programs will be successfully implemented without the assistance of these enterprises and the management skills they possess. Economic strains on this business community will only delay these efforts.

See the website for the IRRIGATION ENTERPRISE MANAGMENT PRACTICE STUDY at **http://socaddr244.soc.colostate.edu/,** where you will find, as presented below, reports on business trends of irrigation districts and mutual ditch and irrigation companies in the Rocky Mountain region. On the website you will also find the prototype of "Irrigation Enterprises," a new trade magazine designed to serve the business needs of irrigation districts and mutual ditch and irrigation companies.



The shaded counties are in our study. Stars represent participating Irrigation Enterprises.

Welcome to the...
IRRIGATION ENTERPRISE MANAGMENT PRACTICE STUDY

About the IEMPS

The following information is available:

IEMPS Executive Summary

IEMPS Irrigation Enterprises

IEMPS Counties

Irrigation Enterprise Business Trends

Issues & Constraints

Governance & Management

Questions & Comments

County Population Charts

County Harvested Acreage Charts

Colorado State University Agricultural Experiment Station

IRRIGATION MANAGEMENT AND WATER AND SOIL QUALITY PROTECTION IN WESTERN IRRIGATED AGRICULTURE

by Grant E. Cardon, Department of Soil and Crop Science

OBJECTIVE 1

Conjunctive irrigation and nutrient management

In almost every case, fertilizer application guidelines have historically been developed from experimental yield response data that did not account for the irrigation or precipitation levels operative in the studies. The lack of inclusion of moisture data may result in two errors, both of which may introduce considerable inefficiencies into the use of fertilizers. First of all, under conditions where inefficient surface irrigation methods may have been used or where high rainfall occurred (or both), the possible leaching loss of applied nutrients, especially Nitrogen (N), would result in the over prediction of N needs. Excessively high N recommendations, resulting from the analysis of such experimental data, could increase the potential for N leaching to ground and surface waters. Typically, furrow and flood irrigation techniques were employed in the historical literature from which current fertilizer recommendations largely have been determined. Leaching under such systems, particularly in years past, likely resulted in significant leaching losses thereby causing an over prediction of crop N requirements.

Second, yield increases in response to applied nutrients are often not seen in experimental data obtained under moisture-limited conditions. Under moisture-limited conditions, crops are not able to effectively use available nutrients in growth and production. If this phenomenon is not considered in the management of fertilizer application, situations could arise under drought or deficit irrigation conditions where applied nutrients go unused, are left in the soil, and subject to possible leaching or erosional losses from off-season winter and spring precipitation and runoff.

Colorado State University Agricultural Experiment Station Project 156122

This project has as its objectives, to 1) test, develop, and refine conjunctive chemical and irrigation management practices for the protection of ground and surface water and soil quality, and for water conservation in both agricultural and urban settings, 2) determine mine, municipal/industrial, and agricultural effluent impacts on soil and water quality in irrigated agricultural settings, and 3) develop irrigation and water management strategies for the amelioration of drought and/or salinity impacts.

Fig. 1. Surge irrigation system installation

Research work in this area has focused on the use of advanced irrigation and chemical delivery systems, coupled with in-season nutrient sufficiency monitoring methods to develop uniform and optimal management practices designed to simultaneously provide for acceptable crop production and the conservation/quality of soil and water resources. The primary goal of the studies has been to reduce/eliminate deep percolation losses of water from the root zone and to minimize residual soil nutrients exposed to leaching and erosion (from wind or water). With that goal in mind, irrigation and nutrient management must always be considered conjunctively. Projects under this objective are too numerous to detail individually, but several key publications and graduate theses that summarize the work are cited below.

All of these projects have been accomplished with a high degree of cooperation from many funding and research entities around the state—a fact that we are both proud and appreciative of. Cooperating entities include the Colorado Department of Agriculture, the USDA-ARS Water Management unit, Soil-Plant-

Colorado State University Agricultural Experiment Station

Nutrient Research unit, and Great Plains Systems Research unit, The USDA-NRCS, the US Bureau of Reclamation, the US Geological Survey, Northern Colorado Water Conservancy District, Central Colorado Water Conservancy District, the Dolores Water Conservancy District, Coors Brewing Company, faculty from the departments of Soil and Crop Science, Agricultural and Resource Economics, and Chemical and Bioresource Engineering at CSU, and Cooperative Extension specialists and agents around the state.

Urban water use

Urban water use issues are also important to the state as municipalities grow and develop, particularly along the Front Range. Accurate estimates of turf and shade tree water use are important components to effective projection of water supply needs and the ever-desirable conservation of existing limited water supplies. Work in this area has been a cooperative effort between faculty from the departments of Soil and Crop Science and Bioagricultural Sciences and Pest Management. A seven-acre facility for turf/shade tree water use and health studies has recently been constructed under this cooperation at the Agricultural Research, Development, and Education Center north of Ft. Collins on I-25. The facility currently allows the measurement of water use on open turf (blue grass/ fescue mix) and two popular shade tree/turf combination plantings. The shade trees are Honey Locust and Green Ash. In addition to water use, tree growth and health and turf production are monitored under conditions of under-, over- and adequate irrigation. This work has just commenced now that the trees and turf are fully established. We expect the studies to give us useful data on the water use of typical urban plantings and allow for refinement of best management practices for homeowners and other urban water users.

OBJECTIVE 2

The majority of the work under this objective has been part of the off-site risk assessment of acid-mine drainage impacted water from the Summitville mine used for irrigation in the Alamosa River basin of southern San Luis Valley. A recently completed study evaluated the chemical, physical and morphological properties of the irrigated soils in the Alamosa River basin in an effort to determine the long-term effects on acid buffering capacity and heavy metal solubility. The study, cooperatively conducted by the department of Soil and Crop Science at CSU, the department of Geology and Geochemistry at the Colorado School of Mines, and Agroengineering of Alamosa CO, was funded by the EPA and the Colorado Department of Public Health and Environment (CDPHE). The CDPHE's Hazardous Material and Waste Management Division administered the work and serves as the clearinghouse for the information resulting from the study.

Fig. 2 Modern linear-move sprinkler irrigation

From these studies we have determined that the irrigated soils of the Alamosa River basin have been chemically and physically altered due the addition of Alamosa River water through irrigation. Reduced pH (as many as two units over undisturbed, virgin sites), increased weathering (evidenced by a reduction in the proportion of smectite to kaolinite clays and larger weathering rinds on soil cobbles and stones) and increased metal content and extractability are all indicators of the influence of Alamosa River water quality. Though higher in metal content, these soils do not contribute to excessively high metal content in the crops grown on them. Furthermore, conditions with respect to pH in these soils is not predicted to degrade any further than the present buffering intensity of pH 5.8 due to the high soil clay content (up to 25% at certain depths in the soil) which will continue to buffer pH changes indefinitely. In fact, given that the clean up effort at the Summitville mine has improved the water quality in the river, it is expected that soil conditions will be maintained and even improved over time.

Work under this objective is ongoing, with the current focus being on the release of Manganese from these soils under low-oxygen conditions. Manganese solubility is highly dependent upon the redox condition of the soil. Under waterlogged, or high water table conditions, Mn may be released from these soils at levels that could be detrimental to plant growth. We are investigating irrigation and water management strategies to minimize or eliminate this possibility.

Colorado State University Agricultural Experiment Station

OBJECTIVE 3

Research under this objective has been focused on characterizing and monitoring soil and water (ground and surface) salinity in the Arkansas and South Platte River basins. As water flows through these basins, salt concentration is increased due to evapotranspiration from agricultural and municipal/ industrial water use, and salt content is increased as percolating and return flow water picks up soluble salts from the soil and geologic sources such as ancient marine deposits. A thorough characterization of the intensity and extent of soil and water salinity conditions allows for the monitoring of fluctuations occasioned by changes in water management, and provides data for the refinement of models to predict the potential impacts of water management strategies in these basins.

Most of the preliminary work completed to date has been done in the lower Arkansas River basin as a cooperator to studies initiated by the department of Civil Engineering under the direction of Drs. Tim Gates and John Labadie. Additional work has just been proposed to the USDA Sustainable Agriculture Research and Education (SARE) program. The SARE proposal focuses on the North and South Platte River system. An important aspect to all these studies is the correlation of crop yield data to present and potential soil and water salinity conditions. This information will allow for the evaluation of economic impacts to these regions due to salinity, tying an important practical, decision-making tool to the research (in-field and modeling) being performed.

References

Objective 1

Cardon G.E., R.W. Waskom, A.Y. Ali and J.K. Alldredge. 1997. Barley management practices for Colorado: A guide for Colorado producers. Colorado State University, Ft Collins, CO.

Scheierling, S.A., R.A. Young and G.E.Cardon. 1997. A simulated discrete-input water-crop production function for determining the effect of irrigation water scheduling on yield and evapotranspiration. Irrigation Science 18(1):23-32.

Waskom, R.W., G.E. Cardon, and M. Crookston. 1994. Irrigation best management practices guidebook for Colorado. Colorado Water Resources Research Institute, Completion Report #184.

Iremonger, C.J. 1998. Conjunctive Management of Irrigation Water and Nitrogen Fertilizer on Corn. Ph.D. Dissertation, Colorado State University, Ft. Collins, CO

Objective 2

Cardon, G.E., A.Y. Ali, J. McCann, and A. Lorenz. 1995. Metal content of wheat and potato tissue and associated soils irrigated with Alamosa River water. pp 281-285 In: Posey et al. (eds) Proceedings of the Summitville Forum '95. Colorado Geologic Survey Special Publication No. 38. Colorado Geologic Survey, Denver CO. 375 pages.

Cardon, G.E., J. McCann, and A. Lorenz. 1995. Survey of irrigation structure condition in the Alamosa River basin. pp 286-292 In: Posey et al. (eds) Proceedings of the Summitville Forum '95. Colorado Geologic Survey Special Publication No. 38. Colorado Geologic Survey, Denver CO. 375 pages.

Connolly, S.J. 1998. The Impact of Acidic Irrigation Water on the Chemical and Mineralogical Composition of the Graypoint Soil Series, Alamosa River Basin, Colorado. M.S. Thesis, Colorado State University, Ft. Collins, CO.

Connolly, S. J., S. W. Blecker, G. E. Cardon, and E. Kelly. 1996. Mineralogical alterations of soil irrigated with acidic mine water in the Alamosa River basin. Paper # TRP20310 In: R.A. Thompson et al. (eds), Geologic Excursions to the Rocky Mountains and Beyond. Colorado Geologic Survey Special Publication No. 44. Colorado Geologic Survey, Denver, CO.

Objective 3

Cardon, G.E., and S.R. Grattan. 1997. Management of plants in saline environments. In: Dudley and Guitjens (eds), Agroecosystems and Trace Element Oxyanions, AAAS Special Publication, AAAS. (in press)

Cardon, G.E. and J. Mortvedt. 1994. Salt-affected soils. Service in Action bulletin 0.503, Colorado State University Cooperative Extension. Ft. Collins, CO

Cardon, G.E. and J. Mortvedt. 1994. Management of salt- and sodium-affected soils. Service in Action bulletin 0.504, Colorado State University Cooperative Extension. Ft. Collins, CO

Cardon, G.E. and J. Mortvedt. 1994. Management of salt- and sodium-affected soils. Service in Action bulletin 0.504, Colorado State University Cooperative Extension. Ft. Collins, CO

Colorado State University Cooperative Extension

SAN LUIS VALLEY PRODUCERS PARTNER FOR WATER QUALITY

by Randal J. Ristau

Since 1991, a USDA Water Quality Demonstration Project has been helping valley producers with best management practices.

Protecting water resources is always considered a worthy cause that draws attention, involvement and action in the San Luis Valley. This dedication to local water issues extends beyond the highly visible controversies of water rights and politics. Water quality is also important to the rural community of more than 45,000 residents in this valley that is the head waters of the Rio Grande.

In 1991, a group of valley producers along with representatives of Colorado State University Cooperative Extension, USDA Natural Resources Conservation Service and USDA Farm Service Agency set out to address the critical issue of local ground-water quality. This partnership would expand in the next nine years to involve 15 other agencies and private organizations with numerous additional producers. This group, known as the San Luis Valley Water Quality Demonstration Project, completed its mission this September. Promoting the adoption of water quality conservation Best Management Practices to minimize agricultural non-point source pollution of the water resources in the valley was the project's mission.

"Farmers have been able to request incentive payments through the Water Quality Incentive Program with the project team providing educational and technical help to apply BMPs," explains Don Greenstreet, FSA county executive director for Rio Grande, Hinsdale, Saguache and Mineral counties. "Through publications, seminars, demonstrations and word of mouth, the project team has not only influenced the farmers who received incentive payments, but also neighboring farmers across the San Luis Valley."

During each of the past nine years, 15 to 45 demonstrations have been placed on valley farms. These demonstrations show the positive influence of good management choices on local water resources. The focus is on irrigation, fertilizer and pesticide practices.

"Nitrates and pesticides are a serious threat to valley groundwater due to sandy soils," says Ronald Riggenbach, soil conservationist and NRCS team leader for the project. "For this reason, it is important for agricultural producers to take a proactive attitude to conserving groundwater quality."

A committee of local agricultural producers, along with representatives of local agricultural industry and government agencies, guides the development of recommendations for BMPs directed at conserving water quality. These recommendations will result in a number of publications from the project and have been the basis of numerous educational meetings.

Some producers have shown that by using BMPs, 30-60 pounds of nitrate per acre can be utilized from the groundwater in one growing season. "We, as agricultural producers, need to continue to learn from and evaluate our BMPs," says Greg Colbert, Alamosa County farmer and BMP advisory committee member. "It's important for the entire public to realize we are concerned stewards of the land because we are the first consumers of the water, land and natural resources entrusted to us."

Encouraging innovation and adaptation of new ideas has also been an important project activity. Producers have used BMP information and other project resources to further improve their approach to managing water resources. "Having streamlined access to needed information on potential innovations in valley cropping practices is important to us," says John Haws, Rio Grande county farmer. "The project not only provides the information, but enables farmers to put it to practical use in the field."

Action on specific water quality issues has formed a common ground for establishing local partnerships. The project developed a quarterly USDA news magazine as an effective and efficient means to offer information to the agricultural sector from the 11 USDA associated agencies and groups, including the five local Soil Conservation Districts.

"The project has assisted the SCDs in getting water-quality conservation practices on the ground," says Gerald Mathes, Costilla county farmer and SCD Watershed president and BMP committee member.

"The news magazine helps spread this information." These

partnerships have also resulted in an infusion of additional funds for special programs and publications. More than 10 successful grants are associated with the project and local partners.

"Partnerships of the project with other groups and agencies have enabled a better focus on the current groundwater issues," says Jim Mietz, coordinator of San Luis Valley Resource Conservation and Development. "For instance, the project has brought several entities together to form the San Luis Valley Nitrate Monitoring Network." The monitoring network involved nearly 100 producers who work with government agencies to develop an accurate assessment of the current and future status of the nitrates in the groundwater. The U.S. Geological Survey is an instrumental partner in this effort to better define the nitrate-groundwater issue. "Maintaining a consistent nitrate monitoring network is invaluable in understanding the effectiveness of BMPs on groundwater nitrates," explains Bob Stogner, US Geological Survey hydrologist.

Numerous presentations have been given outside the valley regarding successful activities like the monitoring network. The project was recognized with awards for several publications and won a national award for its integrated pest management programming from the National Association of County Agricultural Agents.

"Our project success in serving the producers is based on strong interagency cooperation," states Riggenbach. "The project used a team approach to meeting the challenges of our mission."

WATER SUPPLY

The summer's above normal water supply conditions continue with all basins showing a positive SWSI value. August rains continued to be high, which supported above-normal streamflows. The rains reduced demands for both stream diversions and reservoir storage, which again contributed to more water in the river channels and higher reservoir levels. The amount of rain has hampered the ability to harvest crops, which will cause some losses to farmers. The surface Water Supply Index (SWSI) developed by this office and the USDA Natural Resources Conservation Service is used as an indicator of mountain based water supply conditions in the major river basins of the state. It is based on snowpack , reservoir storage, and precipitation for the winter period (November through April). During the winter period snowpack is the primary component in all basins except the South Platte basin, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for September 1, 1999, and reflect conditions during the month of August.

Basin	9/1/99 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	3.8	+0.8	+0.4
Arkansas	3.2	+1.2	+1.9
Rio Grande	3.3	+0.8	+3.4
Gunnison	1.9	+0.0	+3.3
Colorado	2.9	+1.4	-0.3
Yampa/White	1.6	+1.2	-1.1
San Juan/Dolores	3.5	+0.7	+3.4

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

THE WATER-INSECT CONNECTION IN OUR FORESTS

by David Leatherman, Entomologist

In the last issue, Bob Sturtevant summarized the Colorado comeback of Mountain Pine Beetle (MPB). Recently completed surveys indicate this trend continues and will be an even greater issue over the next several years. As an entomologist who travels the entire state and communicates with peers from all over the West, it seems safe to say that many forest insects of historical importance are in upsurge mode. Why is this? While any discussion of how physical and biological factors interact is complicated, a few generalities apply.

- Human impacts on our native forests are increasing.
- Fire-suppression policies, while necessary, have both negative and positive consequences.
- Trees under stress naturally attract organisms that can be viewed as "pests."
- Forest cycles can be quite long and difficult to comprehend in human terms.
- In the natural world, including our forests, nothing exists in a vacuum. In other words, it's all connected.
- Mother Nature has the final say.

Let's talk about each of these in the context of water and insects.

HUMAN IMPACTS — We have all heard the figures on Colorado's human growth, both in terms of population and increased tourism. The natural beauty of Colorado is a big part of our attractiveness, and this leads to increased recreational visits to the forest and also an increase of people wanting to live within or very near native stands of trees. The resulting roads to accommodate these residents can change drainage patterns. Leach fields and septic systems are located atop groundwater reserves and near waterways. Soil can be compacted over the root systems of established trees, affecting leaching. Trunks can be overtly wounded during the construction process. The creation of lawns, with associated watering, can drastically change moisture regimes for pre-existing trees nearby. These are but a few direct impacts.

On the positive side, tree values go up. In human economic terms, when a home appears in the forest, those trees near the dwelling now take on much higher values than when they existed as individuals in a vast forest. Trees in a backyard, small acreage, or within view of the front door are much more likely to be appreciated and protected. "Ownership," whether legal or just in the mind, can lead to community actions with far-reaching benefits.

One last human impact on forests is international commerce. A substantial percentage of wooden building products used in Colorado comes from out of the state and out of the country. An increasing number of exotic pest organisms, such as the Asian Longhorn Beetle that gained recent notoriety in Chicago and New York, trace their origins to soil importation in solid-wood packing materials (pallets, crates, spools and dunnage). The list of threats to our forests is not static.

FIRE SUPPRESSION — Since mid-century, forestry agency policy has been to suppress most fires. In ponderosa pine, fires might naturally occur as frequently as every 10 years. In spruce at high elevations, fires might occur every 300 years or even longer. So what happens when Smokey the Bear has his way and fires are prevented or suppressed? Certainly, homes and certain other valuable additions to the forest are protected. But the forest gets older, denser and more uniform. It might also favor one tree species over another. So what? Tree-killing bark beetles, of which MPB is one, favor old, dense forests. If fire suppression has led to extensive forested areas of the type the beetles like, is it any wonder that homeowners are now plagued by them in their beloved backyard trees? The issue of fire and insects comes full cycle when one also considers that extensive areas of beetle-killed trees are at least a temporary fire hazard. Remember the Yellowstone National Park fires? They were fueled to high intensity in places by MPB-killed lodgepole pines. Perhaps carefully introduced prescribed fire can be used to compensate for the negative effects of fire exclusion. Or, there may be a way to minimize these effects with well-designed silvicultural treatments like forest "thinning."

TREE STRESS - Trees must die of something, and in nature it is usually a fire, a bug or a fungus. Usually preceding the agent of death is stress. "Stress" is difficult to define and best left to a later discussion. But obviously, humans and fire suppression have led to important stresses in our forests. Drought, excessive water, other weather-related phenomena like the extensive blowdown north of Steamboat Springs in October 1997, exposure to toxins, and chronic but non-lethal insects and diseases would be others.

Our recent mild winters seem to parallel the insect increases. Radio DJs may glow about a 70-degree day in February or T-shirt skiing during the "January thaw," but our trees developed over the ages with normal amounts of snow and cold. When we experience conditions outside the norm, something has to give. Examples of insects that appear tied to low snowpack, warm winters, and general drought are the Cedar Bark Beetle (which has killed hundreds of junipers and cedars on the eastern plains of Colorado in recent years), Balsam Bark Beetle (which is currently killing tens of thousands of subalpine fir at higher elevations), MPB, and Pine Sawflies and Ponderosa Needleminers, which have been defoliating pines in the Black Forest east of Colorado Springs.

The blowdown event in the Routt National Forest provided a favorable environment for an insect called the Spruce Beetle (to be the sole subject of a future column), which has the potential to build up in the downed trees and spread into nearby standing spruce. At risk are other USFS lands, private forests, and ski areas. Spruce Beetle has been absent from Colorado in epidemic terms for almost 50 years, but its cycle has begun and we will be hearing about it for years to come. Some of our most important watersheds, dominated by high-elevation forests, will be right in the middle of the discussion.

FOREST CYCLES – Insects, El Ninos and fires come and go. It is easy for those of us with life spans of 75 years or so to experience certain of these phenomena only infrequently or never in our time. When we do encounter one, it is also easy to view it as "abnormal" or a sign of impending doom. Deciding what is a normal fluctuation in a natural cycle and what is a real "canary" is difficult. Long-term analysis is needed. For example, analysis of pollen from certain lakebed deposits allows us to look back thousands of years. What a valuable book, if we know how to read it! Some sites show periods of no spruce pollen production. This allows us to say with some certainty that mature, flowering spruce disappear on the landscape at intervals of a few hundred years. The probable cause? Spruce Beetle epidemics or widespread fire.

MPB appears on the order of every 15 to 30 years. When widespread areas are killed, Douglas fir often fills in the gaps. Western Spruce Budworm is a moth that likes to chew Douglas fir in Colorado. (It is what created the expanses of gray trees along the south side of I-70 between Denver and the Eisenhower Tunnel.) When the firs go out, sometimes pine reasserts itself. And so the cycle goes.

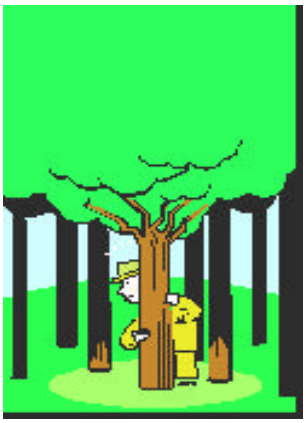
CONNECTIONS - In a world of increasing specialization, it is easy to lose sight of the big picture. Sports teams often refer to "chemistry" as an explanation for why a particular collection of players wins or fails. This is certainly true of the forest. Let's take the Balsam Bark Beetle mentioned above. It appears that the underlying condition necessary for widespread beetle attack is warmer or dryer winter conditions within the range of subalpine fir. Simple cause and effect, right? But more is probably involved. Pathologists now believe that the warm conditions allow certain fungi, like Annosus and Armillaria, which are always present and waiting for potential victims, to assert themselves. Once root disease begins, then the bark beetles attack. After the bark beetles come wood-boring beetles, followed by yeast, bacteria, fungi, woodpeckers, cavity-nesting birds like Mountain Chickadees, carpenter ants, decay fungi, pillbugs, earthworms and a new seedling on the prepared soil. There are literally hundreds of other organisms involved in this constant recycling process, all connected directly or indirectly to the others. To function properly, the system relies on the proper balance of generalists and precise specialists to do their thing in the right sequence and place. The amount of water in the system is a critical driver of organism function.

WHO'S IN CHARGE? Obviously, Homo sapiens is capable of doing what it wants to our planet. I-25, Coors Field, Pueblo Reservoir and the Mesa Verde cliff dwellings are, indeed, impressive. But they pale in comparison to the Great Sand Dunes, an evening lightning display in Baca County, Long's Peak, the Coke Ovens at Colorado National Monument, or the wind that knocked down a million trees near Clark, Colorado.

They say Spruce Beetles floated inches deep for miles along the western edge of Trappers Lake during the big outbreak of the 1940s. Plowed October snows towered over the roofs of cars in downtown Lamar a few years back. It would seem that our role as natural resource owners, managers, recreators, and appreciators is to understand as much as possible about Nature, and then mimic it as best we can and to the extent necessary to meet our needs from renewable systems like the forest. But we can never totally control it. We should never be surprised when hail breaks our windshield, a tornado ruins a crop, or water fills the crawl space. We live amid awesome natural features, including the awesome forces that shaped them — and water and insects are but two of these features.

For help with your private forestland, you are encouraged to contact your local office of the Colorado State Forest Service. If we do not know the answer to your question, we will try to find it for you.

Or you can contact our website at: **www.colostate.edu/Depts/CSFS/csfsmgnt.html.**



MEETING BRIEFS

WESTERN STATE COLLEGE HOSTS ANOTHER OUTSTANDING MEETING OF THE COLORADO WATER WORKSHOP

John M. Sayre, Felix L. Sparks honored as Living Legends in Western Water

With a theme of ***Garden of Dreams v. High-Desert Reality: Can we Save Everything, Keep Our Lawns Green … and Have Enough Water for Everyone?,*** the 24th annual Colorado Water Workshop attracted 185 people to the campus of Western State College in Gunnison July 28-30, 1999. The workshop included the 1st Annual Water Conservation/Conservancy District Managers' Forum, as well as a number of pre-conference water education sessions. Thirty-two excellent presentations were delivered during the two and one-half- day meeting.

Left: John Sayre, Living Legend Honoree, and Robin Helken, Colorado Water Workshop Director

Dick Bratton's keynote address, *'The Appropriation Doctrine Meets Miss Manners: Can a Social Conscience be Developed Within the Prior Appropriation Doctrine?,'* provided a thorough examination of the Metropolitan Water Supply Investigation report in light of the need to supply water for a growing population while also attempting to protect the environmental, social and economic values of Colorado citizens. A summary of his remarks follows this brief overview of the workshop.

Right: Dick Bratton, Attorney at Law, Bratton & McClow, LLC and Colorado Water Workshop Co-Founder talking to Megan Murphy, Second Year CU Law School student

Responses to the keynote address were provided by Commissioner of Agriculture Don Ament, Arapahoe County Commissioner Polly Page, CH2MHILL Vice President Peter Blinney, and Environmental Defense Fund Senior Scientist Dan Luecke. David Robbins provided an excellent overview of Colorado's interstate compact obligations and the impacts such obligations have on the water supply for Colorado (see page 25).

♦Right: Sara Duncan, Denver Water, Bob Young, Prof. Emeritus at Colorado State University and Peter Evans, Director of the Colorado Water Conservation Board in conversation at the Colorado Water Workshop♦

John M. Sayre, Attorney at Law, and Retired Brigadier General Felix L. Sparks were honored as ***Living Legends in Western Water,*** an annual event of the Colorado Water Workshop.

♦Left: Kathleen Klein, Manager of the Upper Gunnison Water Conservancy District, talking to Darcy Temple, graduate student in Soil and Crop Sciences at Colorado State University♦.

Robin Helken, Director of the Colorado Water Workshop, must be recognized for her excellent stewardship of this water tradition in Colorado, and Western State College must be recognized for being an excellent host institution. Look for announcements of the 2000 Colorado Water Workshop and make plans to attend – you will definitely walk away with a better understanding of Colorado's water management system and the issues it must address today.

THE APPROPRIATION DOCTRINE MEETS MISS MANNERS: CAN A SOCIAL CONSCIENCE BE DEVELOPED WITHIN THE APPROPRIATION DOCTRINE?

by L. Richard Bratton

BRATTON & MCCLOW, LLC
Gunnison, Colorado

To paraphrase *Our Common Future* (Bruntland, 1987), a sustainable water supply meets the needs of the present without compromising the ability of future generations to meet their own needs. Colorado faces the increasing consumption of its existing water resources with continued population growth and the increasing economic development that is fueled by that growth. The waters that now supply the Front Range are a finite resource: the surface supplies (renewable) of the South Platte River, the Arkansas River, and the Colorado River; and underground supplies — the Denver Basin (non-tributary/nonrenewable), and Beebe Draw (alluvial/renewable).

The Two Forks Dam Project was a major part of plans for the Metro Denver water supply, but we can now anticipate that any new major water supply project will face the same veto. The Two Forks Dam veto was tied to loss of stream-based aquatic values — aesthetic and recreational aspects of the proposed site would have been lost. Essentially it was a land-use decision made in Washington, D.C. The creation of a lake environment with greater than one-for-one in-kind mitigation of all fish, wildlife and recreational impacts lost out to the existing "natural" stream-type environment. No water quality problems were referenced in the Environmental Protection Agency's veto finding; in fact, Two Forks may have resulted in improvements to water quality.

With the demise of Two Forks, Governor Romer, Colorado legislators and those state agencies involved in the proposed dam sought to find new ways of providing a sustainable water supply to satisfy the State's needs.

THE METROPOLITAN WATER SUPPLY INVESTIGATION

In January of 1993 Governor Roy Romer, through the Colorado Department of Natural Resources, convened the first Colorado Water Convention, focusing on issues related to Front Range water supply planning and interbasin transfers of water. Governor Romer voiced deep concerns about the heavy economic and social costs of water supply planning through litigation ($80 million in unsuccessful litigation and permitting efforts, mostly for transmountain diversion projects). Mentioned by Romer were the Two Forks permitting process ($43 million), Union Park litigation ($12 million), the San Luis Valley American Water Development Inc. litigation (amount to date unknown) and others. Other costs not mentioned by Romer included Homestake litigation and 50 years of expensive, time-consuming major legal/political battles by the Denver Water Board, Arkansas River interests, the Cities of Colorado Springs and Aurora, and the Northern District and Colorado River District.

Discussion of additional transmountain diversions to meet Front Range water needs raised a great deal of controversy and concerns. Potential adverse effects related to these exports on local communities and their water supplies included: water quality, water-based recreation, and environmental values. The need for new legislative protection for basins of origin was also discussed. The following suggestions emerged from discussions at the Convention:

- develop a cooperative approach to water supply planning
- focus on better use of already-developed water supply systems
- be sensitive to multiple perspectives that would allow workable ideas to emerge
- realize that further sacrifice from West Slope, agricultural and environmental interests could not reasonably be expected until Metro Denver first "put its own house in order" through more reliance on water conservation, reuse, conjunctive use, and other means of full and efficient utilization of existing systems
- develop a "systems integration" approach to water supply planning
- provide a cooperative and inclusive water supply planning process

Following the Convention, in October 1993, an Executive Order was issued outlining the need for water supply planning and management. The Colorado General Assembly authorized the Colorado Water Conservation Board to spend up to $450,000 to investigate opportunities for enhanced coordination in meeting the water supply needs of metropolitan Denver. State agencies were authorized to

provide support in developing data and information systems to help make informed decisions on water supply. The Front Range Water Forum was created, with extensive membership including representatives from the Western Slope. A Technical Advisory Committee was appointed by Forum members to provide guidance and oversight in investigating water supply systems, in particular, the integration of specific supplies and reallocation of storage in Chatfield and Bear Creek Reservoirs, the cooperative integration of Denver metropolitan area and Northern Colorado District and conjunctive use of surface and groundwater, including use of tributary sources of water in groundwater recharge projects.

A management team was designated with staff from the State Engineer's office, the Colorado Water Conservation Board and the Water Quality Commission, which was authorized to hire a management consultant to coordinate and manage the investigation. The primary focus of the MWSI was an analysis of supply-side options involving cooperative use, operation and/or linkage of existing water supply systems to enhance water yield. The resulting MWSI report identified and evaluated water supply options in four primary categories: conjunctive use; effluent management; interruptible supply arrangements; and other system integration opportunities. The report concluded that cooperative water supply options exist to help meet a large part of the anticipated future needs in the major geographic subregions of the Metropolitan Denver area.

Cooperative Water Supply Opportunities

(Summarized from the MWSI report)

♦Conjunctive Use would involve the linkage of groundwater systems currently serving communities in parts of Douglas and Arapahoe counties with the Denver Water system. Water available from the Denver system in average and wet years could be used to meet demands and for recharge of Denver Basin aquifers. Groundwater sources would be used to meet demands not fully satisfied by surface water sources and during periods of drought. For the example project analyzed, conjunctive use arrangements could yield up to 60,000 acre-feet per year to meet new demands or reduce existing groundwater pumping from the Denver Basin aquifers.

♦Effluent Management involves cooperative and coordinated approaches for utilizing metro Denver area providers' reusable return flows. The area currently generates reusable return flows in excess of its current reuse needs of approximately 80,000 feet per year. These undeveloped reusable return flows are projected to increase to more than 120,000 acre-feet per year under providers' current plans as the metro Denver area grows.

♦Interruptible Supply would involve cooperative arrangements with agricultural water users along the Front Range that would give cities the right to use agricultural water during times of drought in exchange for financial compensation to farmers. This report provides an overview of possible types of interruptible supply arrangements, estimates of gross supply potential, and discussion of perceived barriers to implementation. The total amount of dry-year, high-quality water supply potentially available for interruptible supply arrangements is approximately 190,000 feet. This supply estimate does not reflect the competing needs of long-term (beyond 2020) future growth in the Northern Front Range. Example projects involving this source and specific project yields were not investigated.

♦Other Systems Integration Opportunities involve the Northeast and Northwest sub-regions and Chatfield Reservoir. Other cooperative approaches identified but not investigated include possible development of joint storage for regulation of supply from the Windy Gap and Moffat systems, and creation of a market for water saved through conservation initiatives. Some of the systems integration studies that were looked at included the following:

Denver/Aurora area — opportunities and issues

Southern region opportunities — Northern Douglas County, South Central Arapahoe County. The Douglas County Water Resource authority is currently participating in cooperative action investigation with Denver Water and the Colorado River District Board. The preliminary conclusion reached is that up to 60,000 acre-feet of potential additional yield could be cooperatively developed through conjunctive use. Douglas County also adopted land use strategies to manage growth and urbanization, including downsizing and open space acquisition efforts over the past 10 years resulting in a 10 percent reduction in the county's build-out population estimates.

Northwest Region Opportunities and Issues — Attention is to be focused on identifying storage levels in major reservoirs and levels of use of major conveyance facilities.

♦THE METROPOLITAN WATER SUPPLY INVESTIGATION

As presented in the MWSI Executive Summary, prepared by Hydrosphere Resource Consultants for the Colorado Water Conservation Board and the Colorado Department of Natural Resources, the primary focus was the analysis of supply-side options involving the cooperative use, operation and/or linkage of existing water supply systems in a manner that would enhance water yields. The MWSI did not explore new water development projects, nor did it examine the potential savings from additional water conservation programs. The MWSI identified and evaluated cooperative water supply options in four primary categories: conjunctive use, effluent management, interruptible supply arrangements, and other system integration opportunities. The information summarized in the table and text below by sub-region provides valuable context that enhances understanding of the roles and benefits of the cooperative water supply opportunities evaluated through the MWSI.

Northwest Region— The group is engaged in further study of cooperative water development opportunities on the South Platte River below Denver, including looking at water quality problems on the South Platte below the metro Denver area.

Northern Region — This area involves the Northern Colorado Water Conservancy District. Surface water supplies include 800,000 acre-feet of native flows plus 300,000 acre-feet of transbasin imports for approximately 1 million acres of irrigation. Several integration opportunities between Northern and Metro Denver were initially identified, including interruptible supply and substitution arrangements with irrigated agriculture, purchase and delivery of Windy Gap supplies to Northern Metro Denver via the Carter Lake Pipeline, and joint storage projects for regulation of Windy Gap and Moffat systems with the use of CBT facilities to deliver Moffat supplies to the Denver area.

Water Conservation Marketing — The creation of a market for water saved through conservation measures could take many forms. Many water conservation measures have not been broadly pursued, because reductions in consumption could reduce operating revenues, resulting in rate increases.

♦Table 1. A Summary of MWSI Findings

Cooperative Supply Category	Supply or Yield Potential	Actions/Items/ Unresolved Issues
Conjunctive Use	up to 60,000 acre-feet of surface water yield under example project analyzed	South Platte and Blue River stream depletions Water right constraints Feasibility of long-term, large-scale recharge IGA's among participants Balancing groundwater depletions with increased use of surface waters
Effluent	up to 120,000 acre-feet of excess reusable return flows; specific project yields were not investigated	Relatively high costs Public acceptance of potable reuse Effects of exchanges on water quality Effects on instream flows
Interruptible Supply	up to 190,000 acre-feet of interruptible supply; specific project yields were not investigated	Would require major institutional changes Impacts to agricultural communities Geographic/cost considerations
Other System Integration Opportunities	up to 20,000 acre-feet of yield under example projects analyzed	Water right constraints IGAs among participants Federal action (Chatfield storage reallocation).

Also, some water suppliers have more than adequate supplies and there is no need, or they have access to a source of supply that is less costly than additional conservation measures. A water conservation market could encourage further implementation of conservation measures. This may require a change in law.

♦Chatfield Reservoir — The reservoir, with a capacity of 336,000 acre-feet, was originally created by the Corps of Engineers for flood control purposes as part of the Tri-Lakes project that also includes Bear Creek and Cherry Creek Reservoirs. Numerous Metro water providers expressed interest in using the storage space, especially after Two Forks was rejected. Interest in the reservoir includes utilizing it for management of instream flows for environmental and recreational purposes. Both the state and the COE have secured funding for a feasibility study which they estimate will take two to three years at a cost of approximately $1.7 million.

MWSI Conclusions

A relatively clear picture has emerged regarding cooperative approaches that could potentially play a significant role in meeting future water needs, although there are a number of unresolved issues to be addressed through ongoing cooperative planning processes. Cooperative water supply approaches play an important role in meeting future water supply needs in a manner that could potentially reduce both the cost and environmental permitting risks associated with other options.

Overview of Water Supply Strategies

Metro-Denver area water providers currently rely upon a combination of six supply-source categories to meet existing and future needs, generally addressed beyond the year 2030, and in most cases reflect the providers' projected ultimate or build-out area demands: The Metro-Denver area existing supply and future mix of water management strategies are shown in Figures 1 and 2.

♦It currently appears that large, capital-intensive projects with major environmental impact issues will probably not be required.

♦Additional transbasin diversion using existing facilities and water rights may be necessary to meet the growth in the metropolitan area, particularly Douglas and Arapahoe Counties,

♦South Platte flows out of Colorado are likely to increase as the result of a mix of water supply sources being developed. Much of the basin's future water demands will be met with additional transbasin diversions, transfers from agriculture and nontributary groundwater development. These supplies increase the return flow applied to the region. The increase will occur in fall, winter and early spring due to relatively higher municipal return flows during that period. The utility of a Tamarack recharge project to re-regulate those flows to help meet endangered species needs downstream is required.

Figure 1: Existing Municipal & Industrial Water Supply, South Platte Basin of Colorado

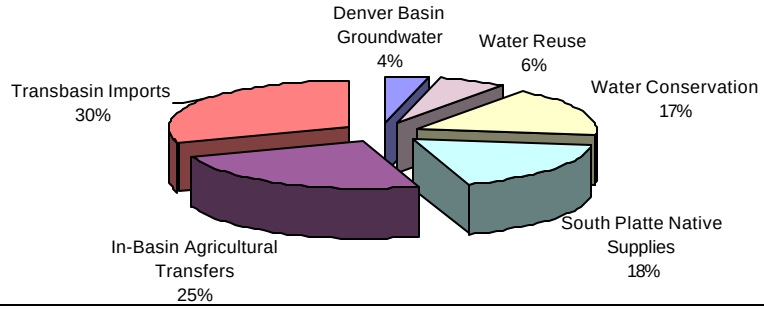
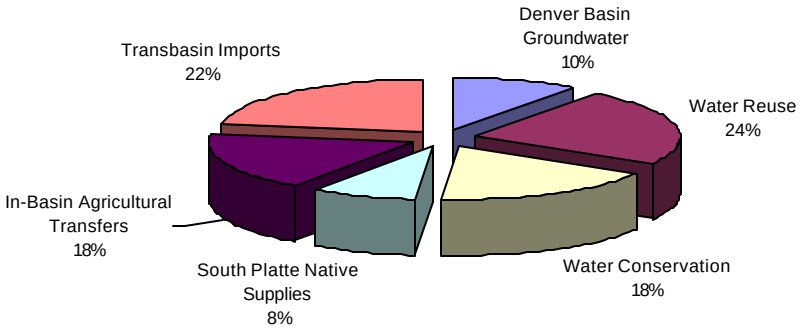


Figure 2: Future of Water Management Strategies, Metro Denver Area



♦Current plans of water providers envision conversion of about 76,000 acre-feet of water from irrigation to municipal/industrial use from a total of over 2.5 million acre-feet of existing irrigation use.

♦Use of Denver Basin groundwater will remain at relatively low levels, even without conjunctive use.

♦Under current plans, transmountain diversions from the Colorado River Basin to the South Platte from existing facilities and water rights would increase from current levels to about 450,000-550,000 acre-feet per year.

WHERE DO WE GO NOW?

MWSI is a breath of fresh air. For over 60 years individual water suppliers have pursued their own separate water supplies, based either on the constitutional right of appropriation or the purchase and conversion of agricultural rights. In both cases, water has been diverted from another water basin for use in the Front Range and caused injury to the basin-of-origin. Forgetting for a moment what may be seen as parochial views of individual water basins, an objective statesman's approach to the solution of the water supply problems of Colorado's Front Range would conclude that the approach and conclusions of MWSI are appropriate, even long overdue.

The Broader Benefits of the Collaborative MWSI Process

The information in Table 2 below provides an understanding of the roles and benefits of the cooperative water supply opportunities evaluated through the MWSI.

Sub-region	Projected Future Water Demand, AF	Basis of Projection	Reasonably Certain Future Supply, AF (1)	Future Unmet Needs, AF (2)	Applicable Cooperative Supply Opportunities (3)
Denver Central Sub-region	454,000 (4)	build-out	410,000	14,000 to 44,000 (5)	Conjunctive use with South sub-region, effluent management with NE subregion, system integration with NW sub-region and Aurora
South Metro Sub-region	127,000	build-out	127,000	0	Conjunctive use with Denver, effluent management within Cherry and Plum Creek Basins
City of Aurora	105,000 (6)	2030	75,000	30,000 (6)	Effluent management with NE sub-region, coordinated reservoir operations with Denver
NE Metro Sub-region	125,000	build-out	61,000 to 100,000 (7)	25,000 to 64,000 (7)	System integration and effluent management among Denver, Aurora, Brighton, South Adams County WSD, Thornton and the Barr Lake companies
NW Metro Sub-region	100,000	build-out	90,000	10,000	System integration with Denver, effluent management within Clear Creek and Big Dry Creek basins
Total	911,000		763,000 to 802,000	79,000 to 148,000	

(1) Based on planning efforts to date, water providers have a relatively high degree of confidence in these supplies.
(2) Providers have a relatively lower degree of confidence in their plans to meet these needs.
(3) Cooperative supply opportunities could be used.
(4) Includes Denver Water and Englewood; Includes Denver Water's 30,000 AF safety factor.
(5) Based on the expected range of Denver Water's future safety factor.
(6) Includes Aurora's 10,000 AF planning reserve.
(7) Depends on the degree of implementation of Thornton's Northern Project.

♦The Problems — Unfortunately, there will be problems in implementing the recommendations of MWSI. Clearly, the most difficult are: the Appropriation Doctrine (first in time, first in right); and the property "takings" clauses of the Colorado and United States

Constitutions, both of which protect senior water rights. Several concerns also have been raised by particular regions that would be affected by implementation of the MWSI. In Northern Colorado, there is strong concern regarding water transfers out of the region to the Denver area because that region greatly values its diversified economy that includes a significant amount of irrigated agriculture. Western Colorado is concerned that continued increases in water diverted to the Front Range will impact West Slope water needs and rights. Denver Basin water users are concerned about long-term impacts on the underground/nonrenewable water supply. Denver is concerned about its right to maximize existing water rights priorities to supply users. Arkansas River basin citizens are concerned about the adverse impacts of further drying up of agricultural lands, especially in view of the adverse consequences of the diversion and dry-up caused by the prior transfers by Aurora. Other problems that concern water suppliers generally are the unknowns about future federal requirements, weather uncertainties including droughts, and the uncertainty of future growth needs.

♦Recommended Solution — Develop a set of weighted principles to apply to future water supply decisions that results in a sequencing of priorities for utilization of water supply sources, as distinguished from strict reliance on priority of right, including right to purchase and change water rights, if that is inconsistent with the principles established. The principles would be based on a balancing of numerous factors, including:

♦Seniority of water rights involved
♦Cost
♦Economic impact on basin-of-origin
♦Environmental impact on basin-of-origin
♦Recreational impact on basin-of-origin (economic/environmental)
♦Social impact on basin-of-origin
♦Water quality impact on basin-of-origin
♦Relative need of entity proposing to utilize the new water source
♦Reasonable alternatives available, including in the basin-of -need
♦Relative need for the same supply by the basin-of-origin
♦Specific legal rights involved in any project, other than the seniority issue
♦Endangered species impacts in basin-of-origin
♦Relative benefit to the area that will utilize the proposed water source
♦Other unique issues related to the proposed project.

It is acknowledged that implementing the application of these principles will be difficult.

THE QUESTION IS:

Can a social conscience be developed within the Appropriation Doctrine?

THE ANSWERS ARE:

♦Under existing laws, it probably cannot be forced without the agreement of the owners of senior water rights involved.

♦There is nothing under existing laws that will prevent it from occurring with agreement of interested parties.

♦The Clean Water Act may mandate some aspects of it.

♦Depending on the uses contemplated, new laws may be required to implement specific uses.

♦The solutions will be difficult, but appear promising enough compared to the alternatives available, to pursue further investigation.

MWSI RECOMMENDATIONS

It is recommended that a continuing state-sponsored cooperative supply planning forum be established.

The MWSI has improved communication, mutual understanding and cooperation between Metro-Denver area water providers, West Slope interests and environmental interests. It has resulted in several ongoing collaborative studies designed to increase water supplies in mutually acceptable ways. It has also had a major effect upon other ongoing planning efforts including:

♦ Quadrant investigations of various cooperative water supply opportunities
♦The Platte River Cooperative Agreement and EIS process
♦The Upper Colorado River Basin Study
♦The Colorado River Endangered Fish Species Water Availability Study♦
The Chatfield Reservoir Reallocation Feasibility Study
♦The U.S. Forest Service's South Platte Wild & Scenic Study and associated negotiations
♦The Northern Regional Water Coalition's investigation of long-term future M&I water needs of the Northern Front Range

These studies are proceeding independently, but are highly interrelated and deal with complex issues that affect numerous parties.

It is recommended that the MWSI database be periodically updated through a state-coordinated effort as part of the continuing state-sponsored forum.

INTERSTATE COMPACT OBLIGATIONS: IMPACTS ON COLORADO WATER SUPPLY

From a Speech by David W. Robbins, Attorney at Law, Hill & Robbins, P.C.
At the 24th Annual Water Workshop, Gunnison, Colorado

I would like to start the discussion about compacts and their implications with a discussion of the nature of compacts. Interstate compacts are contractual agreements, like treaties, between two or more states or, in some cases, between states and the federal government. In colonial America, it was a common practice for colonies to settle boundary disputes by agreement, subject to approval of the Crown. This practice was carried over in the Articles of Confederation and the Constitution. Article I, Section 10, Clause 3 provides:

> ***No State shall, without the consent of Congress . . . enter into any Agreement or Compact with another State, or with a foreign Power, ...***

> ***Water compacts have, in the West, one thing in common: they are designed to allocate consumption. It doesn't matter how the compact goes about doing it. When you strip away all of the gloss, they are allocating consumption. They do it in a variety of ways.***

Although the Constitution seems literally to require congressional consent for any agreement between states, the U.S. Supreme Court has limited the requirement of congressional consent under the Compact clause to interstate agreements which may affect the political balance within the federal system or infringe on a power delegated to the federal government. Early compacts dealt primarily with boundary issues, but in the twentieth century, compacts have been used to cover a wide variety of subjects, including the allocation of interstate rivers and streams. There are compacts on bridge tolls, compacts on low-level hazardous waste, compacts on water — be clear that the compact works in the legal realm where the federal government has not asserted, or the Constitution has not provided for, federal sovereignty. There is a low-level hazardous waste compact in the West, and Colorado is a signatory to it. The Compact deals with material like x-ray film that have a very small amount of radioactivity, and several states have entered into a compact to regulate for its disposal. Clearly, that is an area where Congress could decide, under the health, safety and welfare clause of the Constitution, that it was going to take primacy, and probably could singularly overrule that compact with a broad-based piece of federal legislation.

> ***. . . the Colorado Doctrine of Prior Appropriation, the constitutional right that vests in each citizen of this state the right to appropriate and put water to beneficial use if it is available, operates ONLY against the quantity of water that is allocated to this state by the compact.***

Compacts are the law of each signatory state. Each state has responsibility to ensure that its laws are enforced, and compacts are no different. They are also a law of the United States, and have been so described by the U.S. Supreme Court. Finally, they are a contract, enforceable by its terms under the principles of contract law. Compacts can occur when Congress consents to the states agreeing upon certain matters of common sovereignty. Congress can consent before the states actually draft the specific terms, or as in some instances, Congress consents after the states have agreed. Upon consent, you have the congressional action necessary to transform the compact into a law. I will describe later why that is important. Congress cannot unilaterally amend compacts. To change a compact requires the action of the signatories. Congress must ratify a compact, and Congress may regulate the same resource by other mechanisms (i.e., The Clean Water Act), but I don't believe the Congress could simply pass a law that had as its sole purpose the unilateral amendment of a compact. That is not to say that Congress could not act within its constitutional powers to legislate on a subject that limited the way in which a compact actually operated.

Water compacts are used at various places throughout the United States, most in the West, but not only in the West. There are also compacts on several rivers in the East. Water compacts have, in the West, one thing in common: they are designed to allocate consumption. It doesn't matter how the compact goes about doing it. When you strip away all of the gloss, they are allocating consumption. They do it in a variety of ways. They do it by effectively limiting future water development. The Arkansas River Compact was designed to do that. Or, they seek to set in place a given amount of consumption for a given basin or for a given state. The Rio Grande Compact, the South Platte Compact, and the Colorado River Compact do that. People think of the Colorado River Compact in terms of flow in the river, but that is not really what the compact allocates — the compact allocates a right to consume a portion of that flow.

The other principle I want you to be clear about at the outset is that the Colorado Doctrine of Prior Appropriation, the consti-

tutional right that vests in each citizen of this state the right to appropriate and put water to beneficial use if it is available, operates ONLY against the water that is allocated to this state by a compact. That is a very important principle.

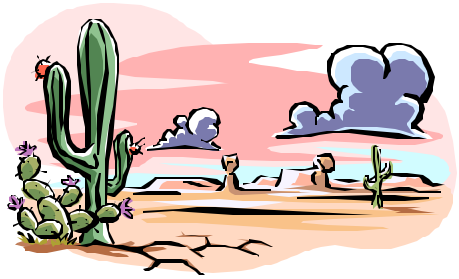
On the La Plata River, there was disagreement over 50 years ago over whether the state could require La Plata River irrigators with priority dates senior to the La Plata River Compact to shut off, since they had a constitutionally recognized property right. The U.S. Supreme Court, in the case of Hinderlider v. La Plata and Cherry Creek Ditch, enunciated the rule that is good today: Colorado's Doctrine of Prior Appropriation ONLY operates against that portion of the La Plata or any other river in the state that is apportioned to the State of Colorado. In the case of the La Plata, the rest of the flow of the river belonged to New Mexico; it wasn't ours. By agreeing to a compact, we had in effect acknowledged sovereign control over a portion of the river to another state. It is the same with every compact. When you say, "There is more water; we should be able to use it," remember that it is not ours even to talk about. It may flow through our state, but it does not belong to us. We have a legal obligation to deliver it to our neighbor.

Finally, I want to make it clear that compacts drive river operations. Water must be delivered downstream in the amounts that the compact contemplates and in the time frames that the compact contemplates. We are different than California, at least as to rivers which arise in California and flow to the ocean. California does not have a compact with the ocean. On rivers which arise in California, California is free to undertake conservation measures, free to undertake reuse programs, and free to continue to increase the amount of water that it uses in its rivers and streams through all these mechanisms. Colorado is not. Colorado, on each of our rivers, is obligated to deliver a significant quantity of water downstream, and one person's conservation, reuse, and expanded use, requires another person to forego use of the resource. In the end, at the state line gages, the quantity of water that has been delivered historically must continue to be delivered, and this makes the lives of all of the people attempting to manage water resources very complicated.

I have been asked to talk specifically about the Rio Grande and South Platte River Compacts.

THE RIO GRANDE COMPACT

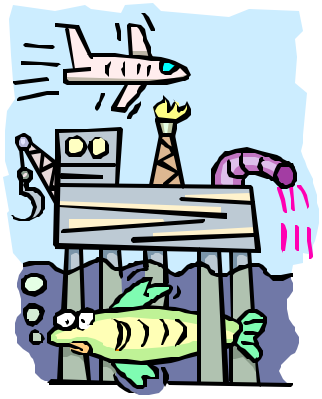
Let me talk briefly about the Rio Grande Compact. It was signed in 1938 based upon 10 years of study on the Rio Grande conducted by a federal agency. It was designed to allocate the waters of the Rio Grande among the States of Colorado, New Mexico, and Texas. You will see that it is a compact, from Colorado's perspective, that uses a tabular relationship between four inflow gages and a single outflow gage at the state line. The State of Colorado is obligated to deliver a percentage of the flow of the river that changes depending on the amount of inflow. If you think about it, what we are doing here is limiting consumption in Colorado. If you look at the two tables in Article 3 of the Rio Grande Compact, you will see that as the inflow increases, the percentage that may be consumed by Colorado goes down. That is true on both the Rio Grande and the Conejos, which have separate tabulations. The purpose, obviously, is to keep Colorado from using all the water in a wet year. On the other hand, it was intended to protect Colorado's agricultural economy in a dry year. The same is true for New Mexico. If you ever doubt what a good job Colorado's negotiators did, look at the relationship between the opportunities for Colorado to consume water in Article 3 as compared to the opportunities for New Mexico to consume water in Article 4.



The problem with the Rio Grande Compact, obviously, is that it requires delivery each and every year. In Colorado, there are very few reservoirs in the Rio Grande Basin. As a result, we do not have the opportunity and the flexibility that we have on the Colorado, for example, where you have a bucket like Lake Powell that allows the upper basin states to store two or three years' supply and gives us the freedom to make decisions about our water resources in this state, including the freedom to have instream flows and to allow rivers to remain undammed. If we didn't have Lake Powell, we wouldn't have that flexibility.

On the Rio Grande, water users suffer because they do not have a large bucket, and each year the State of Colorado must curtail water use to make certain that the supplies required to be delivered to New Mexico are, in fact, delivered. All water supplies in the Rio Grande, as the Compact contemplated, are fully used as far as Colorado's share of the basin is concerned, except in the limited years when Elephant Butte Reservoir fills and spills. The 10-year study tried to draw hydrologic relationships between the amount of water provided each year by Mother Nature, the amount of use in the San Luis Valley, and the amount of water obligated for delivery downstream. It did not provide a significant amount of water for additional growth. It was designed to hold Colorado to a certain amount of consumption. When those hydrologic relationships were developed, it was understood that the San Luis Valley contained a large groundwater basin and its existence, and its relationship to surface streams, was impliedly accounted for in the Compact.

From the early 1950s until the mid-1960s, Colorado allowed well development to occur, and at the same time allowed the ditches senior to the compact to continue to divert. By 1966 or 1967, we were almost one million acre-feet in debt to the States of New Mexico and Texas. We were sued by the two states in the U.S. Supreme Court. Colorado sued for peace and agreed that henceforth, from 1968 onward, it would deliver at least what the tables of relationship required in each and every year. That lawsuit remained a viable legal proceeding until 1985, when it was dismissed because of the enormous water years in the '80s that filled and spilled Elephant Butte Reservoir, which is an event in the Compact that wipes out past debits.



At the present time, we are in a situation, with regard to the Rio Grande Compact, where we probably are consuming more water in the basin today than Mother Nature will replace during a normal hydrologic cycle. Remember, we have been in a 20-30 year wet cycle. The time will come, with the existing level of use that occurs in that basin, when sacrifices will have to be made. The priority system will have to operate very strictly for us to continue delivering water to New Mexico and Texas. Understand that the people in the San Luis Valley are very clear about the circumstances in which they live, and thus you see the almost violent reaction when others try to convince them that there is more water available that can be taken, and try to convince them that 100,000 or 200,000 acre-feet of additional water can be taken out of the basin without creating any adverse consequences. This is fantasy; it is absolutely wrong. If you take more water out of the basin, you are only exacerbating problems to be faced under the Compact in the future. The way the State was forced to meet the compact terms from 1968 to 1985, and the way the State does it today, is to curtail senior water rights — senior surface ditches in order to get the water through to the state line so it can be gaged.

THE SOUTH PLATTE COMPACT

The South Platte Compact, one of the two compacts Delph Carpenter negotiated, was signed in 1923. It allocates consumption as well. The South Platte Compact provides that during the irrigation season Colorado must not permit diversions by priorities junior to June 14, 1897, which will diminish the flow of the river at the state line below 120 cubic-feet-per-second as a daily average. Clearly, if at such times Colorado fails to shut off all water rights junior to 1897, which will diminish the flow of the river at the state line below 120 cubic-feet-per-second, and which is necessary for beneficial use within Nebraska, then Colorado is operating contrary to the compact. The Compact is clearly designed to limit additional consumption in the lower river. It is based upon the very real operational scenario that the priority system will operate.

WHEN COMPACTS DON'T WORK

Some compacts have within them a negotiation framework that can be used if there are disagreements, but when the states cannot agree upon the proper interpretation of the compact terms, they are enforced in one way — by a lawsuit in the U.S. Supreme Court. There have been quite a number of lawsuits. I am involved as counsel for Colorado in a lawsuit on the Arkansas River, where Kansas sued Colorado alleging violations of the compact. I want to make a point here, because occasionally I hear that the compact was designed to deal with surface water and did not apply to groundwater. I want you all to realize that had you lived in Nebraska or Texas, or Arizona, you might be able to legitimately make that argument. But Colorado, in our wisdom, is one of the states that understood the unity of tributary groundwater and surface water and that development of groundwater effects surface water flows. Our case law makes that abundantly clear. When your own state has acknowledged the direct and immediate connection between ground and surface water, it is very hard, with a straight face, to argue to the U.S. Supreme Court that a compact has nothing to do with the tributary groundwater. States, like Nebraska, that apparently don't really think all of this is hooked together, may be able to make that argument. Their law doesn't compel them to acknowledge the tie.

Colorado, I want to emphasize again, has a duty to enforce compacts by their terms. Colorado cannot claim the benefits of compacts, the freedom to use the part of the water apportioned to us as we see fit, without accepting the detriments, the duty to deliver water to our neighbors. It is a package where benefits and detriments are tied together, just like any other contract. I think it is arrogant to believe that we would be smarter or more able to fashion an allocation of water that is better than those contained in the existing compacts. Remember, people just like us populate our neighboring states. They are smart, thoughtful, careful, and will not come into compact negotiations with the idea that Colorado, as the mother of several large rivers, deserves better treatment than they. That was my problem with the suggestion yesterday that we construct a pipeline from the mouth of the Missouri and bring the water back to Colorado. Hello — the people in Missouri, the people along the Mississippi River, have this notion that the river benefits them and their environment. The concept

that we could go down there without enormous struggle, and despite the physical problems, simply put in a pumping plant and bring water up because we want it, the notion boggles my mind. What we want is of little importance or consequence to the people in these other states.

States have always been prone to collide when they are threatened on issues such as their future ability to survive, to have a tax base, and to have a vibrant economy. At this stage in our history, we are no different than we were back in the '20s, '30s, and '40s, when these compacts were negotiated — our neighbors desperately need the water, would like the water, and will make every conceivable argument about why we ought to send it down to them. Each of you has the responsibility to join in making certain that Colorado's entitlements under these compacts are protected by the terms of the compacts. I don't believe we must use all the water that is compacted to us today or tomorrow; we can use it in another generation. But we have the same obligation to our kids and grandkids that Delph Carpenter felt he had to us: to pass the opportunity to make the choice.

The U.S. Supreme Court has taken a position with regard to compacts that is very helpful to the State of Colorado. In at least four recent cases, it has said that it will not modify, change, or alter the terms of a compact unilaterally or permit compacts to be reinterpreted under present circumstances. If states don't like the way compacts are currently operating, there is a mechanism to change them, but the Supreme Court is not going to make that change. It is up to the state legislatures and the Congress. The court even took that position in a boundary dispute, the Ellis Island case. There was a boundary compact from the early 1800s between New Jersey and New York defining who had what jurisdiction in New York harbor. The federal government took over Ellis Island and needed more room to process immigrants into the country, so they expanded the island. The expansion caused the island to grow from New York territory into territory allocated by the compact to New Jersey. There was a big disagreement about who controlled Ellis Island when the federal government closed its facility. The U.S. Supreme Court shrugged and suggested that it may not make much sense but the two states had agreed to the boundary line compact, and it runs through the middle of Ellis Island, so New Jersey gets its part and New York gets its part. If the states don't like the compact, they should change it.

The U.S. Supreme Court has said the same thing in Texas v. New Mexico, Kansas v. Colorado, namely, that the court doesn't care what people have BEEN doing; the court is going to read the compact and enforce it. That is very good from Colorado's perspective. Lots of people like to argue that if we don't use the water we will lose it — California will take it; Las Vegas will take it; San Diego will take it. No, they're not taking it. If we don't need it, they are entitled to use it. We always say that they are using our water, but they are not using our water. The compact says if we don't need it, we are obligated to let it go downstream so they can continue to use it. By standing by that principle, we protect ourselves as a state against claims that in the future we are not entitled to make additional uses of the water on any of our rivers. With all of these compacts, as long as you live by their terms, you have a strong likelihood that you will be protected.

WATER MARKETING

Let me talk about the Trojan Horse for a minute. There are some who believe that water marketing is an answer to our problems. Water marketing interstate is an anathema to the interests of the State of Colorado, unless your vision of this state is as a water farm for states below us under these compacts; unless your belief is that our share of the consumption of these rivers ought to be turned over to other states. We do not have the economic throw-weight to compete with Albuquerque and El Paso. We do not have the economic throw-weight to compete with Las Vegas and Los Angeles. When you get into a bidding war over water without the protections of the compacts, Colorado is going to lose that war. We do not have the growing season for agriculture that they do in the Imperial Valley, so water there has an incrementally larger value.

There is no reason in the world to assume that we are obligated to sell water interstate. Congress, by ratifying our eight compacts, has agreed to an allocation of a commodity that, but for the compacts, would be an article of interstate commerce. Congress has regulated that commodity by agreeing that each state is entitled to consume a portion of the supply of each of the rivers that we have compacts on. Colorado has a right to regulate in any way it wants the water that is compacted to it within its boundaries. And we do that regulating through the state constitutional Doctrine of Prior Appropriation, and we do allow a property right to vest in the person owning that water right. On the other hand, the right to make the beneficial use of the water runs to the State of Colorado under the compact.

We will make a serious mistake if we EVER, EVER succumb to the notion that we should abandon our compacts and go to a market-driven system. The people who advocate that have one of two things in mind: one group says, "I can make a lot of money." And maybe they can. But is that stewardship? Is that our responsibility to the generations to come? I say "No." The second group wants to see marketing occur because they believe it is a way to curb growth in this state. They believe that if they can get a market going, they can, in fact, get water sold out of this state to a point that the state no longer has flexibility in the use of its water supplies; they see environmental benefits in states below us by improving streamflows, and they are driven by that view. I believe that if we want to let water go, we should do it under the compacts. We should not do it in a permanent fashion that markets the water to a point that our sons, daughters, and grandkids can never get it back.

HYDROLOGY DAYS 1999 PROGRAM GIVES STUDENTS A WORLD PERSPECTIVE ON WATER

The ***19th Annual Hydrology Days***, co-sponsored by the Water Resources Engineering Division of the American Society of Civil Engineers, was held August 16-20, 1999 on the campus of Colorado State University. The meeting was dedicated to Dr. Roger E. Smith and Dr. David A. Woolhiser, scientists with the Agricultural Research Service, U.S. Department of Agriculture (retired); and former students and professional colleagues of Professor Morel-Seytoux.

For students, oral presentations of papers in the Masters and Ph.D categories and poster presentations in the Masters and Ph.D categories were highlights of the meeting. Research papers or posters were presented by students from Colorado State University, the Universities of Alabama, Arizona, Colorado, Georgia, Nevada, New Mexico, Oklahoma and Virginia; Florida State University; the Universidade Federal de Ceara, Brazil, the Free University of Brussels, Belgium, and the Ecole Polytechnique, Montreal, Canada. Best oral presentation award in the Masters category went to Michael Hobbins, Colorado State University, for "The Complementary Relationship in Regional Evapotranspiration: Comparing and Evaluating the CRAE Model and the Advection-Aridity Approach." In the Ph.D. category, Ayman G. Awadallah, Ecole Polytechnique, Montreal, Canada, was the winner for his paper, "Forecasting the Nile Flood Using Sea Surface Temperatures as Inputs: A Comparison Between Transfer Function with Noise and Neural Networks." Best student poster presentation award in the Masters category went to David Kinner, University of Colorado, for his poster "Hydrology of Two Tropical Catchments with Variable Slope and Soils for Wet and Dry Seasons." In the Ph.D. category, Hongsheng Cao, Florida State University, took first place with a poster on "Water Sources of the Springs and Sinkholes of Leon-Wakulla Counties, Florida: Geochemical Evidences."

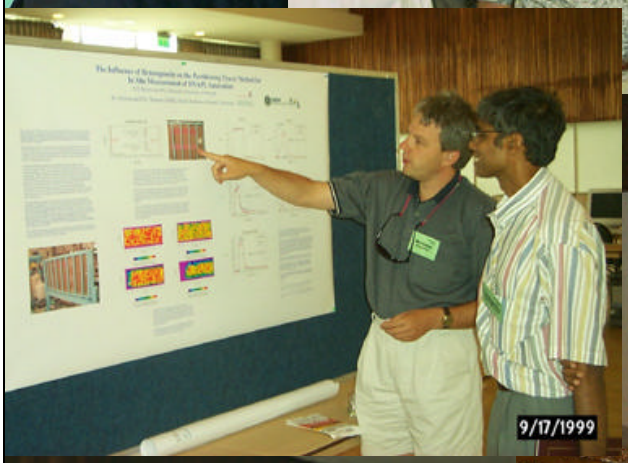
Justice Greg Hobbs of the Colorado Supreme Court was the luncheon speaker on August 17, discussing "Beneficial Use: The Basis, Measurement and Limits of the Appropriative Water Right." At the August 18 luncheon, speaker Bill Stanton, Chief, Office of Water Conservation, Colorado Water Conservation Board, presented an overview of issues facing the CWCB.

The four-day program drew speakers from across the United States and from across the world – from Canada, the United Kingdom, Mexico, Australia, Brazil, France, Iran, Japan, Saudi Arabia and New Zealand. Presentations on many aspects of hydrology were made by university faculty from Colorado State; the Colorado School of Mines; the Universities of Alabama, California, Colorado, Connecticut, Georgia, Nebraska, Oklahoma, and South Florida; City College of the City University of New York, Cornell University, Manhattan College (NY), Massachusetts Institute of Technology; Michigan State University; Princeton (NJ); Oregon State College; Simpson College, (IA); Utah State University, Virginia Polytechnic Institute; the Mexican Institute of Water Technology, Kochi University, Japan; the Universidade Federal de Ceara, Brazil; the National Institute of Water and Atmospheric Research, New Zealand; King Saud University, Saudi Arabia; the University of Grenoble, France; the University of Quebec and the Ecole Polytechnique, Montreal, Canada; the University of Technology, Tehran, Iran; and the University of Reading and the University of East Anglia, the United Kingdom.

Federal agencies represented included the U.S. Geological Survey's Denver office and the EROS Data Center in Sioux Falls, South Dakota; the U.S. Environmental Protection Agency's Athens, Georgia Lab, and from the USDA's Agricultural Research Service representatives from Arizona, Colorado, Idaho, Mississippi, Ohio, Oklahoma, and Oregon. Others presenting papers or posters included representatives from the South Florida Water Management District, the Pacific NW National Laboratory (WA); the National Institute for Environmental Renewal (PA); the Swiss Federal Institute of Technology, Zurich; Soai Co., Ltd., Kochi-shi, Japan; the Ministry of Energy, Tehran, Iran; and the Institute of Technology, India.

The national and international expertise on hydrology was outstanding, and presentations, plus the opportunities to mingle with hydrology experts from around the world, provided an excellent learning experience for all attendees.

The national and international expertise on hydrology was outstanding, and presentations, plus the opportunities to mingle with hydrology experts from around the world, provided an excellent learning experience for all attendees.



Photos from upper left clockwise: ***Tissa Illangasekare, Colorado School of Mines, and Greg Hobbs, Justice, Colorado Supreme Court; Honorees David Woolhiser (left) and Roger E. Smith (right) with meeting participant; Luncheon Speaker Bill Stanton, Chief, Office of Water Conservation, Colorado Water Conservation Board; Michael Hobbins, Colorado State University, winner of the award for best oral presentation in the Masters category, "The Complementary Relationship in Regional Evapotranspiration: Comparing and Evaluating the CRAE Model and the Advection-Aridity Approach," with Hubert Morel-Seytoux; Hongsheng Cao, Florida State University, winner of first place in the Ph.D. category for his poster on "Water Sources of the Springs and Sinkholes of Leon-Wakulla Counties, Florida: Geochemical Evidences," with Hubert Morel-Seytoux; Hubert Morel-Seytoux with Ayman G. Awadallah, Ecole Polytechnique, Montreal, Canada, winner of best oral presentation in the Ph.D. category for "Forecasting the Nile Flood Using Sea Surface Temperatures as Inputs: A Comparison Between Transfer Function with Noise and Neural Networks;" and Tissa Illangasekare with Mart Oostrom, Pacific Northwest National Laboratory, at the Hydrology Days Poster Session.***

CWRRI

CSM, CU Water News

Colorado Water Resources Research Institute

NOAA/CIRES CONFERENCE ON CLIMATE VARIABILITY AND WATER RESOURCES IN THE INTERIOR WEST JUNE 21-22, BOULDER, COLORADO

NOAA's Climate Diagnostic Center and the University of Colorado's Cooperative Institute for Research in Environmental Sciences (CIRES) sponsored a conference on climate variability and water resources in the Interior West on June 21-22 in Boulder, Colorado. It brought together an interdisciplinary group of about 70 recognized authorities in the fields of climate prediction, water resources, water management, and water policy for the Interior West.

This conference was held in conjunction with the NOAA/CIRES Western Water Assessment, an interdisciplinary study linking climate variability, water resources, social trends, institutions, economics, water quality, and aquatic ecosystems. The user assessment component of the study will seek to identify stakeholders and to involve them in the study.

One of the goals of the Western Water Assessment will be to evaluate the predictability of precipitation and temperature in the Interior West and to develop climate forecast products. Co-variations of climate and hydrology will also be examined, leading to the development of hydrologic forecasts for the region. Such forecasts could serve to mitigate the impacts of extreme hydrologic events, such as drought and flood. Prediction of water supply variability could also potentially extend water resources through increased efficiency of water management.

The purpose of the conference was to describe and analyze the current status of water science, management, and policy as they relate to the Interior West, and to project the main developments in these fields over the near future, especially as related to improved capability for prediction of climate variation.

The two days of the conference were divided among four Plenary Sessions and four Workshops. Plenary Session I focused on Climate Variability: Patterns and Predictive Capability in the Interior West." Randy Dole of NOAA's Climate Diagnostic Center spoke on the prospects of predicting climate and weather variations. Also participating in the session were Kelly Redmond of the Western Regional Climate Center in Reno, Nevada, and Connie Woodhouse from NOAA's Paleoclimatology Program. Redmond spoke on complex spatial structure associated with topography, and observational issues, as related to climate variability, in the Intermontane West. Woodhouse presented "Dendrochronological Evidence for Long-Term Hydroclimatic Variability."

Plenary Session II, "Water Management in the Interior West: Current Practice and Future Change," was comprised of talks by Terrance Fulp from the Center for Advanced Decision Support for Water and Environmental Systems (CADSWES), Kenneth Strzepek, from the University of Colorado at Boulder (CU), and Eugene Stakhiv, Policy and Special Studies Division of the U.S. Army Corps of Engineers. Fulp spoke on management of Colorado River resources in a changing climate. The impact of climate variability on water resources management was addressed in the talk by Strzepek. Stakhiv presented "Water Management Policies and Priorities for Climate Possibilities." "Control of Hydrology by Climate Variability in the Interior West" was the topic of the third plenary session. Martyn Clark of CIRES spoke about atmospheric controls on montane snowpack and water resources. Upmanu Lall, of Utah State College, presented a talk on interannual climate variability and hydrologic extremes. Dennis Lettenmaier, from the University of Washington, gave a talk entitled "An Approach to Modeling the Implications of Climate Variability on Hydrology and Water Resources in the West: the Pacific Northwest Experience."

Plenary Session IV, "Social and Economic Changes in the Use and Distribution of Water in the Interior West," featured David Getches from the CU School of Law, Tom Cech, Central Colorado Water Conservancy District, and John Loomis from Colorado State University (CSU). Getches presented "It Takes a Crisis — And Other Lessons Western Water Law Teaches Us." Cech gave a talk on groundwater management along the South Platte River. "Economic and Institutional Strategies for Adapting to Water Resource Effects of Climate Change" was presented by Loomis.

David Matthews of the U.S. Bureau of Reclamation and C. Booth Wallentine of the Utah Farm Bureau Federation led the first of four workshops, "Can Climate Predictions be of Practical Use in Western Water Management?" Rene Reitsma, formerly of CADSWES, and Phillip Pasteris of the U.S. Department of Agriculture's National Water and Climate Center, led Workshop 2, "How can Useful Climate Data be Acquired, Managed, and Disseminated?" Workshop 3, "Has Modeling of Water Resources Reached its Full Potential?" was led by John Labadie and Luis Garcia, both of CSU. The fourth Workshop, "Social, Policy, and Institutional Issues: More of the Same, Radical Change, or Gradual Evolution?" was led by Kathleen Miller from the National Center for Atmospheric Research, and Steven Gloss, University of Wyoming. Closing remarks were provided by Patricia Limerick from CU's Department of History.

International Ground-Water Modeling Center
Colorado School of Mines
Golden, Colorado, 80401-1887, USA
Telephone: (303) 273-3103
Fax: (303) 384-2037

International Ground-Water Modeling Center

FALL 1999 Short Courses

PHREEQC: GEOCHEMICAL AND REACTION TRANSPORT MODELING	OCT 21-23	$1095	$1$1295 after 10/9
MODFLOW: Introduction to Ground Water Modeling	OCT 20-23	$1345	$1545 after 10/9
UCODE Universal Inversion Code Automated Calibration of "Any" Code	OCT 22–23	$995	$1195 after 10/10
Subsurface Multiphase Fluid Flow and Remediation Modeling	OCT 28-30	$1095	$1295 after 10/15
IN SAN FRANCISCO AFTER THE AGU MEETING			
Hydrus-1D and -2D Software for Variably Saturated Flow and Transport	DEC 17-18	$ 995	$1095 after 12/1
IN GOLDEN NEXT SPRING			
Less than Obvious :Statistical Methods for for Data below Detection Limits	MAR 16-17	$ 650	$750 after 3/8
Applied Environmental Statistics	JUN 19-23	$ 650	$750 after 3/8

FOR INFORMATION CALL 303/273-3103
FOR REGISTRATION CALL 303/273-3321
VISIT http://www.mines.edu/igwmc/ FOR MORE INFORMATION

♦♦♦♦♦♦♦♦

USGS ANNOUNCES FY1999 AWARDS

The U.S. Geological Survey has announced the awards for its FY1999 National Competitive Grants Program. Abstracts for the projects can be found at the website **http://water.usgs.gov/wrri/,** click on "Research Projects."

CA **Bioavailability of Particle-Associated Pesticides in Northern San Francisco Bay**

CA **A Molecular, Community-Based Approach for Tracking Pathogenic Bacteria Through Coastal Watersheds**

HI **Elucidation of sources and fluxes of suspended solids and antropogenically derived heavy metals in streams of small subtropical watersheds, Oahu, Hawaii**

ID **Metal(loid) Cycling in Lake Couer d'Alene, ID as Controlled by Reduced Sulfur Species**

IL **Analysis of Water Use Trends in the United States: 1950-1995**

WA **Surface and Subsurface Transport Pathways of Non-Point Agricultural Pollutants: Analysis of the Problem Over Four Decades of Basin Scale**

WA **A Watershed Scale Study on No-Till Farming Systems for Reducing Sediment Delivery**

WI **Hydrology and biogeochemistry in the Wisconsin river floodplain: implications for rivervine nitrogen loads**

WI **The Spatial Variability of Natural Groundwater Recharge**

WI **Development of Translators for Filterable Metals Based Upon Watershed Characteristics**

RESEARCH AWARDS AT COLORADO UNIVERSITIES

A summary of research awards and projects is given below for those who would like to contact investigators. Direct inquiries to investigators c/o indicated department and university. The list includes new projects and supplements to existing awards. The new projects are higlighted in bold type.

COLORADO STATE UNIVERSITY
FORT COLLINS, CO 80523

Title	PI	Dept	Sponsor
Natural & Cultural Resource Conservation & Resource Management	Shaw,Robert B	Forest Sciences	USDA-USFS-RMRS
Environmental Management Administration	Shaw,Robert B	Forest Sciences	USDA-USFS-RMRS
A Natural Heritage Inventory of Staunton State Park, Jefferson & Park Counties, Colorado	**Spackman,Susan**	**FWB**	**CO State Parks**
Net Carbon & Energy Balance of Savanna Ecosystems at Earth Observing System (EOS) Validation Sites in Southern Africa	Hanan,Niall P	NREL	NASA
Salinity Studies	Gates,Timothy K	Civil Engr.	Bent Soil Conserv. Bd.
Nutrient Supply Effects on Riparian Vegetation	Binkley,Daniel E	Forest Sciences	DOI-USGS
Visitor Response to National Wildlife Refuge at Recreation Fee Demonstration Projects	**Vaske,Jerry J**	**NRRT**	**DOI-USGS**
Air Quality Effects	**Baron,Jill**	**NREL**	**DOI-USGS**
Support for Global Change Research Program	**Binkley,Daniel E**	**NREL**	**DOI-USGS**
PSF Skull Valley - Task 5	**Abt,Steven R**	**Civil Engr.**	**SW Research Inst.**
Hydrocoverage for Colorado	Laituri,Melinda J	Earth Resources	CDOW
Boreal Toad Habitat Modeling	Wilson,Kenneth R	FWB	CDOW
Modeling & Analytical Services	**White,Gary C**	**FWB**	**CDOW**
DEC Monitoring Sites 1996-1998	**Watson,Chester C**	**Civil Engr.**	**COE**
Automation of Crop Classification from Landsat Satellite Imagery	**Nuckols,John R**	**Environmental Health**	**HHS-NIH-NCI**
Statistical Estimation for Annual Forest Inventory & Monitoring	**Davis,Richard A**	**Statistics**	**USDA-USFS-RMRS**
National Environmental Policy Act Documentation Support at Fort Drum, New York, ON-CAMPUS	**Shaw,Robert B**	**Forest Sciences**	**DOA**
National Environmental Policy Act Documentation Support at Fort Drum, New York, OFF-CAMPUS	**Shaw,Robert B**	**Forest Sciences**	**DOA**
Pilot Studies Investigating Organic Composition of San Joaquin Valley Fogs & Techniques for Measuring Fog Deposition	Collett,Jeffrey L. Jr	Atmospheric Science	ENSR Engr.

FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Department of the Army, DOE-Department of Energy, DON-Department of the Navy, DOT-Department of Transportation, EPA-Environmental Protection Agency, NASA-National Aeronautics & Space Administration, NBS-National Biological Survey, NOAA-National Oceanic & Atmospheric Admin., NPS-National Park Service, NRCS-Natural Resources Conservation Service, NSF-National Science Foundation, , USBR-US Bureau of Reclamation, USDA/ARS-Department of Agriculture, Agricultural Research Service, USDA/NRS-Department of Agriculture, Natural Resources Service, USFS-US Forest Service, USFWS-US Fish & Wildlife Service.

STATE SPONSORS: CDNR-Colorado Department of Natural Resources, NCWCD-Northern Colorado Water Conservancy District, CDWL-Colorado Division of Wildlife, CDA-Colorado Department of Agriculture, CDPHE-Colorado Department of Public Health and the Environment.

OTHER SPONSORS: CID-Consortium for International Development, AWWA-American Water Works Assn.

UNIVERSITY DEPARTMENTS, INSTITUTES AND CENTERS: Colorado State: BSPM-Bioagricultural Sciences & Pest Management, CBE-Chemical & Bioresource Engr., CIRA-Cooperative Inst. for Research in the Atmosphere, DARE-Dept. of Agric. & Resource Economics, FWB-Fishery & Wildlife Biology, HLA-Horticulture & Landscape Architecture, NERL-Natural Resource Ecology Lab, NRRT-Nat. Resources Recreation & Tourism, RES-Rangeland Ecosystem Science. University of Colorado: IAAR-Institute for Arctic & Alpine Research, CIRES-Cooperative Institute for Research in Environmental Sciences, CEAE-Civil, Environmental, and Architectural Engineering, Lab. For Atmos. And Space Physics, PAOS-Program in Atmospheric and Oceanic Sciences.

Title	PI	Dept	Sponsor
Snow Distribution & Runoff Forecasting, Kings River Basin, California	Elder,Kevin J	Earth Resources	COE
Regional Great Plains Assessment	Ojima,Dennis	NREL	Univ Chicago/ Argonne Lab
Potential Losses of EPTAM during Sprinkler Application & the Influence of Soil Moisture Levels at Time of …	Nissen,Scott J	BSPM	Potato Admin. of CO
Valuing Water Quantity & Quality in the Pacific Northwest	Loomis,John B	DARE	USDA-USFS-Pacific NW Exp. Sta.
Distribution, Habitat & Life History of Brassy Minnow in Eastern Colorado	Fausch,Kurt D	FWB	CDOW
Wildlife Watch	**Robinette, H.R.**	**FWB**	**CDOW**
Data Analyses & Dissemination	**Johnson,Brett**	**FWB**	**CDOW**
Carbon Allocation in Coniferous Forests	**Smith,Frederick W**	**Forest Sciences**	**USDA-USFS-RMRS**
Quantifying the Change in Greenhouse Gas Emissions Due to Natural Resource Conservation…	Paustian,Keith H	NREL	USDA-NRCS
Contained Submarine Maintenance Dredge Code	**Gessler,Daniel**	**Civil Engr.**	**COE**
Contained Submarine Maintenance Dredge Testing & Application	**Gessler,Daniel**	**Civil Engr.**	**COE**
High Resolution Crossings Modeling	**Gessler,Daniel**	**Civil Engr.**	**COE**
Effect of Fuel Treatments on Wildfire Severity	**Omi,Philip N**	**Forest Sciences**	**DOI**
Storm Water Vault Model	Abt,Steven R	Civil Engr.	Jensen Precast
Precision Farming to Protect Water Quality & Conserve Resources	Gates,Timothy K	Civil Engr.	USDA-ARS
Interdisciplinary Approaches to Identification & Mitigation of NPS Water Quality Impacts	Stednick,John D	Earth Resources	Univ. of WY
Land Condition Trend Analysis Technical Support For The U S Army Environmental Center (AEC)	**Shaw,Robert B**	**Forest Sciences**	**COE**
Nitrogen Management Investigation for New Cultivars	Thompson,Asunta	HLA.	Potato Admin. of CO
Mechanisms of Tamarisk Dominance in Western Riparian Ecosystems	**Poff,N. Leroy**	**Biology**	**The Nature Conservancy**
Preferences & Willingness to Pay Related to Natural Resource Management	Loomis,John B	DARE	USDA-USFS-RMRS
Natural & Cultural Resource Conservation & Resource Management	Shaw,Robert B	Forest Sciences	USDA-USFSR MRS
Habitat Management Support	**Roath,L Roy**	**RES**	**CDOW**
1998 Science to Achieve Results (STAR) Fellowships for Graduate Environmental Study	Reardon,Kenneth F	CBE	EPA
Measuring Values & Attitudes Toward Recreation in Colorado	**Vaske,Jerry J**	**NRRT**	**USDA-USFS**
Wetlands Program Technical Support & Environmental Monitoring for Fort Drum, New York	**Shaw,Robert B**	**Forest Sciences**	**COE**

UNIVERSITY OF COLORADO
BOULDER, COLORADO 80309

Title	PI	Dept	Sponsor
Estimation of Transport Parameters Using Forced Gradient Tracer Tests in Heterogeneous Aquifers	**Rajaram, Harihar**	**CEAE**	**DOA**
Dissolved Organic Nitrogen in Alpine and Subalpine Ecosystems, Central Colorado Rockies	**Williams, Mark**	**IAAR**	**NPS**
Virus Attachment, Release, and Inactivation During Groundwater Transport	Ryan, Joseph	CEAE	EPA

Title	PI	Dept	Sponsor
Variations in GPS Time Series: A Study of Hydrologeological Loading Effects	Larson, Kristine	CIRES	NASA
Surface Fluxes and Remote Sensing: The Canopy Effect	**Qualls, Russell**	**CEAE**	**NSF**
Evaluation of Snow Simulation in the Second Phase of the Atmospheric Model Intercomparison Project	**Frei, Allan**	**CIRES**	**NSF**
Generalized Cloud Overlap in the NCAR Community Climate Model	**Bergman, John**	**CIRES**	**NSF**
Power-Primary Photodissociation Paths of Carbonyl Intermediates in Ozone Formation	**Laursen, Sandra**	**CIRES**	**NSF**
A Theoretical Study on the Governing Laws for Fluid Transport in Rough Fractures	Ge, Shemin	Geological Sciences	NSF
Anisotropic Flow, Depth-Age Relationships and Stratigraphic Disturbances in Polar Ice Sheets	**Fletcher, Raymond**	**Geological Sciences**	**NSF**
Radiocarbon, Ocean and Climate Change Over the Last Deglaciation	Hughen, Konrad	IAAR	NSF
Lake Quaternary Glaciation of Northern Novaya Zemlya, Russia	Miller, Gifford	IAAR	NSF
Correlative MR Radar Studies of Large-Scale Middle Atmosphere Dynamics in the Antarctic	**Fritts, David**	**PAOS**	**NSF**
Biological Wastewater Processor Research Work Plan: Bench-Top Bioprocessor Experiments	**Silverstein, Joann**	**Allied Signal Tech Services Corp.**	**American Heart Assn.**
Water Resources Issues Within the Integrated Assessment of the Human Dimensions of the Global Change	**Strzepek, Kenneth**	**CEAE**	**Carnegie Mellon Univ.**
Information for Environmental Evaluations of Sustainable Neighborhoods	**Heaney, James**	**CEAE**	**City of Boulder**
Reservoir Stratigraphy and its Controls on Reservoir Architecture and Performance: An Investigation of Key Surfaces and Fabrics in Marginal Marine Environments	Pulham, Andrew	Geological Sciences	Oil Companies
Meltwater Flow Through Snow From Plot to Basin Scales	Williams, Mark	IAAR	NSF
Interannual Variations of Ozone and Their Relationship to Variations of Tropospheric Structure	Salby, Murry	PAOS	NSF
Local, Regional and Remote Effects of Northern Hemisphere Snow Cover on Wester U.S. and Water Resources	**Nolin, Anne**	**CIRES**	**NSF**
The Pacific Profiler Network: Tropical Dynamics Research	Avery, Susan	CIRES	NSF
Improving the Accuracy of Satellite Sea Surface Temperature Measurements by Explicitly Accounting for the Bulk-Skin Temperature Difference	Emery, William	CIRES	NASA
Land Surface Modeling and Data Assimilation with In-Situ and Remote Sensing Data…	**Qualls, Russell**	**CEAE**	**NASA**
Collaboration on the Development and Validation of the AMSR Snow Water Equivalent Algorithm	Armstrong, Richard	CIRES	NASA
Validation Studies and Sensitivity Analysis for Retrievals of Snow Albedo and Snow-Covered Area…	Nolin, Anne	CIRES	NASA
Application of Satellite SAR Imagery in Mapping the Active Layer of Arctic Permafrost	Zhang, Tingjun	CIRES	NASA
Chemical Characterization of High-Elevation Surface Waters: Implications for UV Radiation Penetration	**Brooks, Paul**	**IAAR**	**NPS**
Disturbance History of Rocky Mountain National Park	**Veblen, Thomas**	**Geography**	**USGS**
Center for Drinking Water Optimization	Summers, R. Scott	CEAE	EPA

Flash Flood Laboratory

Cooperative Institute for Research in the Atmosphere
Colorado State University
Fort Collins, Colorado 80523-1375

CIRA
Cooperative Institute for Research in the Atmosphere

What is the Flash Flood Laboratory? The Flash Flood Laboratory is a problem-focused, multi-disciplinary center providing applied research, education and a communication forum to reduce the future impact of flash flood disasters.

Background--Since the Big Thompson Flood of 1976 there has been a recognized need for increased effort to mitigate the impact of flash flooding along the Front Range area of Colorado. This has increased in importance because, as the memory of the Big Thompson flood fades, a new generation of policy makers, engineers, and scientists has become involved in flood mitigation and there has been considerable growth in population and development in flash-flood prone areas. The significant loss of lives and property at Big Thompson and the more recent 1997 Fort Collins Flood exemplify the need for a center to coordinate research and communicate with multiple agencies and communities concerning flash flooding in this region and throughout the United States.

Purpose--Physical science research addresses many of the complex factors associated with flash floods. The results of this research must be effectively communicated and used by agencies, officials, and communities if we are to reduce the flash-flood problem in the nation. The Flash Flood Laboratory was created to facilitate the necessary communication among scientists, researchers, and practitioners.

Who should be involved? This information and interaction will benefit both the public and private sectors. They include, but are certainly not limited to, agencies involved in community planning, emergency response planning, researchers, and state and federal agencies. Please see contact information if you would like to be included in our laboratory or our outreach programs.

Goals

- To identify and develop a database of the widest range of potential users of the flash flood information.
- Conduct a formal survey of agencies to discover new information and communications needs about flash floods.
- We will be able to guide geophysical and engineering researchers to develop information sets to meet user needs and facilitate the use of new information to help mitigate the impacts of flash floods.
- In the year 2000, we will conduct a workshop on flash flooding in Colorado to provide a forum for agencies, organizations, and communities to share information and to discuss the focus of future research.
- We will also create a website to provide an up-to-date view of current research, to disseminate more widely new research, and to promote awareness of the continuing problems and issues that face Front Range communities.
- Eventually the Flash Flood Lab hopes to be able to help other at-risk communities throughout the Southwest and the Nation through continued research and communication.

For further information contact:

Co-Directors:		Eve Gruntfest
Christopher R. Adams	Kenneth E. Eis	Visiting Research Scientist.
(970) 491-3899	(970) 491-8397	(970) 491-8448
adams@cira.colostate.edu	eis@cira.colostate.edu	gruntfest@cira.colostate.edu

CIRA encourages a wide range of scientists to be affiliated with the Flash Flood Laboratory.

WATER NEWS DIGEST

by Jamie Miller

♦♦

FLOOD MANAGEMENT

Pueblo urged to tackle storm drainage

Pueblo council agrees that the city needs to do something about the real floodwaters that occur after each rainstorm, so it gave informal encouragement to a plan to ask both city and county voters to establish a regional storm-water utility next year. It would require homeowners and businesses to pay a monthly fee to the regional utility and that revenue would be divided between drainage projects in the city and county. Currently, the city has a list of needed drainage improvements that totals more than $40 million.

_____

Chieftain 08/17/99

Muddy water supply prompts investigation

Everyone wants to know why Miller Creek is so mud-filled, and wants to make sure the cause isn't something more than just heavy rains that have fallen in the area over the last month. Miller Creek has been wreaking havoc on area residents with flash floods, washing out roads and leaving wide swaths of debris in their wakes. But the little creek is also dumping some die-hard silt into the reservoir. What is peculiar is for the silt to remain in the water all the way from Lemon to the city's Terminal Reservoir after traveling through a 12-mile pipeline that runs off the Florida River two miles south of the reservoir. This is causing trouble at the Durango water treatment plant, where water is coming in well above normal turbidity levels, forcing an increased use of chemicals in treating the city's water supply.

_____

Durango Herald 08/20/99

Delta in running for flood project award

The city of Delta's precarious location on two rivers, the confluence of the Gunnison and Uncompahgre rivers, provides the possibility of flood damage, but participation in a nationwide program could generate funds to be better prepared for such an incident. Delta Community Development Director Rich Sales said a meeting last week with the coordinator from the Federal Emergency Management Agency (FEMA) produced information that Delta is one of two potential locations in the state to receive a Project Impact Award. The Project Impact Award was established by FEMA in 1996 to help communities throughout the country become more prepared for disasters. Each state has at least two communities with the Project Impact Award designation. Fort Collins, Clear Creek and Morgan County have received the award. This year the Delta community and the six-county San Luis Valley region are the two areas up for the award, which is presented in the form of grant money. The federal entity designates an amount of money to be given out to each state, so the actual monetary award is not known. The figure could be between $150,000 and $300,000. Participation in the Community Rating System led the state FEMA office to nominate Delta to the national board, Sales said. Participation in the rating system also allows residents of Delta to take advantage of lower-cost flood insurance rates.

_____

Montrose Daily Press 9/28/99

♦♦

LITIGATION

Colorado to send more money down the river

A three-month trial on damages that Colorado may owe to Kansas will add another $350,000 to the state's already $11 million cost of the Arkansas River Compact case. Colorado Attorney General Ken Salazar told the Legislature's Joint Budget Committee that he will submit a supplemental appropriation request next month. Denver water lawyers David Robbins and Dennis Montgomery are defending the state against Kansas' claims in the 14-year-old lawsuit, which the U.S. Supreme Court assigned to Special Master Arther Littleworth. Kansas publicly has claimed $78 million in damages, while Colorado has countered by offering payment in the form of water rather than cash. In May 1995, the U.S. Supreme Court adopted Littleworth's findings that Colorado was liable for excessive well-pumping that depleted the Arkansas River flow at the Kansas state line by as much as 420,000 acre-feet since the compact began in 1949.

_____

Pueblo Chieftain 08/25/99

♦♦

WATER DEVELOPMENT/SUPPLY

Florence adds to wastewater plant

The Fremont Sanitation District's $2.6 million de-watering center will be the first in line for improvements designed to keep up with growth in Canon City and Florence. The district serves about 8,500 households or 34,000 customers in Fremont County. The district will be able to keep rates low, thanks to the early payoff of bonds on the regional waste-water treatment plant here and the ability to

secure a loan at 4.2 percent interest from the state revolving loan fund. The upgrades will include the new de-watering center and modifications to the treatment plant, including the use of larger pumps to increase the plant's pumping capacity during storms. Other improvements will include purchase of ultraviolet lights, which will be used to disinfect treated water, replacing the need for chlorine and sulfur dioxide treatment of water.

_____

Pueblo Chieftain 09/08/99

Rocky Ford farmers ready to sell water

Water brought $17 million to more than 100 Rocky Ford Ditch Co. owners who sold the irrigation rights to Aurora. Some have said they plan to sell their water and use the money to keep farming their other fields. Some also said they may continue farming their Rocky Ford Ditch land with water from wells. The city of Aurora hopes to buy at least 275 of the ditch's 333 outstanding shares. One of the oldest irrigation canals in the region, Otero County land records show about half the land irrigated by the ditch is owned or controlled by a half dozen farming families. Aurora already owns 56 percent of the ditch. The sale would yield about 5,000 acre-feet of water to Aurora, which will help the Rocky Ford community switch economies by paying $10,000 or more a year to help replace the taxes farming would have paid. The sale will not affect Colorado's 14-year-old Arkansas River Compact case with Kansas. Certain not to sell are the city of Rocky Ford itself and Colorado State University, which owns the Arkansas Valley Research Center. The city uses its water to replace what is pumped by wells. The research center uses its water for crop research and has for more than 100 years.

_____

The Pueblo Chieftain 08/10/99, 08/13/99, 09/01/99, 09/09/99 *Rocky Mountain News* 09/13/99

♦♦

WATER QUALITY

Gold mine fouling creek near San Luis, EPA says

The Environmental Protection Agency has notified Battle Mountain Gold Co. that discharges of pollutants into Rito Seco Creek at its mine near San Luis are in violation of the Clean Water Act. The notice directs the state to "secure appropriate injunctive relief and collect an appropriate penalty" within 14 days of receipt of the notice. In October 1998, Houston-based Battle Mountain Gold reported that a seep had developed from the west pit of the now-closed mine and was flowing into Rito Seco Creek. During visits to the site in July, EPA inspectors found four seeps that discharged to the creek. Concerns about pollution seeping into Rito Seco Creek are so great that the San Luis People's Ditch has not diverted water from the creek for irrigation this summer. The ditch holds the first decreed water right in Colorado.

_____

Chieftain 08/13/99

Suppliers releasing water quality reports

Next month, water suppliers in Boulder County and all counties in the nation are required to give their customers extensive information on water quality, due to amendments to the Safe Drinking Water Act made three years ago. Municipalities must give their customers an easy-to-read document that explains what's in the water and whether there have been water quality problems during the previous year.

_____

Boulder Daily Camera 09/02/99

U.S. drinking water quality data flawed

Nearly 90 percent of all violations of the Safe Drinking Water Act are not reported in the government database that alerts consumers and triggers legal action when water systems don't meet health standards, a federal audit says. The Environmental Protection Agency audit suggests there are tens of thousands more cases a year than previously documented in which water systems break safety rules. State officials note that all but about 10 percent of the unreported violations involve failure to test properly. Many are missed deadlines or other errors that may not involve safety.

_____

USA Today 09/02/99

Giardia found in Greeley water supply

The parasite giardia lamblia was found in a sample taken at Greeley's water plant on August 30, forcing residents to take precautions like boiling tap water. Greeley Water and Sewer Director Jon Monson said giardia levels have been unusually high in the Poudre River. Since the mid-1990s, the Environmental Protection Agency has required water departments to test for giardia in treated water once a year. But, unlike many other contaminants, the EPA has not established the level at which giardia is considered harmful. No confirmed giardia cases have been reported, health officials said.

_____

Greeley Tribune 09/08/99 *Rocky Mountain News* 09/09/99

Shattuck cap is vulnerable, 2nd study says

An independent study group is the second to warn that a clay cap may not be able to contain a radioactive waste pile in south Denver. Water could get through the cap and wash the material into groundwater and, eventually, the South Platte River, according to a report by the engineering firm SC&A, Inc. The report comes one week after the Environmental Protection Agency's top disaster expert warned that the cap will start disintegrating in 15 years at most, not the 200 years the public was promised. The EPA approved burying the waste at the defunct Shattuck Chemical Co., 1805 S. Bannock St. Similar waste from 10 other sites was shipped to Utah for burial. Residents of the Overland neighborhood have argued for more than a decade that the material should be moved. The SC&A report was commissioned by the EPA as part of a required five-year review of pollution sites. Top EPA officials say the report is among items they will consider in deciding whether the material must be moved. The cap was constructed by the Shattuck Co., which still owns the property. Shattuck attorney John Faught said the cap followed designs approved by the EPA and the Colorado Health Department. But the SC&A report says the cap was designed with a computer model that underestimated the ability of water to get through the clay. The model is no longer used. If a large amount of snow falls on the cap, then melts, it could pass through the cap, carrying radioactive material into the soil below, the report says.

_____

Rocky Mountain News 9/29/99

♦♦

WATER RIGHTS

Interior affirms Utes' water right priority

The U.S. Department of the Interior has ruled that the Southern Ute Indian Tribe has water rights in the Animas and La Plata rivers dating to 1868, settling one of the major criticisms of the Animas-La Plata Project. In a letter to Phil Doe, chairman of the anti-A-LP Citizens' Progressive Alliance, which challenged the 1868 water priority date, an Interior official said the tribe never lost its water rights after the reservation was opened to the public between 1880 and 1938. The water right associated with the year the reservation was created, 1868, precedes all other claims on the two rivers, putting the tribe first in line to use water. The 1868 claim became the basis for the 1988 Colorado Ute Water Rights Settlement Act, of which A-LP is the cornerstone. The alliance had contended that the tribe's water right dates to 1938, when the reservation was restored to the tribe, resulting in a very junior water right and perhaps the doom of A-LP. In August 1998, Interior Secretary Bruce Babbitt proposed "A-LP Ultra-Lite," a mostly Indian water project about a third the size of the proponent-favored "A-LP Lite." Last spring, the Interior Department held a series of public meetings to gather comment on the different A-LP proposals on the table, as called for by the National Environmental Policy Act. During the meetings, the Citizens' Progressive Alliance requested that the Interior Department rule on the Southern Utes' water-right priority issue. Under the Colorado Ute Indian Water Rights Settlement, Ridges Basin Reservoir south of Durango must be completed by Jan. 1, 2000. Otherwise, the Southern Ute Indian Tribe and the Ute Mountain Utes have until Jan. 1, 2005, to decide if they will wait longer or repudiate the agreement and seek a new resolution of their claims in court on the Animas and La Plata rivers. If environmental studies are not delayed, and A-LP legislation survives Congress, construction on the project, first authorized in 1968, is tentatively scheduled to begin sometime in 2001.

_____

Durango Herald 9/29/99

♦♦

WETLANDS

EPA takes over wetlands case

The Environmental Protection Agency has determined Vail Resort's Clean Water Act violation - building a temporary timber-hauling road through a half-acre of wetlands - was "flagrant." U.S. Forest Service personnel discovered the violation last month when Lime Creek Road was not drying out properly. The U.S. Army Corps of Engineers immediately enacted a "cease and desist" order to close the road, which was built in October for workers to haul felled trees from the ski company's controversial 885-acre Category III ski-area expansion site. Federal agencies still are determining what types of mitigation efforts or penalties are appropriate.

_____

Vail Daily 08/24/99

Wetland bank taking shape near Erie

The region's first private wetland bank is taking shape outside of Erie. The site is being cultivated into a diverse, balanced preserve where builders of roads, housing and other types of development can buy credits — in the form of various amounts of land — to make amends for damaging wetlands in another area. The program, regulated by the U.S. Army Corps of Engineers, is a way of complying with an Environmental Protection Agency goal of keeping the nationwide sum of wetlands from dropping as development spreads. Landowner David Yardley and his partner, John Ryan, have the challenge of making a success of a program largely untested west of the Mississippi River.

_____

Boulder Daily Camera 9/28/99

♦♦

WILDERNESS

House OKs Black Canyon bill

A bill that will designate the Black Canyon of the Gunnison National Monument as a national park cleared its last major hurdle September 27 when the U.S. House of Representatives approved the legislation. The action put Colorado one step closer to naming its first national park in 84 years. Rocky Mountain National Park was designated in 1915. The Black Canyon of the Gunnison National Park, named a national monument in 1933, will be the 55th park in the national park system. Under S 323, introduced earlier this year by Sen. Ben Nighthorse Campbell, the Black Canyon of the Gunnison National Park will boast an additional 7,000 acres, including 4,400 acres that will be designated as a wilderness area. Also, another 57,000 acres will be designated as the Gunnison Gorge National Conservation Area. The bill now moves back to the Senate for final approval of minor language changes before being passed on for the President's signature. After several unsuccessful attempts to designate the Black Canyon as a national park since the 1980s, the key to success was cooperation between the National Park Service and U.S. Bureau of Land Management, Rep. Scott McInnis said. He also said he is pleased the bill grandfathers in existing grazing and water rights on the land.

_____

Montrose Daily Press / 9/28/99

Protection from Black Canyon development sought

Congressman Mark Udall has received support from the National Park Service in an effort to protect a tract of land within the boundary of the Black Canyon of the Gunnison National Monument from development. TDX Inc. purchased 120 acres in November 1998 from Louis Allison of Selma, Ala., for $80,000. The company now is offering the property, located near the East Portal Entrance Road of the monument, in three 40-acre lots priced at $190,000 each. " The Park Service director said an independent appraisal for the TDX property has been requested, and results should be available in the next 30 to 60 days. Udall said that if TDX is not willing to sell the property at the appraised price, he will seek to condemn the land as a conservation easement to prevent development. Black Canyon Superinten-

♦♦

MISCELLANEOUS

Mayors urge federal government to make global warming a priority

Boulder Mayor Will Toor and hundreds of mayors from across the United States have released a statement on global warming, urging the federal government to make the environmental issue a priority. Nearly 600 mayors from U.S. cities signed the statement, which read, in part, "Scientific evidence of atmospheric warming continues to grow. In the first three months of 1999 alone, researchers analyzing tree rings and ice cores concluded that the 1990s were the warmest decade of the millennium. (This is) a compelling basis for legitimate public concern over future global and regional-scale changes resulting from increased concentration of greenhouse gases." The mayors asked the federal government to "develop and implement domestic policies and programs that work with local communities to reduce global warming pollution." Toor said that Boulder creates electricity "cleanly" through its water distribution system. As water flows toward Boulder from the Silver Creek Watershed and Nederland's Barker Dam, it passes through a number of generating stations.

_____

Boulder Daily Camera 9/2899

AWRA Colorado Section luncheons again will be held at Denver Water, normally beginning with lunch at 11:45 followed by the presentation. Cost is $10 at the door.		
Nov. 30	**Platte River Study**	**TBD**
Jan. 25	**Radioactive Isotopes in Water Resources**	**Julie Suecker**
Feb. 22	**Endangered Species Issues**	**Deb Freeman**
April 25	**Denver-Thornton Case: Water Quality Issues**	**TBD**
May, 2000	**Student Scholarship Presentations**	
Summer, 2000	**Lining Gravel Pits**	**Mike Applegate**

First Announcement and Call for Papers/Posters
20th Annual American Geophysical Union HYDROLOGY DAYS
April 3-6, 2000

Lory Student Center, Colorado State University, Fort Collins, Colorado USA
Sponsored by: Hydrological Section of the American Geophysical Union

Overview: Hydrology Days was founded by Professor Hubert Morel-Seytoux in 1981 and has been held on the campus of Colorado State University each year since. The purpose of Hydrology Days is to provide a forum for scientists, professionals and students involved in hydrology and hydrology-related fields to get acquainted and to share ideas, problems, analyses and solutions. Students present papers in a friendly, and yet, professional, atmosphere and have the opportunity to meet leading hydrologists and hydrology-related professionals and make presentations in oral or poster form. Papers are welcome on all topics in hydrology.
The four-day program will include contributed papers (mostly); invited papers (a few); student papers (1 and ½ days); and a poster session. Oral presentations will be scheduled for 30 minutes, including discussion. Standard audio-visual equipment (overhead, slide projector and computer projection equipment) will be provided. A written paper is not mandatory for participation in the program.

Student Awards: Awards and prizes will be given for the best student papers as oral and poster presentations in the following categories: Ph.D. Oral Presentation, M.S. Oral Presentation, Ph.D. Poster Presentation, and M.S. Poster Presentation:

Abstract Submittal: Send three hard copies (original plus two copies) of abstract(s) on a single page without a specific format, but font 12 minimum: title, author name, affiliation, full mailing address, telephone, fax, e-mail, and indication of student status (M.S., Ph.D.), if applicable. Include a cover letter indicating presentation preference or oral or poster. Indicate your special audio-visual needs. Early submission is recommended. If time is close to deadline, send first ahead a single copy by fax or e-mail and then send the three hard copies by regular mail. Abstracts are due by January 21, 2000 to: Professor Jorge A. Ramirez, Civil Engineering Department, Colorado State University, Fort Collins, Colorado, 80523. Telephone: ? Fax: (970) 491-7727 E-mail: ramirez@engr.colostate.edu

Paper Submittal: Deadline to submit a final written paper, if desired, for inclusion in the Proceedings is February 18, 2000. Guidelines will be provided on request (contact Prof. Ramirez as early as possible). Proceedings will be available at the conference. For abstract, program information, and registration forms, contact Prof. Ramirez at the above address. You may view the preliminary and final program and registration information on the Hydrology Days home page (http://HydrologyDays.colostate.edu)

First Call for Papers

LIVING DOWNSTREAM IN THE NEXT MILLENNIUM:
RECONCILING WATERSHED CONCERNS WITH BASIN MANAGEMENT

Universities Council on Water Resources
Annual Meeting
July 31-August 4, 2000
New Orleans, Louisiana

ABSTRACT DEADLINE: November 10, 1999

For information see the UCOWR webpage:

http://www.uwin.siu.edu/

MEETINGS

THE SOUTH PLATTE: OLD RIVER – NEW COURSE? CHANGES IN LAND AND WATER USE IN THE SOUTH PLATTE BASIN

The 10th Annual South Platte Forum, October 27-28, 1999
Raintree Plaza Conference Center, Longmont, Colorado

1999 South Platte Forum Schedule, Wednesday, October 27th

8:00-8:45	**Registration and Coffee, Welcome – Robert Ward**

Management for Endangered Species

8:45-10:15	**Session 1 "The Mouse that Roared"** *Consequences of the Preble's Jumping Mouse Listing* **Moderator: Jenny McCurdy** -- Peter Plage – US Fish and Wildlife Service, Steve Dougherty – ERO, Jim Sullivan – Douglas County Commissioner, Bennett Raley – Attorney at Law
10:15-10:45	**Coffee Break and Poster Viewing**
10:45-12:00	**Session 2 "The Bird-Dog Session"** *Status of the Mountain Plover and Blacktail Prairie Dog listings* **Moderator: Jay Skinner** -- Robert Leachman – US Fish and Wildlife, Fritz Knopf – USGS Biological Resources Division, Mountain Plover, Gary Skiba – Division of Wildlife, Prairie Dog
12:15-1:30	**Keynote Luncheon – Bill Brown, water lawyer and South Platte representative to the Colorado Water Conservation Board**
1:30-2:45	**Session 3 "To Your Health"** *Source Water Protection* **Moderator: Marcella Hutchinson – EPA** -- Dick Parachini – CDPHE, Ben Alexander – City of Ft. Collins WTP, Herman Wooten – Colorado Rural Water Association
2:45-3:15	**Coffee Break**
3:15-4:30	**Session 4 "Amendment 14, It's the Law"** *Impacts of CAFO regulation* **Moderator: Reagan Waskom – CSU Cooperative Extension** -- Air Quality: Margie Perkins – State Air Quality Control Commission, Economic Quality: Brad Anderson – Colorado Livestock Association, Water Quality: Cindy Hickert – Water Quality Control Commission
4:30-6:00	**Cocktail Hour and Poster Presentation Session**

1999 South Platte Forum Schedule, Thursday, October 28th

8:30-9:00	**Coffee**
9:00-10:15	**Session 5 "Fishes and Feathers: Three States Agreement"** *Endangered Species Regulation* **Moderator: Curt Brown – South Platte EIS,** Becky Mathisen: Wyoming State Engineers Office, Dayle Williamson: Director of Nebraska Natural Resources Commission, Kent Holsinger: Assistant Director of Water Issues, Colorado Dept. of Natural Resources, Dan Leuke: Environmental Defense Fund
10:15-10:45	**Coffee and Poster Viewing**
10:45-12:00	**Session 6 "From Your Backyard and Your Back 40 to My River"** *Nonpoint Source Pollution Issues and Solutions* Moderator: Gene Schleiger – NCWCD -- Doug Lofstedt – EPA, Jim Geist – Colorado Corn Growers, Jeanette Hillary – League of Women Voters
12:15-1:30	**Keynote Luncheon – Greg Walcher, Executive Director of the Colorado Department of Natural Resources**

For information contact: **South Platte Forum**
c/o Northern Colorado Water Conservancy District
P.O. Box 679, Loveland, CO 80539

SEMINARS

DEPARTMENT OF EARTH RESOURCES, CSU

DATE	SPEAKER	TITLE
Nov. 1	Ellen Wohl, CSU	Virtual Rivers: Historic Channel Change in the Upper South Platte Basin
Nov. 8	Lee MacDonald, CSU	Evaluating and Managing Cumulative Watershed Effects

All seminars are on Mondays and begin at 4:10 p.m. in Room 109 of the Natural Resources Bldg. with snacks at 4:00 p.m. For information call 970/491-5661 or see updates on the departmental web page at http://www.cnr.colostate.edu/ER/.

DEPARTMENT OF AGRICULTURAL AND RESOURCE ECONOMICS, CSU

DATE	SPEAKER	TITLE
Oct. 27	Stephan Weiler, CSU	Informational Market Failure in Economic Development: Colorado Micromalting
Nov. 3	Dana Hoag, CSU	Seven Crises in Agriculture
Nov. 10	Patty Champ, USFS Anna Alberini, CU & UM	Analyzing Uncertain Contingent Valuation Responses: Noxious Weeds in Colorado
Nov. 17	Douglas Rideout, CSU Dennis Dean, CSU	A Spatial Land Allocation Model Based on the Comparative Advantage Principle

These lunchtime seminars are on Wednesdays, 12:10 to 1:00, Room 107 of the Forestry Bldg. For information call 970/491-6955.

INTERNATIONAL CONNECTIONS, CSU

DATE	SPEAKER	TITLE
Nov. 2	George Wallace, CSU	A Decade of Training International Park & Protected Area Managers
Dec. 7	R. Allerheilegen, J. Boyd, S. Charlton, M. Christen, L. Crabtree & K. Long CSU Faculty and Administrators	The Yangtze Expedition: Exploring the World's Largest Dam Building Project

A Brown Bag Lecture Series held on Tuesdays, 12:10 p.m. to 1:00 p.m., Room 165 Lory Student Center. Brought to you by: The Office of International Programs. Call 970/491-6793 for more information.

MARK REISNER KEYNOTE SPEAKER FOR STUDENT WATER SYMPOSIUM

Students and the general public are encouraged to attend the Third Annual Student Water Symposium; come learn more about water-related research from fellow CSU students and a top expert water management in the west, Marc Reisner, author of Cadillac Desert. The Symposium, which is sponsored by the Water Center and several departments of CSU, will be held in the Lory Student Center at Colorado State University from November 3-5, 1999. The Symposium gives graduate and undergraduate students the opportunity to give oral or poster presentations on their water-related research or projects. Outstanding presentations will be acknowledged at the closing reception on November 5. The Symposium will also be honored by a distinguished keynote speaker, Marc Reisner, on Wednesday, November 3 at 7:00 p.m. in the Theatre of the Lory Student Center, CSU. Mr. Reisner is best known as the author of Cadillac Desert, an account of the American West's romance with dams and aqueducts and the artificial paradise they have created and caused. Cadillac Desert was made into a four-hour documentary film series, which aired on PBS nationwide in 1997. Mr. Reisner lectures throughout North America on issues he has addressed in his books and confronts in other work. He is currently a consultant to the Institute for Fisheries Resources, the American Farmland Trust, and the Nature Conservancy, and is involved in entrepreneurial efforts to promote environmentally benign groundwater banking programs and water transfers in California and elsewhere.

Registration for the keynote will be made at the door. Student presentations will be made throughout the symposium in rooms 213-215 in the CSU Lory Student Center. For more information and a schedule of events, refer to our web page http://lamar.colostate.edu/~watersym, or contact Lindsay Martin (491-1141). Schedules will also be available at the Symposium.

CALENDAR

Oct. 29	A SYMPOSIUM: STEWARDSHIP OF THE CHERRY CREEK WATERSHED AND ITS RESERVOIR: NATURAL WONDERS & URBAN REALITIES, Terrace Garden @ Dove Valley, Englewood, CO. Sponsored by Cherry Creek Basin Stakeholders.
Nov. 4-6	INTERNATIONAL RIVERBANK FILTRATION CONFERENCE, Louisville, KY. Contact: National Water Research Inst., Phone 714/378-3278, FAX 714/378-3375.
Nov. 7-10	4TH USA/CIS JOINT CONFERENCE ON ENVIRONMENTAL HYDROLOGY AND HYDROGEOLOGY, Sponsored by American Institute of Hydrology, San Francisco, CA. Contact: AIH, Phone 651/484-8169, FAX 651/484-8357, e-mail: AIHydro@aol.com, Website **http://www.aihydro.org/**.
Nov. 7-11	HYDROLOGIC ISSUES FOR THE 21ST CENTURY: ECOLOGY, ENVIRONMENT AND HUMAN HEALTH, 1999 Annual Meeting, American Inst. Of Hydrology and the 4th USA/CIS Joint Conference, San Francisco, CA. Contact: AIH, Phone 651/484-8169, FAX 651/484-8357, e-mail AIHydro@aol.com, Web Site: **http://www.aihydro.org**.
Nov. 8-9	RESTORING NATIVE ECOSYSTEMS, 3rd Annual Conference, National Arbor Day Foundation, Nebraska City, NE. Contact: June Parsons, National Arbor Day Fdn., Phone 402/474-5655, FAX 402/474-0820, e-mail: jparsons @arborday.org.
Nov. 8-10	NASULGC '99, San Francisco, CA. Contact NASULGC AT Phone 202/478-6040, FAX 202/478-6046, Website at **http://www.nasulgc.org**.
Nov. 15-17	UNDERSTANDING & ADDRESSING RISKS TO GROUNDWATER, 5th Annual Groundwater Foundation Symposium, Atlanta, GA. Contact: Cindy Kreifels or Zoe McManaman at 1/800/858-4844, or e-mail at info@groundwater.org.
Nov. 16-17	WETLANDS & REMEDIATION, Salt Lake City, UT. Sponsored by Battelle. Contact: The Conference Group, Phone 800/783-6338 or 614/424-5461, FAX 614/488-5747, e-mail: conferencegroup@compuserve.com.
Dec. 1-4	WATER: 21ST CENTURY GOLD, No. American Lake Mgmt. Soc., Reno, NV. Contact: Terry E. Thiessen at phone 608/233-2836 or e-mail thiessen@nalms.org, Website **http://www.nalms.org**.
Dec. 2-3	THE RIO GRANDE COMPACT: IT'S THE LAW!, Santa Fe, NM. Sponsored by NM Water Resources Research Institute. See the Institute webpage for details and registration forms: **http://wrri.nmsu.edu**.
Feb. 6-7	ADDRESSING WATER CONSERVATION ISSUES THROUGH EFFECTIVE PARTNERSHIPS, AWWA Water Conservation Workshop, Salt Lake City, UT. See AWWA webpage at **http://www.awwa.org**.
Apr. 30-May 4	WATER RESOURCES IN EXTREME ENVIRONMENTS, Anchorage, Alaska. See AWWA webpage at **http://www.awwa.org**.
June 21-24	WATERSHED MANAGEMENT 2000 CONFERENCE, Science and Engineering Technology for the New Millenium, Fort Collins, CO. Contact Marshall Flug at Phone 970/226-9391, FAX 970/226-9230, e-mail marshall_flug@usgs.gov, ASCE website: **http://www.asce.org**.
July 10-14	USCOLD 20TH ANNUAL MEETING AND LECTURE, DAM O&M ISSUES - THE CHALLENGE OF THE 21ST CENTURY, Seattle, WA. Contact: Larry Stephens, Phone 303/628-5430, FAX 303/628-5431, e-mail stephens@uscold.org, webpage **http://www.uscold.org/~uscold**.

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

PRESORTED
STANDARD
US POSTAGE PAID
FORT COLLINS CO 80523
PERMIT NUMBER 19