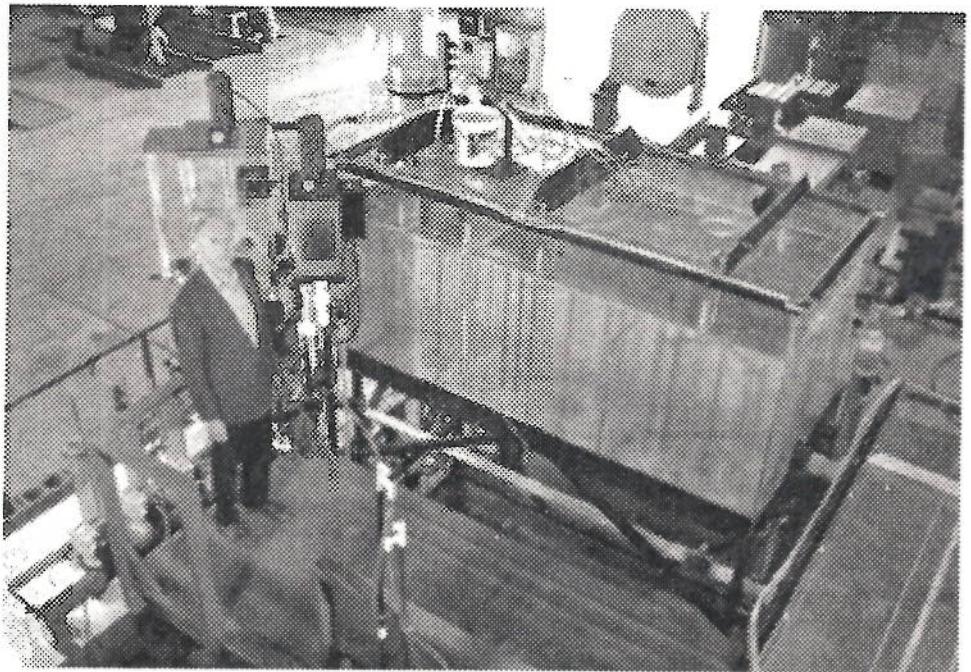


Colorado Water

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

AUGUST 1998

CSU's computer-controlled Water Treatment Research Pilot Plant, originally designed to treat contaminated water sources at Department of Defense sites, serves as a research and teaching facility in the Environmental Engineering Program. Dr. David W. Hendricks, the plant's originator, specializes in wastewater treatment processes. SEE PAGE 16.



ALSO IN THIS ISSUE: *The Effectiveness of Residential Water Conservation Price and Nonprice Programs -- SEE PAGE 7*

**Colorado
State
University**

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COLORADO WATER

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Editor: Shirley Miller
Writer: J.B. Bryant

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Robert C. Ward, Director

EDITORIAL



EVALUATING URBAN WATER CONSERVATION MEASURES

Editorial by Robert C. Ward

As urban water conservation increasingly becomes institutionalized and concrete results are expected, various means of achieving urban water conservation are being carefully evaluated. This issue of *COLORADO WATER* contains the results of a research project that evaluated the effectiveness of residential water conservation price and non-price programs. The study, conducted with excellent cooperation from Denver and Broomfield water departments, and under the direction of Ari Michelsen of Washington State University at Vancouver (a CSU graduate), reveals the difficulty in trying to use water data for a purpose for which it was not intended. In other words, one of the study's major findings is that to thoroughly evaluate water conservation programs, data collection systems must be designed specifically for that purpose.

With the above as a qualifier, the study was able to glean from the existing data that consumers are very unresponsive to price increases under current rate structures — in other words, large price increases result in small reductions in demand. Non-price conservation programs appear to be most effective when a substantial number of programs are conducted over longer periods of time. Small changes in water rates or implementation of haphazard conservation programs most likely will not produce discernable results.

While Ari's study takes a macro view in evaluating urban water conservation programs, work currently underway at the University of Colorado at Boulder, under the direction of Jim Heaney, takes a micro view. Jim and his colleagues have intensively reviewed water use at 1200 homes over a four-week period. Their site-specific findings complement the broader view presented by Ari and his colleagues. Jim is preparing a summary of his work for the October 1998 issue of *COLORADO WATER*.

Using knowledge from research projects such as those noted above, urban water conservation is increasingly being refined and incorporated into the day-to-day operations of most Colorado water departments. As these conservation programs become more effective, there are a number of consequences that will also need to be studied and understood. For example, the Colorado landscape industry is concerned about the impact urban water conservation programs may have upon their businesses, customers and Colorado's landscapes. There is now a need for this industry to carefully assess the potential impact and position itself to remain economically viable with less water. GreenCO, a coalition of landscape industry professional associations, has formed a Water Task Force to inform the industry about potential impacts of urban water conservation programs and evaluate options for sustaining the industry as these programs impact urban water use patterns, particularly outdoor use of water.

Water research is an ongoing component of water management, as the above situation describes. As society's water needs and uses continue to change, research can help managers understand the consequences of the changes and evaluate options to adjust. This has been the mission of the Colorado Water Resources Research Institute (CWRRI) for the past 33 years and will be so in the future. CWRRI, since its funding was reduced three years ago, has focused increasingly on developing partnerships with those needing new knowledge/understanding about water-related topics. The number of these cooperative projects is increasing as faculty work hand-in-hand with practitioners and successful projects are completed. For information about developing a joint project with CWRRI, please contact me or any of Colorado's higher education faculty listed on CWRRI's home page (<http://www.ColoState.edu/Depts/CWRRI>).

RESEARCH OPPORTUNITIES



AWWARF ANNOUNCES REQUEST FOR PROPOSALS

The American Water Works Association Research Foundation (AWWARF) is a non-profit organization dedicated to advancing the science of water. AWWARF sponsors practical, applied research for the drinking water community and, since 1986, has managed research projects worth over \$100 million. AWWARF has announced that Requests for proposals for new research will be available on the AWWARF web site, <http://www.awwarf.com>, after August 17. Proposals submitted in response to RFPs must be postmarked by November 2. Unless otherwise indicated, project proposals must include 25 percent of the total project budget as in-kind or cash contribution. In-kind contributions can be in the form of labor, laboratory services, or other support, and may come from utilities, consulting firms and universities. Contract awards for all projects will be determined by an AWWARF project advisory committee appointed for each project. Proposal evaluations will be based on responsiveness to the RFP, scientific and technical merit, and qualifications of the researchers.

The new projects and their maximum funding levels are listed below. For additional information, contact AWWARF at 303/347-6100, or the AWWARF web site at <http://www.awwarf.com>.

Impacts of Fire Flows on Distribution System Water Quality, Design, and Operation (RFP 2554, AWWARF/Kiwa Collaborative Project). Determine the economic and water quality impacts of designing water distribution systems to meet fire flows. Determine if fire flow requirements are appropriate for modern situations and identify possible alternatives (\$300,000).

Innovative Biological Treatment Processes in Conjunction with Membrane Filtration for Advanced Water Treatment (RFP 2560, Tailored Collaboration Project). Explore the potential of integrating several innovative biological and filtration processes for advanced treatment of surface water. Target processes include slow sand filtration followed by membrane filtration, slow sand/catalytic conditioner/nanofiltration, and rapid sand filtration operated in a biological mode followed by membrane filtration (\$400,000)

Comparing Basins, Galleries, and Shallow Wells for the Recharge of a Deep Aquifer (RFP 2529, Tailored Collaboration Project). Compare and determine the feasibility of three different methods of aquifer recharge for an aquifer system where depth of the water table is over 350 feet and suitable storage volume is available (\$250,000).

RESEARCH



FY1998 WESTERN REGION AWARDS ANNOUNCED

Colorado State is the lead university for one of four regional grants awarded in the FY1998 Western Region Grants Competition of the State Water Institutes Program. The research project, Meeting Time-Dependent Instream Flow Requirements in a Fully Appropriated Multi-State River Basin, will be funded through the federally authorized program. The Western Region solicited proposals from Institutes or Centers located in Alaska, Arizona, California, Colorado, Idaho, New Mexico, Nevada, Oklahoma, Oregon, Texas, Utah, Washington, and Wyoming. A requirement of the competition was research collaboration among two or more states in the Western Region. Water institutes in Arizona, Nevada, and Washington State also received FY1998 awards.

Twenty-six proposals were entered in the regional competition. The Western Region Selection Panel, which met in early June to determine which projects to fund, was comprised of institute directors from New Mexico (Thomas Bahr), Nevada (John Hess), Idaho (Roy Mink), Colorado (Robert Ward), and from Utah (Manu Lall, Associate Director of the Center for Water Resources Research at Utah State University). Ex-officio members were Steven P. Gloss, Director of the Wyoming Water Center, and John Scheffer, Office

of External Research, Water Resources Division, U.S. Geological Survey. The projects selected for funding are described below.

COLORADO

◆ Meeting Time-Dependent Instream Flow Requirements in a Fully Appropriated Multi-State River Basin

The Platte has become a highly regulated system designed to maximize use of its water resources for economic and direct human uses. Its physical infrastructure captures, pumps and delivers water for offstream uses, especially irrigated agriculture. Water laws of the involved states have evolved to protect past investments in water development and define management rules for water usage. Now, this highly structured, extensively developed system faces a major challenge: integration of the aquatic ecological needs of native plant and animal species — especially those listed as threatened or endangered under the Endangered Species Act. The states of Wyoming, Nebraska and Colorado and the federal government (U.S. Department of the Interior) have entered into a three-year cooperative agreement to further evaluate and identify options for a habitat recovery program for endangered species in the Platte River Basin. This research will develop a conceptual analytical framework to evaluate the feasibility, effectiveness, and economic and hydrologic impacts of alternative approaches for supplying additional instream flows to the central Platte River in Nebraska. Award: \$291,932.

Co-principal Colorado investigators are Dr. Marshall Frasier and Dr. Robert A. Young,, Department of Agricultural and Resource Economics at Colorado State; Dr. Tim Gates, Department of Civil Engineering is co-investigator. Co-investigators from other states are: Dr. Ari Michelsen, Washington State University-Vancouver; Dr. James Booker, Alfred University, NY; Dr. Garth Taylor, University of Nebraska; and Dr. Steve Gloss and Dr. Mark Squillace, University of Wyoming, and Larry MacDonnell, Consultant, Boulder, Colorado. The project director is Dr. Robert C. Ward, Director, CWRRI.

NEVADA

◆ A Multi-Level Approach to Modeling Ground and Surface Water Exchange in Agriculturally-Dominated Settings

Conversion of agricultural water rights to other “higher-valued” uses in the western U.S. is often initiated under the assumption that improved water quality will be one of the benefits realized from this change. In western Nevada, for example, one by-product of the Truckee River Water Quality Settlement is a plan by Washoe County, the Cities of Reno and Sparks, and the U.S. Department of the Interior to purchase up to 24,000 acre-feet (af) of Fernley Bench agricultural water rights. The proposed purchase would serve a dual purpose: augmenting Truckee River flows to meet water quality objectives; and potentially reducing non-point source (NPS) groundwater return flows (and associated solutes) from irrigated agriculture in the lower river basin. A probable outgrowth of this initiative will be a pollution swapping request by the cities that includes relaxation of the TDS standards in their NPDES discharge permit at the regional wastewater treatment facility. The outcome of this request will rely, to a large degree, on the ability of the cities and county to demonstrate that NPS pollution in the lower river will be reduced as a result of the change in land use. This multi-leveled project will:

- provide a template for modeling complex ground- and surface water systems in areas especially dominated by irrigated agriculture,
- conduct a drilling and sampling program to determine the chemistry of sediments and associated groundwater in the lower Truckee River Basin; and
- integrate the results of this effort with ongoing surface-water studies by investigators in the lower Truckee.

Award: \$229,696

The principal investigator is Dr. W. Alan McKay, Desert Research Institute, University and Community College System of Nevada. Drs. Elizabeth A. Jacobson and Eric V. McDonald, also of the Desert Research Institute, are co-investigators.

Co-investigators from other states are: Dr. Michael E. Campana, Department of Earth and Planetary Sciences, University of New Mexico; and Dr. John J. Warwick, Director, Graduate Program of Hydrologic Sciences and Dr. Gary Vinyard, Department of Biology, University of Nevada, Reno. The project director is Dr. John Hess, Director, Nevada Water Resources Center.

STATE OF WASHINGTON

◆Evaluating Water Policy Affecting Fish Habitat, Hydrology and Irrigated Agriculture in the Snake River Basin

Changes in water management policies for the Snake River are required as a consequence of the 1991 classification of Salmon River Sockeye as endangered and the 1992 classification of Spring and Summer Chinook Salmon stocks as threatened under the Endangered Species Act. As in many western basins, the Snake River is heavily appropriated for irrigation and hydroelectric power production, resulting in problems relating to water quantity and quality in Idaho, Oregon and Washington. In addition, surface water and groundwater are highly interdependent in the region. Deep percolation of irrigation water in the upper Snake River basin recharges the Snake Plain aquifer, and outflows from the aquifer augment river flows in the lower basin. This research is designed to evaluate alternative water policy choices for salmon recovery in the Snake River basin for effects on quantity and quality of streamflow, groundwater recharge and discharge, irrigated agricultural production, hydroelectric production, and the region's economy. Award: \$128,159.


The principal investigator is Dr. Gareth P. Green, Department of Agricultural Economics, Washington State University. Dr. David W. Holland of the same department, and Dr. Claudio O. Stockle, Department of Biological System Engineering, are co-investigators. Co-investigators from other states are: Dr. Joel R. Hamilton, Department of Agricultural Economics, University of Idaho, Moscow and Dr. Gary Johnson, Department of Geology and Geologic Engineering, University of Idaho, Idaho Falls; and Dr. Marshal English, Bioresource Engineering Department, Oregon State University, Corvallis. The project director is Dr. William Funk, Director, State of Washington Water Research Center.

ARIZONA

◆Decision Support for River System Management Under Hydroclimatic Variability

Reservoir operators frequently base decisions on streamflows that are less than the average flow to provide a safety factor during operations. Thus, reservoir operating decisions may be far from optimal and result in spillages. This research will focus on developing a decision support system (DSS) that will help decision makers improve reservoir and river basin management by taking into account varying climate conditions. New methodologies will be developed to make streamflow, precipitation, and snow water equivalent (SWE) forecasts on a monthly time step for at least a year into the future. The hydroclimatic effect of the El Nino-Southern Oscillation (ENSO) in different regions in the western U.S. and its effect on forecasts will also be identified. The DSS will allow reservoir-system operators to easily analyze the impact of decisions under a spectrum of forecasted streamflow scenarios. In addition, optimization tools will be included in the DSS to determine optimal release policies for a deterministic or stochastic forecast. Thus, reservoir-system operators can examine the potential gain from varying their releases and target storage policies, as well as the risk of achieving that gain. Benefits that accrue from reduced forecasting uncertainty will be examined. The impact of improved forecasts will be tested with reservoir systems in Arizona, California and Idaho. Award: 147,495.

The principal investigator is Dr. Juan B. Valdes, Department of Civil Engineering and Engineering Mechanics, University of Arizona, and Dr. Kevin Lansey, same department. Co-investigators from other states are Dr. Roy Koch, Department of Civil Engineering, Portland State University; and Dr. Hugo Loaiciga, Department of Geography, University of California. The project director is Dr. Peter J. Wierenga, Acting Director, Arizona Water Resources Research Center.

 **EFFECTIVENESS OF RESIDENTIAL WATER CONSERVATION PRICE AND NONPRICE PROGRAMS**

by Ari M. Michelsen, J. Thomas McGuckin and Donna M. Stumpf



How do residential consumers respond to water conservation efforts by municipal water suppliers?

Do consumers in different cities Respond similarly?

Accomplishing more with less, which is essentially what water conservation is all about, requires a foundation of knowledge about the effectiveness of conservation measures...initiatives will be more effective if they are also socially acceptable; that is, a significant proportion of water users must be willing to adopt them.

Christopher L. Lant,
Southern Illinois University-Carbondale

A wide variety and number of conservation measures are used in utility demand-side management programs, and in general are classified as either price or nonprice programs. Conservation price programs involve direct economic incentives for consumers to conserve through increases in price levels (cost) and/or rate structures where consumer costs increase with the amount of water consumed. Conservation nonprice programs are also being used nationwide as a substitute, or in addition to, price conservation programs. Examples of nonprice conservation programs include: public media messages and printed materials to increase public awareness and encourage conservation; school education programs; rebate and retrofit device programs to

encourage installation of water-efficient devices in existing homes; temporary ordinances that require consumers to reduce specific or overall water use during drought shortage situations; and permanent ordinances such as water-efficient plumbing codes designed to reduce long-term water demand.

The move to conservation price programs is evident in the number of utilities that have switched to conservation-oriented rate structures. Over the past decade an increasing number of utilities have changed from declining block-rate pricing to

more conservation-oriented uniform and inclining rate structures where the price per unit remains the same or increases as water consumption increases (see Fig. 1). By 1994 the number of water providers using declining rates structures was less than 40 percent, down from 60 percent in 1986, and the number of providers using inclining rate structures had increased from eight percent in 1986 to more than 22 percent in 1994. Utilities nationwide are also using nonprice conservation programs as a substitute, or in addition to, price conservation programs in efforts to reduce residential demand.

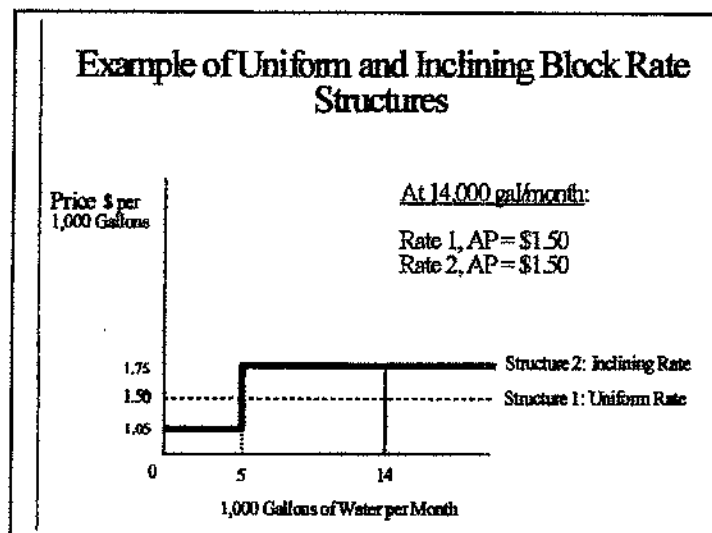


Fig. 1. Uniform/Inclining Block Rate Example

How have consumers responded to price and nonprice conservation measures? Accurate information about consumer response to conservation programs is critical for

selecting and implementing appropriate demand-side management strategies that will effectively encourage conservation in the long term and that can be used to manage cyclical drought-induced supply shortages. Residential consumer response to conservation programs is also important in forecasting long-term demand, managing water supplies, determining acquisition requirements, formulating financial management decisions, and for integrated resource management and planning.

- ◆ How responsive are consumers to changes in the price of water?
- ◆ Are consumers responding to the average price, marginal price, or some combination of the two?
- ◆ How does demand change or respond to the implementation of nonprice conservation programs?
- ◆ Is it appropriate to model and apply study area results to other cities in the region?

Investigators developed information and evaluated and compared the effects of price and nonprice conservation programs on residential consumption in different urban areas of the western U.S. with the following four objectives:

- ◆ To collect, enter into a database and document water demand information for selected regions in Southern California, Colorado and New Mexico.
- ◆ To analyze the data using statistical methods to identify trends in water use, impacts of water conservation efforts, socioeconomic, and climatic-related parameter changes.
- ◆ To develop and evaluate alternative models of water demand including a core model of water demand and conservation that can be broadly applied in different urban and regional areas.
- ◆ To explore the interaction of weather, price and conservation programs.

Development of Water Demand Models

Previous water demand estimation study methods, advances and limitations were reviewed and, building upon and extending this research, three water demand models were developed to investigate consumer response to price and nonprice conservation programs and other factors that influence demand.

- ◆ The first model (Regional) assumes that consumers in different cities respond similarly across the region and throughout the year to rate structures, price levels, nonprice conservation programs, climate, income and other factors.
- ◆ The second model (Season Specific) is designed to investigate seasonal variations in consumer response across the region to changes in rate structure, price levels, nonprice conservation programs, climate, income and other factors.
- ◆ The third model (City specific) is designed to investigate individual city and seasonal variations in consumer response to rate structure, price levels, nonprice conservation programs, climate, income and other factors.

Study Areas, Data Collection and Development of a Water Demand Database

Seven study areas were selected and with the cooperation of water utilities in three southwestern states information on residential water consumption, rate structures, revenue and nonprice conservation programs covering the period from 1984 through mid-1995 was collected. The study area cities were: Los Angeles and San Diego, California; Broomfield

and Denver, Colorado; and Albuquerque, Las Cruces and Santa Fe, New Mexico. Similarities and differences in residential water use, prices and rate structures, climatic conditions and socioeconomic characteristics across the study areas provided an excellent cross-section of cities in the southwestern United States. These cities also exhibit a wide

range of nonprice conservation programs, from cities that have numerous concurrent conservation programs to cities that have yet to implement nonprice conservation programs. A database of the residential water demand information was created and consistent series of monthly observations for all of the water demand variables for each study area was developed and refined. Computational adjustments were required to

develop consistent data series from billing and other reporting period observations and to verify and correct anomalies in reported data. The data gathered for this research and data development and adjustment procedures are described in detail in a separate report entitled Residential Water Demand, Price Structure and Nonprice Conservation Program Information (1997).

Water Demand Model Estimation and Analysis

Each of the three water demand models was tested, refined and analyzed using maximum likelihood regressions of the pooled ten-year time series, cross-sectional database. Particular attention was given to analyzing the price elasticity of water demand (responsiveness) and consumer recognition of conservation pricing programs. The issue of consumer recognition and perception of price programs involves the questions: Are consumers responding to the average price of

water consumed? Or, as is assumed by economic theory and proponents of conservation and increasing block-rate-price structures, do consumers perceive and respond to increasing block-rate structures (marginal prices) by lowering their use? In addition to consumer response to price programs, nonprice conservation programs are evaluated for overall significance and effect on water demand.

Evaluation of Regional Applicability and Water Demand Models Predictions

The Regional, Season Specific and City/Season models were also evaluated to determine:

- ◆ whether a single regional model can and should be used to estimate consumer response to price and nonprice programs and predict water use throughout a region; and
- ◆ whether multiple individual city demand models can and should be developed.

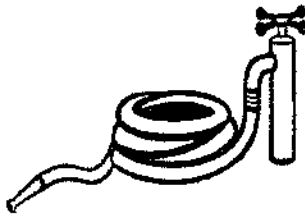
The overall predictability of the three models was compared via a likelihood test to determine if one model was superior to the others, and an alternative water demand model functional form was examined as a test of the analysis.

RESULTS

All three models (Regional, Season Specific and City/Season) predicted water demand with a high degree of accuracy and almost all of the coefficient estimates were statistically significant and had the expected demand relationship. The models were also designed to ascertain whether the modeling results could be extended beyond the seven cities in the database for a more general statement about residential water use in the Western U.S. This was not the case. Though all three models predict residential demand with a high degree of accuracy, the City/Season-specific model was statistically a "better fit." However, this model lacks the generality and data variation to make

statements about the effectiveness of price and nonprice programs beyond the scope of an individual city -- that is, Los Angeles' nonprice water conservation programs have been effective in that city, but one cannot say that such programs will be effective elsewhere. Although the Regional and Season Specific models were statistically not as close a fit, the parameter relationships (coefficient values) estimated by each of the three models were very similar. The Season Specific model provides a compromise in statistical accuracy and generality of results, incorporating the broader range of parameter values considered (all cities) on a detailed seasonal basis.

Conservation Program Effectiveness and Water Demand Relationships



What are the general findings of the statistical modeling?

Water price has a significant and negative impact on water use, but water demand is very price-inelastic, more so than has been suggested in other studies. The highest elasticity estimate was for summer use

(approximately -0.20). At this degree of consumer responsiveness, water utilities could double their water rates and expect, at a maximum, only a 20-percent decrease in water use during the peak season. More likely, utilities should expect a water elasticity of -0.10 on an annual basis; a hefty 50-percent increase in rates will reduce use by 5 percent.

Statistical tests to determine whether consumers perceive and respond to marginal prices or average prices were inconclusive. Consumers appear to be responding to some combination of marginal and average prices.

This makes it more difficult to design effective rate structures because it is not clear which price or prices consumers are responding to. This mixed consumer response is, in part, a result of the service charges so prevalent in current rate structures. The use of fixed service charges with uniform or block rate structures results in declining average prices as consumption increases, even when marginal prices are rising. These results indicate that utilities interested in using price to encourage conservation should

reexamine the incentives provided by their rate structures and, specifically, focus on reducing or even eliminating the fixed charge component.

Nonprice conservation programs appear to be effective if the water utility achieves a critical mass of programs. For Los Angeles, San Diego and Denver, the number of nonprice programs has had the desired effect. For cities with fewer programs or relatively new experience with conservation programs, the nonprice programs had no effect on demand. Conservation programs work independently of a drought environment, such as California had in the late 1980s and early 1990s, and continue to work after the drought conditions have ceased. Conservation programs may be ultimately necessary

simply to counteract an exogenous long-term increase in residential uses.

Climate affects residential use in predictable ways. Water use is strongly correlated with average monthly temperature and seasonal variation in temperature. Precipitation was consistently insignificant in all models. All cities in this analysis are semi-arid to arid in climate, and thus the ratio of evapotranspiration to precipitation is much greater. Landscape watering is necessary if one wants to maintain traditional residential lawns and trees. Random and infrequent rains don't change residential watering patterns to a significant degree.

Other variables, such as residential income and the size of the city, also vary but their influence is estimated to have a relatively minor impact on residential use.

In summary, price and nonprice conservation programs are effective, but require a major commitment to implement. Consumers are very unresponsive to price increases under current rate structures, requiring large increases in price to achieve small reductions in demand. Nonprice conservation programs appear to be most effective when there are a substantial number of programs conducted over longer periods of time. Because the information regarding nonprice programs is incomplete, the effectiveness of individual types or specific programs nor the residual or lasting

effects of nonprice programs could not be distinguished. Small changes in water rates or implementation of haphazard conservation programs will most likely not produce discernable results.

A significant finding of this study is the overall lack of information available regarding the implementation of nonprice conservation programs and the lack of detail and consistency of water use information necessary to evaluate changes in demand. With improved information, combinations of programs, proven to be successful in reducing water use levels in one city, could be applied to cities with similar characteristics in different regions of the United States.

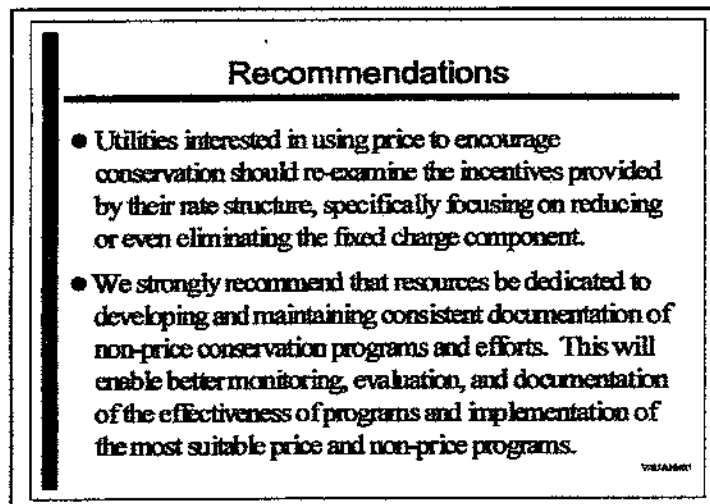


Fig. 2. RECOMMENDATIONS

The report on which this summary is based was prepared by Ari M. Michelsen, Washington State University, Vancouver; and J. Thomas McGuckin and Donna M. Stumpf, New Mexico State University. It was published by the AWWA Research Foundation and the American Water Works Association.

The research was sponsored by the AWWA Research Foundation and Member Institutes of the Powell Consortium: Wyoming Water Resources Center, University of Wyoming; Colorado Water Resources Research Institute, Colorado State University; New Mexico Water Resources Research Institute, New Mexico State University; and the School of Ecology, University of California, Irvine.

- Cooperating agencies were Denver Water, Broomfield Water Department, Los Angeles Water and Power Department, San Diego Water Utilities Department, Albuquerque Water Utilities Division, Sangre de Cristo Water Company of Santa Fe and Las Cruces Water Resources Department.



Members of the AWWARF Project Advisory Committee were Clive Jones, Economic Data Resources; David LaFrance, Denver Water; William Macklaus, Macklaus Water Management; and Dan Bishop, Montgomery Watson. AWWARF Project Managers were Kim Hout-Garrity, Kathryn Martin and Albert Ilges.

For additional information about the project, contact: Kim Garrity at khgarrity@aol.com or 303/221-1578. For information on how to obtain copies of the publication, contact Phalita Hampton, AWWA Research Foundation, phampton@awwarf.com, or 303/347-6121.

WATER RESEARCH AWARDS

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

COLORADO STATE UNIVERSITY FORT COLLINS, CO 80523

Title	PI	Department	Sponsor*
Influence of the Tropical Western Pacific on Climate Dynamics	Schubert, Wayne H	Cira	NOAA
International Satellite Cloud Climatology Project Sector Processing Center for GOES...	Vonderhaar, Thomas H	Cira	NOAA
REU: Undergraduate Research Opportunities in Water Resources	Ramirez, Jorge A	Civil Engineering	NSF
Further Analysis of the Shipboard Radar Data from COARE...	Rutledge, Steven A	Cira	NOAA
Convective & Boundary-Layer Processes in the Vicinity of the So. China Sea...	Johnson, Richard H	Cira	NOAA
Earth Fest 98	Haas, Glenn E	Nat Res Rec & Tourism	City of Ft. Collins
SW Colorado River Basin Water Quality - Grand Valley Hydro-salinity	Gray, Mary Mcphail	Cooperative Extension	NRCS
Design, Field Protocols & Advice on Data Analysis for Environmental Contaminant Studies	Anderson, David R	Coop Fish & WL Res	USFWS
Wetland Management Field Support at Fort Drum, New York	Shaw, Robert B	Forest Sciences	DOD/Arm
Uncompahgre Basin Assessment	Lyon, Margarette J	Fish & Wildlife Biology	Valley Land Cons.
Analysis of Soil Erosion Models for Natural & Cultural Resources	Doe, William W	Forest Sciences	USFS
Completion of Lower Sheenjek River Wild & Scenic River Study /Legislative EIS	Vaske, Jerry J	Nat Res Rec & Tourism	NPS
Using Multi-Sensor Data to Model Factors Limiting Carbon Balance.	Ojima, Dennis	Nat Res Ecology Lab	NASA
Completion of the Endangered Species Section of the Integrated Natural Resource Management Plan	Brozka, Robert J	Forest Sciences	USFS
Assess Ecological, Hydrological, & Geochemical Effects of the Dome Fire on the Capulin Watershed	Clements, William H		
Ka Band Propagation Studies Using ACTS Terminal & CSU			

Title	PI	Department	Sponsor*
Mixed Layer Processes & Parameterization in High Resolution Ocean Models	Randall,David A	Atmospheric Science	DOE
SW Colorado River Basin Water Quality - Lower Gunnison Well A Syst in Colorado	Gray,Mary Mcphail Gray,Mary Mcphail	Cooperative Extension Cooperative Extension	NRCS NRCS
Integrative Riparian Ecosystem Modeling Along the Yampa River, Colorado	Wohl,Elten E	Earth Resources	Nature Cons.
Ecological Classification of Riparian Ecosystem & Seral Communities	Child,Dennis R	Rangeland Ecosys Sci	USFS
Evaluation of the National Hydrogeomorphic Slope - Wetland Guidebook...	Steingraeber,David A	Biology	CDNR
The Effect of Dams on Riparian Vegetation Dispersal	Wohl,Ellen E	Earth Resources	NSF
Development of a Next-Generation Atmospheric General Circulation Model	Randall,David A	Atmospheric Science	DOE
A New Approach to Remote Sensing of Cirrus Clouds Parameters	Stephens,Graeme L	Atmospheric Science	NASA
Erosion & Sedimentation on St. John, U.S. Virgin Islands	Macdonald,Lee H	Earth Resources	Univ. of V.I.
Glenn-Colusa Irrigation District (GCID) Model Study	Abt,Steven R	Civil Engineering	Ayres Assoc.
Broadening the Constituencies of Natural Resource Agencies	Zimmerman,Donald E	Journalism	USFWS
Riparian Classification Arkansas River/Lower San Juan & North Platte River Basins	Sanderson,John S	Fish & Wildlife Biology	CDNR
Uncompahgre Basin Wetland Assessment & Inventory	Sanderson,John S	Fish & Wildlife Biology	CDNR
Review of L-Bar Sediment Analyses	Julien,Pierre Y	Civil Engineering	NRC
GIS & Remote Sensing Systems Applications to Watersheds & Sedimentation	Fontane,Darrell G	Civil Engineering	Winrock Int'l.
Climate Change in the Colorado Rocky Mountains: Bounding Projected Changes in Region...	Pielke,Roger A	Atmospheric Science	NPS
A Study of Boater Recreation at Lake Berryessa, California, Phase I	Wallace,George N	Nat Res Rec & Tourism	USBR
Demonstrate the Use of Irrigation Scheduling Tools	Berrada,Abdelfettah	Soil & Crop Sciences	USBR
Development of Recommended Water Quality Criteria for Irrigation...	Gates,Timothy K	Civil Engineering	NCWCD
Classification of Colorado's Wetlands	Cooper,David Jonathan	Earth Resources	CDNR
Partitioning of Ecosystem Respiration & Vectors of Water Loss...	Kelly,Eugene F	Soil & Crop Sciences	NASA
Water Quantity/Routing Model Development Klameth River Basin, Oregon & California	Flug,Marshall	Civil Engineering	NBS
Identification and Characterization of Division of Wildlife Wetlands	Sanderson,John S	Fish & Wildlife Biology	CDWL
Review of Uranium Recovery Facility Reclamation Plans	Abt,Steven R	Civil Engineering	SW Res. Inst.
Water Management Education Program for Navajo Nation Water Users	Podmore,Terence H	Chem/Biores.Engr.	USBR
Recreation Needs Assessment: Green River Wyoming	Aukerman,Robert	Nat Res Rec & Tourism	USBR
Hydrologic Effects of the Grand Ditch on Rocky Mountain National Park	Macdonald,Lee H	Earth Resources	NPS
Geomorphic Assessment in Vicinity of Old River Complex	Watson,Chester C	Civil Engineering	COE
Water Quality Characterization of Jackson Lake Reservoir	Stednick,John D	Earth Resources	Coio State Parks

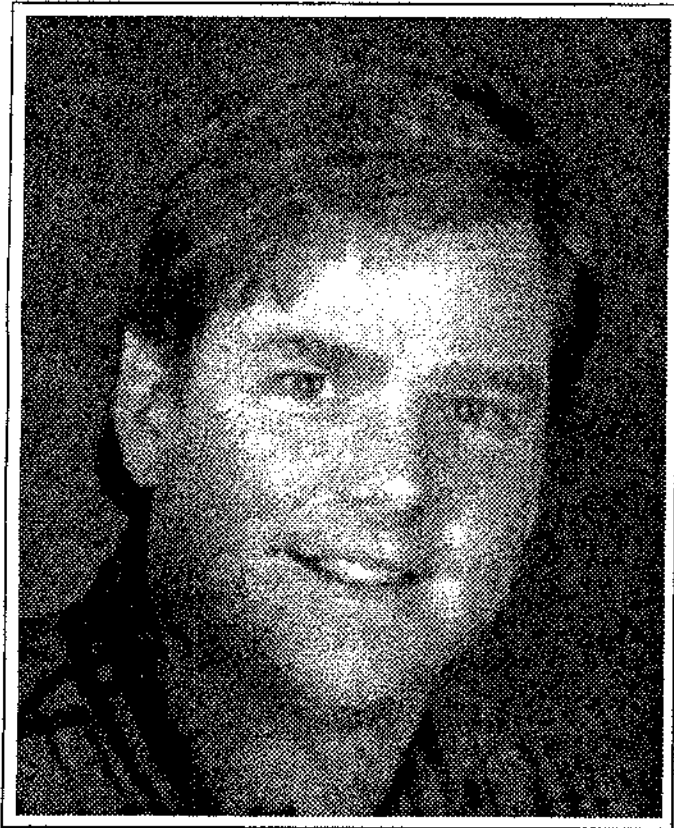
**THE UNIVERSITY OF COLORADO
BOULDER, CO 80309**

Agricultural Impacts of Global Agriculture: Integration of Remote Sensing and Biogeochemical Models for Trace Gas Assessments	Emery, William	Univ. of New Hampshire
Observations and Modeling of Flow and Fracture Processes Leading to Iceberg Calving	Pfeffer, Tad	NSF
Experimental Study of Basin Stratigraphy	Pratson, Lincoln	NSF

Title	PI	Department	Sponsor*
Feedback Coupling Between Flow and Reactions in Heterogeneous Porous and Fractured Media: Computational and Experimental Studies	Rajaram, Harihar	Civil, Env. & Arch. Engr.	NSF
Direct Measurement of the In-Situ Stress Tensor at Depth in Glacier Ice: A Collaborative Study	Amadei, Bernard	Inst. Of Arctic & Alpine Research	NSF
Dynamics of the Mesosphere and Lower Thermosphere of the Arctic and Antarctic	Forbes, Jeffrey	Aerospace Engineering	NSF
Enhanced Antarctic Research with LANDSAT: Ice-Sheet Dynamics, History, and Cartography	Scambos, Theodore	Coop. Inst. For Research in Env. Sciences	NASA
Land and Land Use Change in the Climate Sensitive High Plains: An Automated Approach with LANDSAT	Goetz, Alexander	Coop. Inst. For Research in Env. Sciences	NASA
Meltwater Flow Through Snow From Plot to Basin Scales	Williams, Mark	Inst. Of Arctic & Alpine Research	DOD/DOA
Alluvial Architecture and Floodplain Paleosols: Field Evaluation of Theoretical Models	Kraus, Mary	Geological Sciences	NSF
Transitions - A Study of the Spatial and Temporal Transitions of Climate and Ecosystems in the Circumpolar Arctic	Lynch, Amanda	Coop. Inst. For Research in Env. Sciences	NSF
An Integrated Use of Experimental, Modeling and Remote Sensing Techniques to Investigate Carbon Isotope and Phosphorus Dynamics in the Humid Tropics	Townsend, Susan	Inst. Of Arctic & Alpine Research	NASA
Modeling of Atmospheric Aerosols Properties for Earth's Radiation Budget and Climate Change Studies	Sokolik, Irina	Atmos. & Oceanic Sciences	NASA
Arctic Regional Sea-Ice Anomalies: A Diagnosis of Ice-Atmosphere Ocean Interactions & Linkages to Large-Scale Climate	Lynch, Amanda	Coop. Inst. For Research in Env. Sciences	NASA
The Effects of Climate Variation on Disturbance Regimes and the Dynamics of Montane Forests in the Colorado Front Range	Veblen, Thomas	Geography	NPS
Channel Monitoring to Evaluate Geomorphic Changes on the Mainstream Colorado River	Pitlick, John	Geography	NPS
A Modeling Study of Atmospheric Response to Perturbations in Greenhouse Gases with a Spectral Mesosphere/Lower Thermosphere Model	Akmaev, Rashid	Aerospace Engineering	NSF
An Experimental Data Base for the Evaluation of Theories for Upscaling in Modeling of Groundwater Flow, Solute Transport and Multiphase Fluid Flow in Aquifers	Illangasekare, Tissa	Civil, Env. & Arch. Engr.	DOA
Airborne Measurement of Air-Sea Fluxes in the Eastern Pacific Ocean During an El Nino Winter	Persson, Ola	Coop. Inst. For Research in Env. Sciences	Univ. of CA at San Diego
Algorithm Development for Snow & Sea Ice Mapping for NPOES	Nolin, Anne	Coop. Inst. For Research in Env. Sciences	Hughes Info & Tech Corporation
McMurdo Dry Valley Long-Term Ecological Research: A Cold Desert Ecosystem	McKnight, Diane	Inst. Of Arctic & Alpine Research	Desert Research Institute
Late Quaternary History of the Western and East-Central Ross Sea, Antarctica: A Contribution to the West Antarctic Ice Sheet Initiative	Andrews, John	Inst. Of Arctic & Alpine Research	NSF
Climate, Substrate, and Vegetation: Distribution and Causes of Moist Nonacidic Tundra	Walker, Donald	Inst. Of Arctic & Alpine Research	NSF
Impact of Tropical Ocean Surface Fluxes on the Atmosphere and Upper Ocean: Extension from TOGA COARE	Curry, Judith	Aerospace Engineering	NSF
Development of a 3-D Sea Ice Model for Climate Applications	Curry, Judith	Aerospace Engineering	NSF

*SPONSORS: NOAA-National. Oceanic & Atmospheric Admin., NSF-National Science Foundation, NRCS-Natural Resources Conservation Service, USFWS-US Fish & Wildlife Service, DOA-Department of the Army, USFS-US Forest Service, NPS-National Park Service, NASA-National Aeronautics & Space Administration, DOE-Department of Energy, CDNR-Colorado Department of Natural Resources, NRC-Nuclear Regulatory Commission, USBR-US Bureau of Reclamation, NCWCD-Northern Colorado Water Conservancy District, NBS-National Biological Survey, CDWL-Colorado Division of Wildlife, COE-Corps of Engineers, DON-Department of the Navy, EPA-Environmental Protection Agency.

UNIVERSITY WATER NEWS



NEW FACULTY IN WATER

Dr. Kenneth Carlson
Department of Civil Engineering
Colorado State University

Colorado State University has selected Dr. Kenneth Carlson for an environmental engineering faculty position to begin in August 1998. Dr. Carlson received a B.S. in Chemical Engineering from the University of Wisconsin in 1983. He completed the Master's degree program at Colorado State under Dr. David Hendricks in 1993, and was then accepted into the doctoral program at the University of Colorado working for Dr. Gary Amy.

In January of 1993, Dr. Carlson was employed as a Process Engineer for the Fort Collins Water Treatment Facility. Through this relationship, he developed a research program that was funded by the City of Fort

Collins. The research program satisfied the Master Plan goals for the utility and also contributed to the research required for his dissertation. He received his Ph.D in Civil Engineering in 1996. Dr. Carlson's dissertation received the 1996 Academic Achievement Award from the American Water Works Association.

Since August 1996 Dr. Carlson has worked as a Senior Process Engineer at CH2M Hill, an international environmental consulting firm, in its Denver office. He was involved in a variety of projects in the drinking water field.

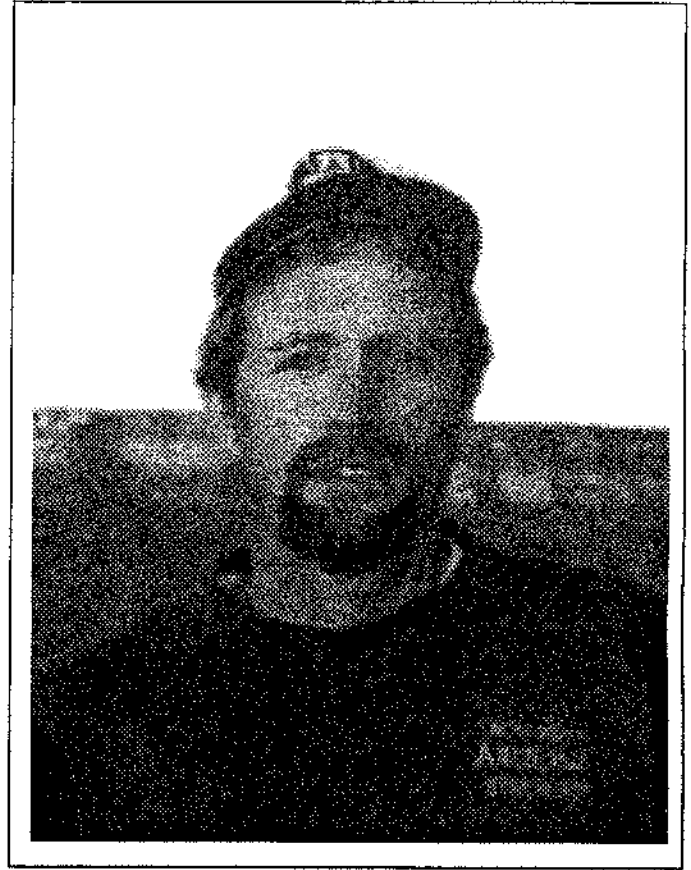
Dr. Carlson plans to specialize in water quality and water treatment. His teaching interests are in aqueous chemistry and unit operation/process design and optimization. His extensive experience with the design and operation of pilot plants for drinking water research will be an asset to the environmental engineering program that Colorado State has developed. As a graduate research assistant at Colorado State, Carlson was involved with the design and construction of the Advanced Water Treatment Pilot Plant at the CSU Engineering Research Center. He also was the lead process engineer for design and construction of a pilot plant for the Pittsburgh Water and Sewer Authority and designed and supervised construction of pilot plants for Denver Water.

Dr. Carlson has taught at the Boulder Water and Wastewater Operators school for the past four years, and was also the co-organizer for an advanced operators seminar that was held jointly at the Fort Collins Water Treatment Facility and the CSU Engineering Research Center in the Fall of 1997.

NEW FACULTY IN WATER

Dr. John McCray
Department of Geology and
Geological Engineering
Colorado School of Mines


The Department of Geology and Geological Engineering at Colorado School of Mines added a new geohydrology faculty member. Dr. John McCray will join the Mines faculty as an Assistant Professor in August 1998. He recently completed his Ph.D degree in Hydrology and Water Resources at the University of Arizona, where he was a recipient of the National Science Foundation Trainee fellowship. He received an M.S. in Environmental Engineering and Science from Clemson University, and a B.S. degree in Engineering from West Virginia University.



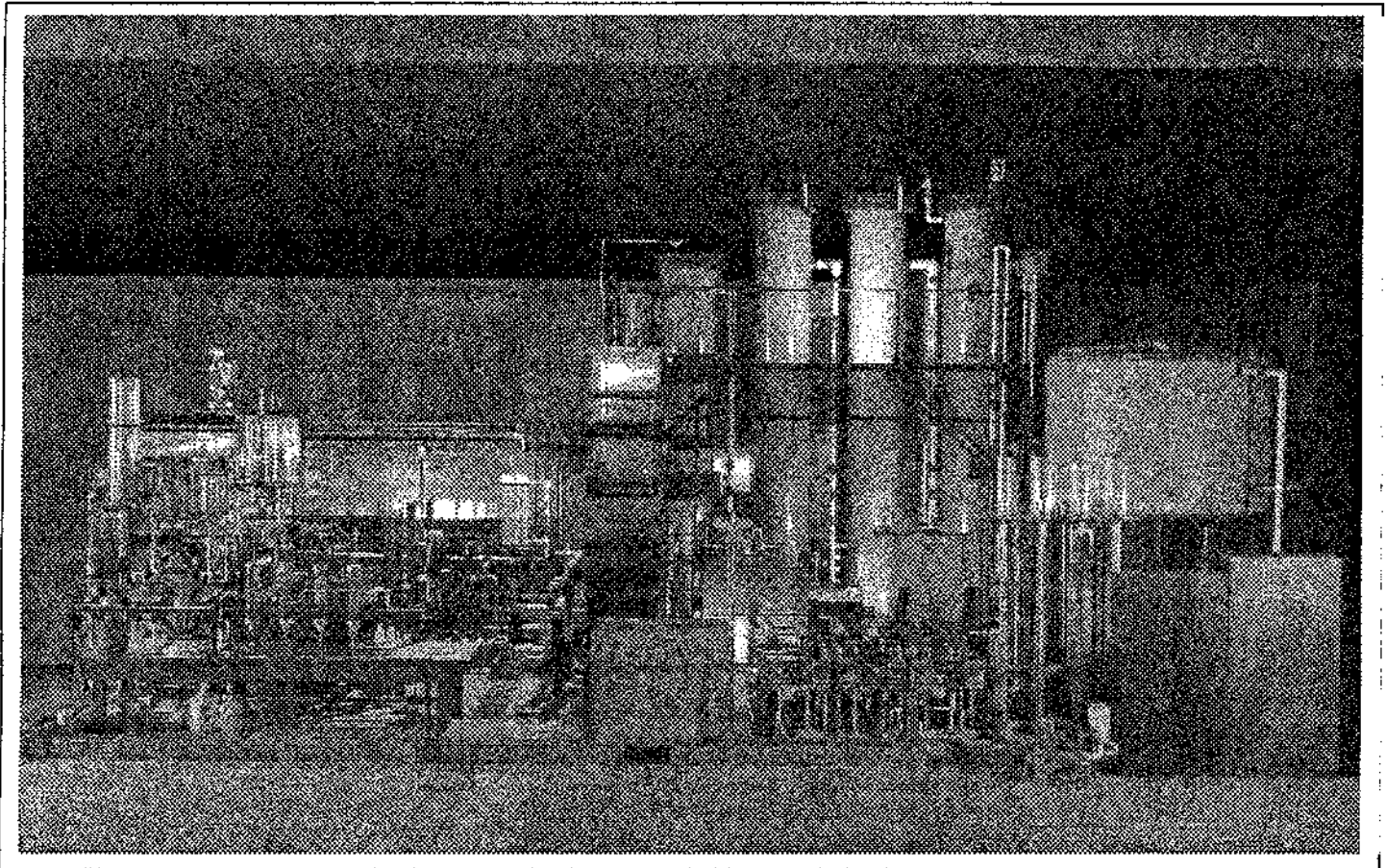
Dr. McCray's primary research interests are related to characterization, transport, and remediation of contaminants in ground-water systems. While at the University of Arizona, Dr. McCray and his colleagues conducted field experiments at a hazardous-waste site in Utah to test the effectiveness of a sugar-based complexing agent for enhanced subsurface remediation of nonaqueous phase organic liquid (NAPL) contamination. This research included the application of partitioning tracers for saturated-zone NAPL characterization.

Previously, he conducted theoretical studies of air sparging for NAPL remediation using a numerical multiphase-flow model. In addition, he has field and laboratory experience related to transport of sediment and chemicals in a mountain trout stream impacted by construction of a hydroelectric dam, and remains interested in surface water-contamination problems.

Dr. McCray is also interested in the application of vadose-zone tracers for subsurface NAPL characterization, and in other subsurface remediation techniques such as surfactant- and cosolvent-enhanced flushing, and soil vapor extraction. Dr. McCray's teaching interests include ground-water engineering, vadose-zone hydrology, contaminant hydrology, and soil science. He is looking forward to an exciting hydrogeology career at Mines, and to working with the local and regional water-resources community.

 **WATER TREATMENT RESEARCH PILOT PLANT
PROVIDES SIMULATION TRAINING
FOR STUDENTS AND ENGINEERS**

A unique component of Colorado State's Environmental Engineering Program is the computer-controlled Water Treatment Research Pilot Plant — a research and teaching facility located at the Engineering Research Center just below Horsetooth Reservoir. Initial operation of the plant came about through a 1992 project sponsored by the U.S. Army Corps of Engineers (COE) to set up a water treatment train that could treat a wide range of contaminated water sources found at Department of Defense sites. A water treatment train is a series of continuous processes designed to treat water, with each individual process meeting a particular treatment objective.

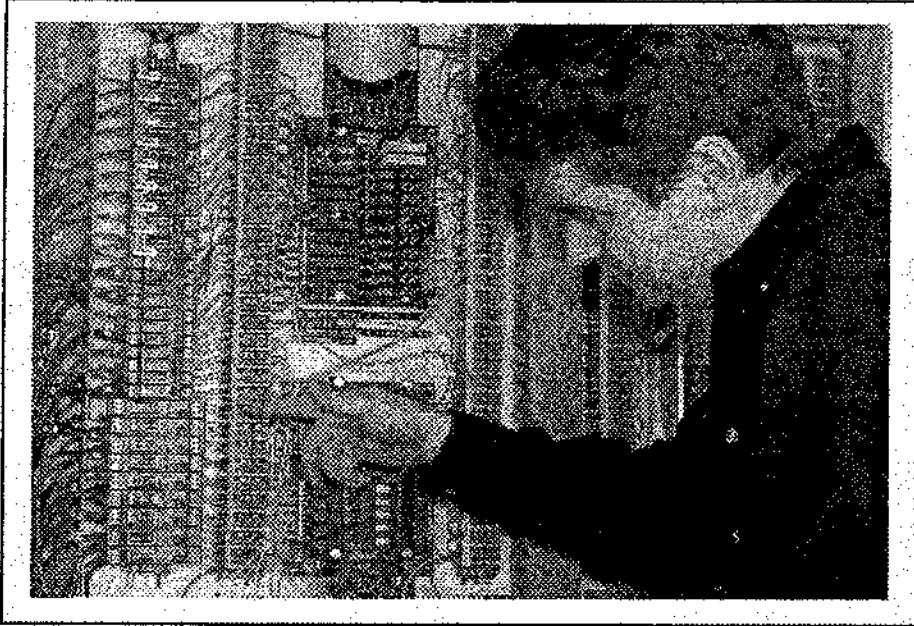


WATER TREATMENT RESEARCH PILOT PLANT (Photo by Joe Mendoza, CSU Photography)

At its inception, the following treatment objectives were established for the pilot plant:

- ◆ Remove particles and chemicals from water at pilot-scale flow rates – Ten unit processes were chosen for the treatment train encompassing removal of particles, organic compound and metals. The pilot plant can treat a wide variety of source waters and synthetic waters and can be used to optimize the treatment train design.
- ◆ Provide a continuous, safe, 24-hour unattended operation. Safety of personnel and the surrounding environment was paramount to the design.

- ◆ Include a SCADA (Supervisory Control and Data Acquisition) control system capable of automated monitoring, data acquisition and supervisory control.
- ◆ Devise a residuals management strategy that concentrates all wastes in the solids stream and recycles any cross-contaminated water. Part of the residual management plan is the redundant safety systems to prevent hazardous waste spills.



Tory Champlin at Microdac control board. Analog signals from sensors come into the board; signal is converted to reading by computer software. The digital portion of board can turn pumps and valves on and off by signal from computer; done by a micro-relay. (Photo by Joe Mendoza, CSU Photography.)

The pilot plant, while large enough that process behavior simulates full-scale, can be started or stopped within a few hours. It allows testing of alternative treatment trains for a given water or the conduct of research on individual unit processes. Specific waters can be synthesized by adding “spikes” of chemicals or particles (including microorganisms – as done in a recent project sponsored by AWWARF).

The pilot plant is fitted with sensors and sampling points to allow determination of various water-contaminant profiles so different variables can be assessed. Thus, selecting an appropriate treatment train for a given contaminated water will provide effective treatment at lower cost, while optimization of unit process design can result in significant cost savings.

The plant’s source of raw water is piped directly from Horsetooth Reservoir and contaminants are introduced into the water stream from two separate spike tanks. For the initial COE project, contaminants to be treated were metals, toxic organics, and particles with water flow rates of 76 L/min (20 gallons-per-minute). The flow was spiked with a continuous injection of a “chemical soup” of toluene, naphthalene, TCE and cadmium. For such spiking, the plant is tied into the City of Fort Collins sewer, and the pilot plant must not exceed the effluent discharge limits set by the city. This includes documenting that the discharge is in compliance.

The automated pilot plant includes the ability to monitor for abnormal events and react accordingly. Valves can be automatically opened and closed and the sensors provide data. Sensors feed in data from several points on flow, temperature, pressure, and specific electrical conductivity. If the flow sensors detect a difference between flows in and out of the plant of more than ten percent, a “priority one” alarm will shut down the plant. The sensor data also provides a means to troubleshoot and explain unexpected events. Digital proximity sensors are used to provide a signal if the level drops too low. This level will change if a pump fails, a pipe breaks or some other flow-altering event occurs.

Analog inputs including pH, temperature, conductivity, particles and turbidity are monitored with real-time statistical process control trends and used to trigger process shutdowns. Emergency shutdown is accomplished by turning off the chemical and flow pumps and shutting the valves to and from the system.

This supervisory aspect of the control system also assures process consistency during routine processing such as filter

backwashes. In this case, the filter level is monitored using an ultrasonic sensor, and the appropriate valves are actuated to accomplish the backwash when the level gets to a certain height.

The software is a Windows-based package called InTouch by Wonderware, Inc. InTouch provides powerful graphics for operator screens and is user-friendly. For the pilot plant, six screens were created to represent operations and present data. The data that is collected from this plant is compiled in Excel, where it is used to generate reports and formatted into an archival form.

Instrumentation has been expanded by donations in conjunction with research projects, including two particle counting systems from MetOne, Medford, Oregon, and two 1720D turbidimeters, and a streaming current monitor by Hach Company, Loveland, Colorado.

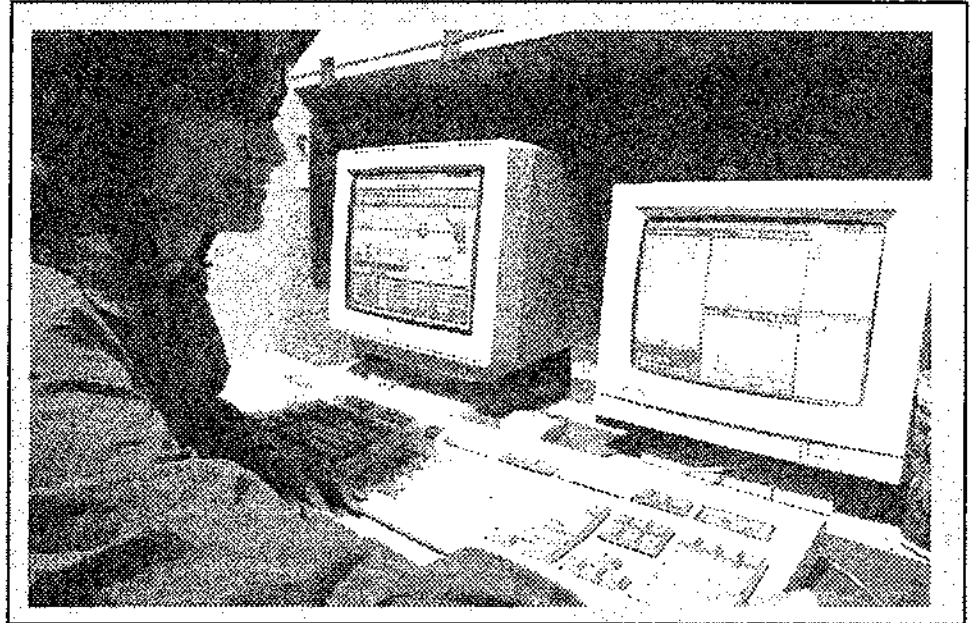
In graduate research, several theses have used the pilot plant as the basis for experimental investigations. Most of these have been by-products of sponsored research, but the pilot plant functions well for investigations with limited funding. For example, the membrane part of the pilot plant was constructed for research in removal of disinfection by-product precursors and membrane fouling. Then, Tory L. Champlin extended the membrane

fouling part of that research to comprise a doctoral thesis as an EPA Fellow. David Pier is conducting filtration research while constructing a smaller side stream pilot filter that will be used in one aspect of teaching. These smaller special purpose systems can be taken off the pilot plant while using its instrumentation.

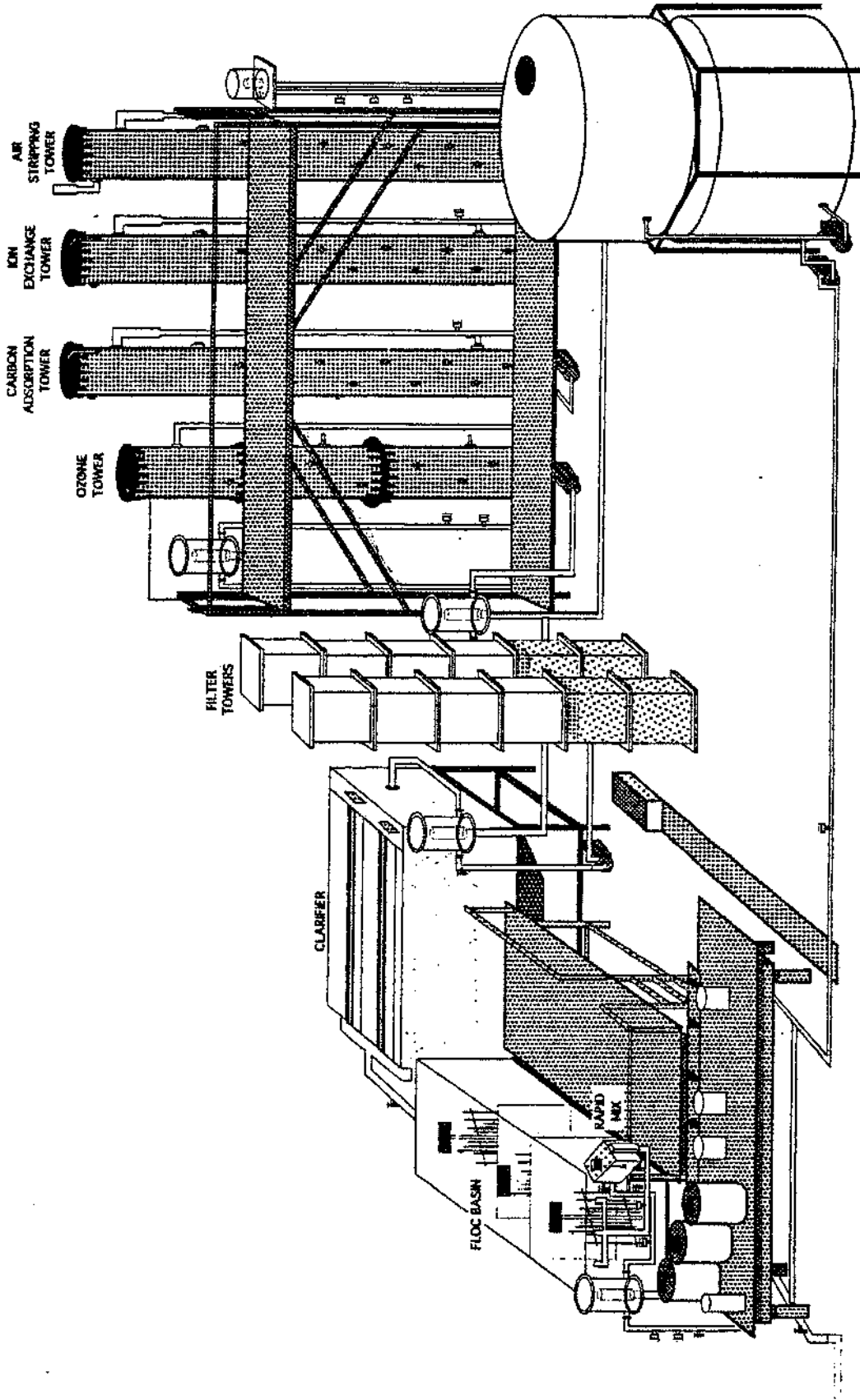
The pilot plant was constructed by CSU Environmental Engineering graduate students and the CSU Engineering Research Center's Machine Shop. In addition to research, the WTRPP has proved its value in graduate education, and also has been used for "hands-on" short courses for engineers and operators. With such "hands-on" experiences, principles can be translated more readily from the classroom to process behavior.

The pilot plant will find continuing use as Dr. Kenneth D. Carlson joins the faculty in Environmental Engineering. In addition to being one of the graduate students who developed the pilot plant in 1992 and doing his MS thesis using the pilot plant, he has had extensive experience designing pilot plants and conducting additional studies with pilot plants at the City of Fort Collins and with CH2M-Hill, consulting engineers.

For additional information about the Water Treatment Research Pilot Plant contact Dr. David Hendricks, Department of Civil Engineering, Colorado State University, Phone 970/491-8273, E-mail dwhbb@lamar.colostate.edu; or Dr. Ken Carlson, same department, Phone 970/491-5048.



Deborah Gonzales at computer for control of pilot plant (on left) and computer for particle counting (on right). (Photo by Joe Mendoza, CSU Photography.)



Overview of Advanced Water Treatment Pilot Plant, Engineering Research Center, Colorado State University
(membrane system not shown)



UCOWR HONORS TWO COLORADANS WITH AWARDS

by Jacklyn Bryant

This year, the University Council on Water Resources (UCOWR) will bestow prestigious awards on two Coloradans. Dr. Neil Grigg of Colorado State University will receive the Warren Hall Medal, and Tom Cech of the Central Colorado Water Conservancy District will receive the Award for Education and Public Service in Water Resources. The honors will be presented at this year's annual UCOWR meeting in Hood River, Oregon.

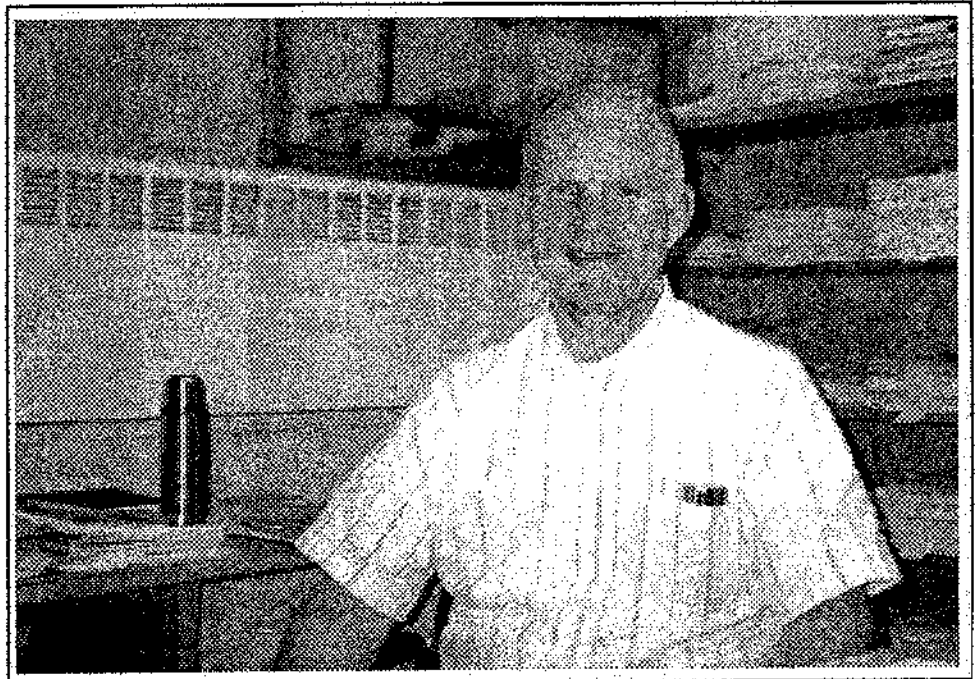
Neil Grigg receives Warren Hall Medal

Dr. Neil Grigg will receive the Warren Hall Medal, acknowledging his contributions in the field of water resources planning and management. During his 36-year career Dr. Grigg has distinguished himself in water resources education, research and consulting as well as in government, professional and community service.

Dr. Grigg has been Professor of Civil Engineering at Colorado State University since 1982 and has been Department Head of Civil Engineering since 1991. He has published five books and many articles in the field of water resource engineering and management. He was instrumental in creating the Water Center at CSU to foster cooperation among colleges and departments in an effort to integrate disciplines working in the field of water resources. Dr. Grigg also served as Director of the Colorado Water Resources Research Institute from 1988 to 1991.

In support of international water resource planning, Dr. Grigg has served as Director of the Office of International Education and Director of the International School for Water Resources at CSU. He has also been a member of the steering committee for the World Congress on Engineering Education and the American Public Works Council on International Collaboration. He developed a UNESCO program for cooperation with Brazil and has led professional delegations to South Africa, Vietnam, Japan and China.

"I was in awe of Warren's extensive knowledge and creative ideas about water resources management. Early in my career, he impressed me as one who understood the critical link between science and politics, and I am deeply honored to receive the Warren Hall Medal."



Dr. Neil S. Grigg, Head, Department of Civil Engineering, Colorado State University

From 1979 to 1982, Dr. Grigg was Assistant Secretary for Natural Resources in the State of North Carolina. While there, he reorganized the state water resources program and created the Division of Water Resources. He was also Director of the Division of Environmental Management where he initiated a vigorous air and water quality enforcement program. He was awarded the North Carolina's Governor's Award for Environmental Protection in 1981.

In the private sector, Dr. Grigg co-founded Sellards & Grigg, Inc., a Denver-based civil engineering firm. The firm specializes in flood control analysis and design, storm water planning, water system distribution and management, and water rights augmentation. He has recently reported on the infrastructure workforce, organization of infrastructure industry and the impact of infrastructure on economic development.

Dr. Grigg believes the biggest challenge we face in water resources management is cooperation. Research and science explain the issues, but obtaining collaboration between people, agencies and nations will determine the future planning and development of the earth's water resources.

The Warren A. Hall Medal was established by friends and family as a memorial to a man known worldwide for his involvement in water resources research and as founder of the Universities Council on Water Resources. Dr. Hall, who unpretentiously introduced himself as Mr. Hall or Warren, was born in 1919 and raised on a dryland farm in Nebraska. He earned a degree in engineering from the California Institute of Technology in 1942 and his doctorate from UCLA in 1952. He began his career as an educator at UCLA and was selected as Director of the Water Resources Center for all campuses of the University of California. The center approached water resource management by merging the social and physical sciences.

Dr. Hall created the Universities Council on Water Resources, now recognized as the authoritative voice on matters of water resources research and education. President Nixon appointed Dr. Hall as Technical Assistant for Water Resources, Office of Science and Technology, Executive Office of the President. Later, he joined the Engineering faculty at Colorado State University and became Director of the International School of Water Resources. He retired from CSU in 1986.

Dr. Hall was a humble, personable, and resourceful professor, consultant and engineer who emanated energy. He was loved and admired by his students and respected by his peers. His door was always open, and his enthusiasm to discuss water-resources problems never diminished. Dr. Hall served as a mentor for many young scientists and engineers and as host to many foreign graduate students. His generosity of spirit and able counsel touched many lives.

Tom Cech receives the Award for Education and Public Service in Water Resources

Tom Cech, the Executive Director of the Central Colorado Conservancy District (CCWCD), has been acknowledged with the Award for Education and Public Service in Water Resources. The award commends significant contribution to public awareness of water resources development, use or management.

Tom is a major contributor to education and public service in Colorado water resources. He has been active and successful as the Executive Director of the CCWCD since 1982. Tom developed and implemented the Children's Water Festival program for Colorado. Modeled after Nebraska's original program, the festivals are designed to educate young people about water and provide hands-on experience. The program, in its seventh year in Colorado, has with 15 active communities that have hosted 75,000 participants. These festivals concentrate on educating children using a wide variety of activities, including classroom presentation, exhibits, poster and essay contests, water knowledge competitions and teacher resource rooms. The success of these festivals is evident in the large and diverse groups that participate in the events. Through promotion by Nebraska and Colorado water educators, the festivals have spread to over 40 states and five foreign countries.

School children from kindergarten to twelfth grade have benefited from two innovative programs created by Tom. He was awarded an EPA grant to develop and implement curriculum materials for a Non-Point Source Water Quality Education Program for primary and secondary schools. The materials have been distributed to 1500 schools and are very successful. A second grant was awarded to include funding for teacher's workshops held in key communities. A second unique program, the WellWatch Network, was developed as a means to educate young people and provide a monitoring system for groundwater. 25 Front Range schools now have playground wells where students perform testing and measure depth to groundwater. Students e-mail or call in their findings to be included in the WellWatch database. This program provides both educational opportunities for the students and information for water managers.

The Water Resource Center at the University of Northern Colorado was created with Tom's assistance. The center is a cooperative effort, with support coming from Project WET, Project River Water (Colorado Division of Wildlife), CCWCD, Sustainable Agriculture, Colorado Reader and others. The organization is now known as the Poudre Learning Center and is directed by Ray Tschillard of UNC.

Tom was an active leader in forming the Centennial Land Trust, a cooperative effort to preserve wildlife habitat and agricultural lands along the South Platte River near Ft. Morgan. The group is comprised of local residents and Fish and Wildlife officials who seek to protect sensitive areas from development by purchasing conservation easements.

"Our challenge for the future is to continue to work with students and teachers in effective water programs and to develop adult water education programs that work."



Tom Cech, Manager, Central Colorado Water Conservancy District, Greeley

Tom was raised on a farm in eastern Nebraska and feels that his agricultural upbringing helped to make water a priority in his life. He has a bachelor's degree in Education and a master's degree in Community and Regional Planning from the University of Nebraska at Lincoln. His early career as a high school math teacher gave him valuable experience as an educator and in public outreach.

The purpose of the Award for Education and Public Service in Water Resources is to recognize individuals, groups or agencies who have made significant contributions to increased public awareness of water resources development, use or management. The activities designed for water education will have made significant contributions to educating the public in the natural, biological and social sciences associated with analysis of water resources. Effects of the program should be regional, of not national, and have private or public sponsorship.

COLORADO SCHOOL OF MINES
NOTICE OF THE RELEASE OF THE PUBLIC-DOMAIN, USGS CODE
UCODE, A Computer Code for Universal Inverse Modeling

*Developed by Eileen P. Poeter, International Ground Water Modeling Center, Colorado School of Mines
and Mary C. Hill, U.S. Geological Survey*

Historically, when computer models needed to be calibrated to observed data, users of groundwater modeling programs would go through a trial-and-error methodology; i.e., changing values of hydraulic conductivity and recharge for different areas of the model. However, many combinations of these two parameters often led to an apparently satisfactory calibration, leaving the user to believe that he/she had a unique calibration to the best fit parameter values. Now, automated calibration programs such as UCODE utilize regression concepts to perform inverse modeling, where observed hydraulic head and flow data are compared with model output, and model parameters, such as hydraulic conductivity and recharge, are adjusted by the code to minimize differences between data and computer output. UCODE's automated calibration program applies to any computer model that needs to be calibrated to observed data.

Statistics are calculated and printed for use in (1) diagnosing inadequate data and identifying parameters that probably cannot be estimated; (2) evaluating estimated parameter values; (3) evaluating the model representation of the actual processes; and (4) quantifying the likely uncertainty of model simulated values. UCODE is intended for use on any computer operating system: it consists of algorithms programmed in perl, a freeware language designed for text manipulation, and Fortran90, which efficiently performs numerical calculations. UCODE may be used on PCs, MACs, and UNIX computers, because it is platform independent. The UNIX example files are slightly different than the PC files (e.g., paths include forward, rather than backward, slashes).

Dr. Eileen Poeter, Director of the International Ground Water Modeling Center, Colorado School of Mines, and Dr. Mary Hill of the U.S. Geological Survey authored UCODE. Dr. William Wingle, research professor at the Colorado School of Mines, developed the GUI (graphical user interface) for UCODE.

UCODE was developed in cooperation with: the U.S. ARMY WATERWAYS EXPERIMENT STATION and the INTERNATIONAL GROUND-WATER MODELING CENTER. It is documented in U.S. Geological Survey Water-Resources Investigations Report 98-4080. related documentation — Hill, Mary C., 1998, Methods and guidelines for effective model calibration: U.S. Geological Survey Water-Resources Investigations Report 98-4005. UCODE FTP DOWNLOAD LOCATIONS: ZIP and TAR files (with documentation, source, and example files) reside at the following URL: <http://www.mines.edu/igwmc/freeware/ucode>.

- ◆ DOWNLOAD and EXTRACT INTO ROOT DIRECTORY (it creates directory C:\wrdapp\ucode1.0 [wrdapp\ucode1.0] on unix).
- ◆ READ the README.txt FILE in C:\wrdapp\ucode1.0 for further DIRECTIONS [wrdapp\ucode1.0] on unix]
- ◆ REVIEW the PDF files: wr984080.pdf which is the MANUAL, and wr984005.pdf for GUIDANCE in conducting a CALIBRATION PROJECT.

Currently scheduled courses that facilitate the use of UCODE include:

CALIBRATION and UNCERTAINTY of GROUND-WATER MODELS — University of Minnesota, August 24-27. Instructors: Mary Hill, Claire Tiedeman, & Eileen Poeter; Fee: \$500, student rate \$250 (the course is subsidized by a National Science Foundation Grant). For information and registration: 612-625-7332 or mperson@darcy.geo.umn.edu.

UCODE — Universal Inversion Code: Automated Calibration for Many Codes — Colorado School of Mines, Golden CO, October 1-2, Instructors: Eileen Poeter, William Wingle. Fee: the course is associated with the MODFLOW98 Conference — \$795 with conference registration, \$995 without conference registration. For information: 303 273-3101 or igwmc@mines.edu. For registration: 303 273-3321 or space@mines.edu

For information contact: Eileen Poeter, Co-Director, IGWMC (International Ground-Water Modeling Center), Dept. of Geology and Geological Engineering, Colorado School of Mines, 1500 Illinois St., Golden, CO 80401. Phone (303)273-3829 fax (303)384-2037 email: epoeter@mines.edu URL http://www.mines.edu/fs_home/epoeter/



PUBLICATIONS



WWPRAC Releases Final Report on Western Water Resources

The Western Water Policy Review Advisory Commission (WWPRAC) has announced the release of its final report, *Water in the West: The Challenge for the Next Century*. The report fulfills the Commission's charge under Title XXX of Public Law 102-575 in which Congress directed the President to undertake a comprehensive review of federal activities affecting water resources in the western United States. In addition, the Commission produced 22 research reports addressing western water issues. The final report as well as the 22 research reports are available at the WWPRAC web site, <http://www.den.doi.gov/wwprac>. Printed copies of the report will be available in mid-August.



CSU Water Center Publishes Proceedings of Fort Collins Flood Conference

On July 28, 1997, an extreme flood disaster hit Fort Collins, Colorado, with the heaviest rains ever documented in an urbanized area of the state. It was quickly labeled a "500-year event," and was one of the major urban floods of recent years in the United States. The storm dropped 10 to 14 inches of rain in 31 hours, and some peak discharges greatly exceeded projected 100-year and 500-year flows. Five people died, 54 were injured, about 200 homes were lost, and 1500 homes and businesses damaged. Damages at Colorado State University totaled about \$100 million. Emergency response was outstanding, and scientists and engineers from Colorado State University and the City of Fort Collins quickly began to analyze the storm. In the spirit of the land grant university, the Water Center organized a conference to capture the experiences and lessons of the flood, so that others might learn from Fort Collins' experience. According to news reports, some 400 people attended the flood conference, which took place three months after the flood. Proceedings of the conference are now available. For information on how to obtain a copy, contact Marilee Rowe, Department of Civil Engineering, Colorado State University. Phone 970/491-5247, FAX 970/491-67871, E-mail mrowe@enr.colostate.edu.



Report on Colorado Sediment Issues Now Available from CWRRI

For a free copy of "Inheriting Our Past: River Sediment Sources and Sediment Hazards in Colorado," contact CWRRI at Phone 970/491-6308, FAX 970/491-2293, or E-mail CWRRI@ColoState.EDU. The publication is No. 7 in CWRRI's series, *WATER IN THE BALANCE*.



NSFC Wastewater Report Released

The National Small Flows Clearinghouse (NSFC) announces the release of an exclusive report on the status of onsite wastewater systems across the nation. *National Onsite Wastewater Treatment: A National Small Flows Clearinghouse Summary of Onsite Systems in the United States, 1993*, is a 414-page document containing information from local health departments and onsite agencies in 46 states. The report provides information on various issues related to onsite technologies. Among the data provided are commonly cited problems with onsite systems, which local agencies work with onsite systems, permit and system costs, and who has responsibility for onsite system maintenance. The NSFC, which initiated the project in 1994, compiled information from more than 1,500 local health departments and onsite agencies involved with wastewater technologies. The report costs \$17./50, plus shipping and handling. Currently, orders are being taken by the NSFC at (800)624-8301 or by E-mail at nsfc_orders@estd.wvu.edu. Orders may also be faxed to 304/293-3161. Request item# WWBKG89 when placing order.



U.S. Geological Survey Publications

Contact the U.S. Geological Survey, Earth Science Information Center, Open-File Reports Section, Box 25286, Mail Stop 517, Denver Federal Center, Denver, CO 80225 or call 303/236-7476 unless another source is provided

Quality of Water in the Alluvial Aquifer and Tributary Alluvium of the Fountain Creek Valley, Southwestern El Paso County, Colorado, 1991-92. Water Resources Investigations Report 94-4118. Supersedes Interim Report Published in 1994.

Comparative Study of Ground-Water Quality, 1976 and 1996, and Initial Gain-and-Loss Assessment of Boulder Creek, Boulder County, Colorado. Water Resources Investigations Report 97-4091.

Effects of Land Use on Water Quality of the Fountain Cree Alluvial Aquifer, East-Central Colorado. Water-Supply Paper 2381-D.

Water-Quality Data for the Arkansas River Basin, Southeastern Colorado, 1990-93. Open-File Report 95-464.



WATER SUPPLY

The SWSI values show the central and southern mountains as having a bit below average water supply conditions, with all basins of the state experiencing reduced water supply conditions compared to last year's excellent conditions. Dry and windy weather is being reported from the Rio Grande, Gunnison, Colorado, and San Juan/Dolores basin administrators, along with a concern about conditions later in the summer if the weather does not change. Throughout the state, reservoirs are holding good amounts of water. Statewide reservoir storage is approximately 113% of normal. Use of reservoir water is occurring, in some places earlier in the summer than is typical.

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the U.S.D.A. Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on stream flow, reservoir storage, and precipitation for the summer period (May through October). During the summer period stream flow is the primary component in all basins except the South Platte basin where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for July 1, 1998 and reflect conditions during the month of June.

Basin	July 1, 1998 SWSI Value	Change From Previous Mo.	Change From Previous Year
South Platte	2.5	-0.7	-1.2
Arkansas	0.1	+0.8	-3.5
Rio Grande	-1.0	-1.5	-3.3
Gunnison	-1.0	-1.6	-4.6
Colorado	-1.6	-2.7	-5.5
Yampa/White	1.0	-1.2	-1.9
San Juan/Dolores	-0.7	-1.6	-3.2

SCALE

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



EDITOR'S IN-BOX



WYOMING CENTER CLOSES

After 33 years of service, outreach and research, the Wyoming Water Resources Center shut down on June 30 due to lack of funding. As late as 1983, the Water Center's funding consisted of a line item in the University of Wyoming block grant from the legislature and a small amount of money from the University's Instruction and Research budget. But by fiscal 1990, budget-tightening had driven the state and university to fund the Water Center nearly entirely from the state's water development accounts. This year the water center requested a little over \$850,000 per year, \$103,000 above the 1997-98 biennium request, to restore the state grants-in-aid program to previous levels. The legislature's Joint Appropriations Committee recommended that the full legislature grant the center's \$1.7 million biennium request after a motion to eliminate the requested increase failed. Then, Sen. President Bob Grieve (R, SD11) introduced the same amendment to cut the Water Center from the water development accounts that he has every year since the center was switched to those funds. His amendment passed this year, 20-10. A similar bill introduced in the House by Marlene Simons (R, HD1) failed by a two-to-one margin. But the Water Center's funding was abruptly snipped in committee on March 6 and Gov. Geringer signed the bill into law on March 13.

According to some legislators, the University of Wyoming was supposed to realize that the Water Center's loss would be too great to accept and fund it through its block grant, but the university had other ideas. At a UW Board of Trustees meeting held on the same day Geringer signed the funding bill, the trustees publicly voiced repulsion at the prospect, but unanimously voted to direct UW President Philip DuBois to begin planning the closing of the Water Center. DuBois advised the trustees that UW cannot absorb the \$750,000 annual bite to finance the Water Center. DuBois acknowledged the need for continued research on water issues in Wyoming and the dependence many other public and private interests have on the Water Center. But the funding situation was forcing him to close the center "as we currently know it," he says.

Sen. President Bob Grieve notes that the Wyoming State Engineer's Office, the Wyoming Water Development Commission and various other state agencies will probably tap the university for help with water-related issues. Unfortunately, with the Water Center (and its \$250,000-\$350,000 annual state grants-in-aid program) out of the picture, they will have to talk directly with departments that won't necessarily concentrate any part of their curricula on water resource issues. For this reason, Rep. Rodney "Pete" Anderson (HD10) sees state agencies expanding their individual capabilities to cover what the Water Center used to do for them — the duplication of services in the agencies coming at a higher cost to taxpayers. (Anderson is a former member of the Water Center's Research, Review and Priorities Committee.)

Much of the life of the center was devoted to gathering data from throughout the state to understand some basic relationships between land, life and water. Center staff helped pin down the hydrologic relationships between riparian vegetation and stream systems, leading the nation's researchers to what eventually became a common-sense approach to maintaining streamside vegetation to avoid stream bank degradation.

Water Center staff conducted pioneering instream flow research. It wasn't always obvious that a certain minimum streamflow is necessary to provide habitat for fish. Water Center studies helped determine some parameters for finding that minimum so that people can maximize their use of the stream without destroying its aquatic systems.

The Water Center's core mission guided the development of the Water Resources Data System and also its library of more than 10,000 volumes. Water Center associate director Tom Wesche points out what an achievement Water Center director Steve Gloss has accomplished in championing and nurturing the center's Geographical Information Systems (GIS) lab. Wesche notes that the center's most enduring legacy may be the graduate students who took on its demanding Water Resource Option, the center-conducted graduate school option. The Water Center will close soon, says Wesche, but it will do it with pride.



WATER NEWS DIGEST

by Jacklyn Bryant



DAM SAFETY

Pueblo Dam repairs await Congressional approval

Work on the Lake Pueblo dam safety project could start in late fall and move fast enough to lift water restrictions by spring 1999. The water district has formally signed off on the Bureau of Reclamation's controversial dam-repair contract. Congressional approval is expected in July. The district had questioned items in the contract, including a projected \$650,000 to relocate 13 federal dam engineers for two years. Also, the water district initially opposed paying any part of the \$29 million repair bill, saying safety flaws were the responsibility of the Bureau, which built the dam in the 1970s. In the end, the district dropped the disputes when the Bureau threatened to bring the project to a halt pending a contract, including a district pledge to pay 15% of the bill. Without repairs, Bureau-imposed water restrictions could continue, and the impact of restrictions could hit hard if dry weather continues. The repairs will take place in two phases with the last segment to be completed in late 1999. Under the repair, crews will pour a 500-foot-wide concrete "door stop" in the plunge pool of the dam. Special bolts will be used to secure the massive block of concrete. Engineers for the Bureau of Reclamation announced last year that new safety standards suggest Lake Pueblo is a greater risk of slipping than first believed. Pueblo engineer Jack Gillespie challenged the ruling, charging that government engineers based their decision on speculative risk modeling, not scientific evidence. The safety project may be linked to a plan by the water district and the Bureau to enlarge the dam. Expansion would require a stronger dam base.

Pueblo Chieftain 6/18/98

Horsetooth Dam and Reservoir come under scrutiny

Continued seepage and low water levels have brought attention to the Horsetooth Dam and Reservoir outside Fort Collins. The embankment dam, built in 1949, retains a reservoir of 156,000 acre feet that provides irrigation, drinking water and recreation opportunities to the Fort Collins area. The dam began to experience increased seepage early this year, prompting the Bureau of Reclamation to obtain consultation on its safety status. The consultant concluded that dissolving geologic formations at the base of the dam were responsible for the seepage. BOR and Northern Colorado Water Conservancy officials will continue to monitor the dam's status and will develop an action plan to address citizen's concerns. The low reservoir water level has resulted from irrigation releases in May, coupled with low rainfall this summer. On June 1, the reservoir was 21 feet below capacity, with another 8 feet of releases are planned through July to meet agricultural and domestic water needs. Boaters and fishermen worry that the low water will adversely affect their recreation this season. Officials advise that the reservoir level will rise again soon and there is no reason to remove boats or change summer recreation plans.

Fort Collins Coloradoan, 5/16/98, 6/6/98, 6/15/98, 6/17/98, 6/19/98, 6/22/98, 6/29/98, 7/3/98



ENDANGERED SPECIES

Feds may limit water use to protect endangered fish

The collapse of negotiations between federal and state officials on protecting rare fish likely will lead to restrictions on Colorado water users. The U.S. Fish and Wildlife Service has decided a state plan to protect four species of fish in the Colorado River is inadequate. The agency is expected to use the powers of the Endangered Species Act to restrict use of the river water. Fish and Wildlife officials feel that Colorado lacks the political will to protect the endangered fish and will likely take over the program this summer, which could lead to cutbacks in additional water supplies users can tap. The fallout will affect Coloradans for years, as traditional sources become limited. After years of meetings, environmental studies and negotiations, the state devised a strategy in 1995 to protect both the fish and water uses. Water districts would have had access to 400,000 acre-feet of river water annually above 1995 consumption levels. Federal wildlife officials said the plan would not leave enough water for the fish. The agency wants to rebuild the fish populations partly by maintaining water levels in a stretch of the Colorado River near Grand Junction called the 15-Mile Reach. The spot is downstream from where Denver draws water into its system before sending it through dams and tunnels to reservoirs on the Front Range. U.S. Fish and Wildlife is expected to limit Colorado water users to drawing only 60,000 acre-feet in additional supplies annually. State officials based their plan on state water law, which allows protection of endangered species if water rights can be fulfilled.

Rocky Mountain News, 6/30/98, *Denver Post*, 6/29/98



ENVIRONMENT

Governor Romer signs water and environmental bills

On May 26, Governor Romer signed several legislative actions designed to protect water and wildlife in Colorado. HB1011 orders a study of the relationship of well-pumping to surface water rights in the Rio Grande Basin (Water Division 3). The objective is to protect San Luis Valley water supplies from deep-aquifer depletions. The \$5 million, two-year study will yield rules governing water use in the basin. The bill was brought at the request of the Rio Grande Water Conservation District, which sought to combat a Stockman's Water Company proposal to pump 150,000 acre feet from the valley. HB1049 requires Colorado law conform to new federal Safe Drinking Water Act provisions. It also establishes a grant program to assist small communities in meeting compliance requirements. In SB191, the Colorado Division of Wildlife was granted permission to proceed with plans buy a 30,000-acre ranch west of Trinidad in the Upper Purgatoire watershed. This acquisition presents a tremendous opportunity to protect wildlife habitat in an area that's rapidly being subdivided. There is little public land in the area, and the property would likely have been destined for housing. The area is home to deer, turkey and 24,000 elk, the state's second largest herd. The bill gives the DOW until Jan. 1, 2001 to complete the transaction.

Pueblo Chieftain, 5/27/98, Loveland Daily Reporter-Herald 5/28/98

Rules may protect Colorado Springs creeks

Concerned that development is threatening the environment along local creeks, city planners are considering rules limiting stream-side construction. The rules aim to preserve natural features of riparian areas by requiring buffer zones next to waterways such as Monument Creek, Fountain Creek, Sand Creek and others. The rules are similar in spirit to those written to protect scenic hillsides in the city. Developers would be required to set aside areas for trails along creeks to make development compatible with the stream-side ecosystems. City planners conceived of the idea because some property owners have mistreated stream banks, causing erosion and pollution problems. For example: Stream banks along Monument Creek are smothered in construction debris and gravel. Some property owners appear to simply push debris over the bank to build up their land. By doing that, the social and environmental aspects of the creek are completely lost. There are existing agencies and rules in place to guide stream-side development: the Army Corps of Engineers, the regional floodplain administrator, and various city zoning and building ordinances. But city planners have concluded that none of the rules has the teeth needed to prevent the stream sides from becoming dumping grounds and ensure the stream sides can be made into the recreational areas, complete with trails, as envisioned by existing city plans.

Colorado Springs Gazette 6/19/98



LITIGATION

Kansas sues Nebraska over river water

Kansas has filed a long-promised lawsuit against Nebraska in the decades old dispute over the Republican River. Kansas alleges Nebraska has illegally withheld water from Kansas under a 1943 agreement regarding distribution of the natural flow. Kansas contends that water well drilling for irrigation is depleting Kansas of 10 billion gallons of water each year. Nebraska's Attorney General doubts that Kansas has a case. The Supreme Court may decide to rule on the case within three months.

USA Today 5/27/98



PEOPLE

Director of Colorado Department of Natural Resources resigns

Jim Lochhead, director of the Colorado Department of Natural Resources since 1994, resigned his position effective June 22. Mr. Lochhead plans to return to his home in Glenwood Springs and to a career in the private sector. He was instrumental in preserving 300,000 acres in the state Stewardship Trust, promoted Great Outdoors Colorado and helped built the Legacy program to secure wildlife habitat. His water expertise was focused on resolving the ongoing battle with Kansas and pushing California to live with its current share of Colorado River water - securing water for endangered species.

Grand Junction Daily Sentinel 5/20/98



WATER QUALITY

Raw sewage discharged into Plum Creek

Up to a million gallons of raw sewage may have poured into Plum Creek northwest of Castle Rock after a sewer line in the area broke in late May. Plum Creek flows into Chatfield Reservoir, about 18 miles downstream from the break. Officials from the Plum Creek Wastewater

Authority diverted the flow to spare tanks in the old Castle Rock WWTP within 30 minutes discovering the break. The cause of the break was unconfirmed, but natural diversion of the creek may have scoured the area around the sewer line and put pressure on the pipe. Repairs on the damaged pipe began the following day. The area where Plum Creek flows into the reservoir is not highly used, but officials set up monitors at the reservoir and signs were posted alerting swimmers of the situation.

Denver Post 5/30/98, Grand Junction Daily Sentinel 5/31/98

Opponents to appeal RCC wastewater plan

While the state Department of Corrections won a step in the battle to make wastewater improvements at the Rifle Correctional Center part of its expansion plan, opponents plan an appeal. The state Water Quality Control Commission recently approved DOC plans for the wastewater improvements. The WQCC also upheld the DOC's current "pump and haul" operation to the city of Rifle as a legitimate temporary bypass until permanent improvements at RCC are complete. The ruling will allow the current rate of 20,600 gallons per day to be pumped. The RCC will need to expand when the treatment plant is at 80% and 95% capacity. The DOC is pleased with the Commission's order and confident that the wastewater plan is workable. The appeal by the opposition is one of six that have been filed against the project. The DOC recently received an additional \$3.4 million appropriated by the Colorado General Assembly to pursue additional construction at RCC.

Glenwood Post 6/18/98, Grand Junction Daily Sentinel, 6/19/98

Toxic chemicals released into waterways on the rise

For the second straight year, Colorado ranked 43rd for toxic chemicals releases, but the amount toxic chemicals dumped into waterways increased. The Toxics Release Inventory, an annual report compiled by the Environmental Protection Agency, details toxic chemical releases and transfers of toxic chemicals off-site by companies. Toxic air emissions in Colorado fell by 14% to 3.6 million pounds in 1996 and toxic releases on land fell by 14% to 104,000 pounds. However, surface water discharges rose 209% to 615,000 pounds, up from 294,000 pounds in 1995. The report listed the top 10 facilities for on-site toxic releases in Colorado. Those companies accounted for 57% of the on-site releases in 1996. Kodak of Windsor ranked No. 1 with a 314,000-pound increase. Kodak reduced toxic air emissions but reported increases in surface water discharges of 368,000 pounds. Ball Metal Container of Golden ranked second with 388,000 pounds of on-site releases, down 19%. The report said CF&I Steel, now Rocky Mountain Steel Mills, reduced toxic releases by 50% by eliminating the use of methyl chloroform and sulfuric acids in cleaning and descaling operations. Others on the list are Syntex Chemical Inc. of Boulder, Metal Container Corp. of Windsor, Holnam Inc. of Florence, Leprino Foods of Fort Morgan, Conoco Denver Refinery of Commerce City, Central Products Co. of Brighton and Valley Metal Container of Golden. Nationwide, toxic chemicals dumped into waterways and on the land increased, but less air pollution helped reduce overall industrial releases of toxic chemicals by 4% from 1995 to 1996.

Denver Post, 6/19/98

Denver water musty but healthy

Denver Water has been flooded with hundreds of complaints about the foul taste of tap water. Although utility officials acknowledge problems with a musty flavor, officials maintain the water is clear and meets health code standards. Denver Water attributed the taste problem, which began in mid-July, to the annual weed bloom in the Marston Reservoir. Most of the complaints have come from west Denver and Lakewood around the Sheridan Boulevard corridor, water officials said. Normally, the water department can circumvent the taste problem by using an alternative to the weedy Marston Reservoir. The alternative is a large water conduit, leading directly from the South Platte River to the Marston treatment plant. But the pipe has been plagued by a sediment buildup since heavy rains in the Buffalo Creek area washed tons of dirt into the Platte River and ultimately the conduit. The 1996 Buffalo Creek fire destroyed trees and other vegetation in the Pike National Forest watershed that feeds the South Platte. Without shrubs and plant growth, mountain sediment gushes into the South Platte every time it rains heavily. Sediment buildup has been a recurring problem for Denver Water officials since the Buffalo Creek blaze. Rocky

Mountain News, 7/16/98

High copper levels in Alamosa River another legacy of Summitville mining

The EPA has amended its proposal to lower water quality standards for stretches of the Alamosa River. The EPA and CDPHE had planned to reclassify some river sections to allow higher levels of pollutants resulting from Summitville mine superfund site contamination. Local residents and scientists argued that the higher standards should be maintained to promote restoration of river and wildlife health. As a result, the EPA decided to reclassify only one small, high-altitude stretch of the river. Copper levels remain high in plants that receive water from the river. As a result, local sheep also have higher than normal copper concentrations in their livers. No animal deaths have been reported, but monitoring continues. The Alamosa River has been damaged by pollution from cyanide leaching ponds at the mine and by an attempt to "straighten" the river's course 30 years ago.

Denver Post, 5/15/98, 6/7/98, 6/14/98



WATER RIGHTS

Union Pacific considers diving into Minturn's water rights battle

Union Pacific Railroad filed a motion with the water court in June to intervene on behalf of Minturn in their battle with Vail Associates and a consortium of local water districts. While it's too early to say what financial support the railroad would provide, the company plans to provide some legal assistance. The consortium is suing Minturn over 7 cfs of water rights to the divert water from Cross Creek, a tributary of the Eagle River. Minturn had original rights, dating back to 1916, but the consortium says the town abandoned those rights because it hasn't used more than 2 cfs since the late 1930s. Now Union Pacific is trying to help protect Minturn's water so that it can develop some of its railyard, possibly taking some pressure off Minturn's thinning water budget. But the consortium feels it would be a "huge stretch" for the judge to let the railroad company intervene. The consortium wants access to the water in order to help serve 40,000 Eagle County users, according to the suit.

Vail Daily, 6/19/98

Oregon water issues similar to Colorado

Water was a hot topic at the 131st-annual meeting of the Colorado Cattlemen's Association at the Pueblo Convention Center. Andrew Purkey of the Oregon Water Trust presented the Oregon story. He said legislation there has made it possible for entire water right transfers but the Oregon Water Trust sees a need to transfer only consumptive use. Like Colorado, irrigation water rights are held by the user, with senior rights taking precedence over junior rights. It is a sellable property in both states but must be used or it will be lost. Oregon Water Trust was formed in 1993 as a private nonprofit group with most of its funding coming from public grants. Water rights can be transferred on alternate years. In the off year, the land may be idled or converted from flood to sprinkler irrigation, in addition to outright purchase or lease. Sprinkler irrigation returns less water to the stream late in the season when the salmon need more water to get upstream to lay their eggs. The state annually spends \$150 million or more on the salmon production industry. Most of Oregon cities are on the Western side of the mountains where rainfall is heavier, so there is minimal competition with agricultural irrigation. State people there also have the ability to measure instream flow to determine if there is enough water to meet senior rights, or if upstream junior rights can be used. Oregon leases or purchases water rights from cattlemen for other uses, then pays the cattleman enough to compensate for less hay production on the ranch. Water then is used to improve wildlife habitat, etc. More progressive producers are supportive of the leasing program while more conservative producers are more opposed.

Pueblo Chieftain, 7/1/98



WATER SUPPLY/DEVELOPMENT

Animas-La Plata debate continues

The Clinton administration announced that it opposes A-LP Lite, but offered no alternative during a joint hearing between the Committee on Indian Affairs and the Subcommittee on Energy and Natural Resources in June. The administration hopes Congress can develop a smaller, Indian-only alternative that is less expensive and more environmentally friendly. Sen. Ben Nighthorse Campbell, who supports A-LP Lite, requested an alternative bill and said without the Clinton administration's approval, the project is dead. He will look for ways to attach it to another bill important to the Clinton administration to get it passed. While the tribes consider suing the federal government, the Sierra Club is applauding the Clinton administration for coming out against the project. The original A-LP water project was authorized by Congress in 1968. Costing \$744 million, it would have irrigated 80,000 acres and supplied Animas River drinking water to Durango and the Southern Ute, Ute Mountain Ute and Navajo tribes. It included two reservoirs, 240 miles of pipelines and canals, seven water-pumping plants and 34 miles of electric lines. The scaled-down version, known as A-LP Lite and has a price tag of \$290 million. It includes a pumping plant at the base of Smelter Mountain in Durango and a reservoir in Ridges Basin south of Durango and eliminates almost all irrigation. It claims to satisfy the Ute treaty as well as municipal and industrial water needs of the surrounding area. A-LP Lite also settles a long-standing dispute over water rights between the federal government and the tribes. Under A-LP Lite, nontribal members who benefit would repay the government up to a capped amount. The administration feels the cap on the repayments is too low, and federal taxpayers would bear a disproportionate financial burden. The bill also would divide the original A-LP project into a different phasing than previously proposed and enable the original project to be built at some point if additional water were to become available from the San Juan River Basin. This raises renewed concerns over the same, critical environmental, financial, economic and legal issues that have kept the project from coming to fruition thus far.

Durango Herald 6/24/98, 6/25/98, 6/26/98, *Grand Junction Daily Sentinel*, 6/25/98

Time to revise 'not one drop?'

At a recent meeting, Upper Gunnison board members appeared willing to modify the board's eight-year-old, not-one-drop policy regarding

transmountain diversion of the district's water. That policy began with a motion made in 1990 by then-member Bob Decker that also prohibited the Upper Gunnison River Water Conservancy District board from entering into negotiations or studies of transmountain diversions. A policy statement by former UGRWCD manager Tyler Martineau was circulated which outlined point-to-point the district's rationale which stems from Decker's motion for opposing transmountain diversions. Martineau pointed out that all of the Upper Gunnison's water is being used and a headwater diversion such as Union Park would offer few benefits while imposing huge impacts. Although litigation with Arapahoe County thus far has been successful, future applications will lead to court, rather than the negotiation table. Barring a successful appeal of Judge Robert Brown's Union Park decision, which clearly showed little water is available for transmountain diversion in the streams of the Upper Gunnison Basin, the next likely source is Blue Mesa Reservoir.

Gunnison Country Times, 6/29/98

Arapahoe County gains three Union Park allies

Three Front Range water districts have pledged \$150,000 to carry an appeal to the Colorado Supreme Court contesting Judge Robert Brown's recent Union Park project decisions that favored Western Slope water interests. Brown ruled in April that insufficient water was available in the upper Gunnison River basin to make Arapahoe County's Union Park diversion concept economically viable. The East Cherry Creek Valley and Cherry Creek water districts and the Arapahoe Water and Wastewater District have pledged to carry the fight for Gunnison Basin water to the high court. The appeal will be the second attempt to reverse Union Park rulings. In 1991 Brown ruled that only 20,000 acre feet of water could be diverted to the proposed 900,000 acre-foot Union Park Reservoir. Arapahoe's appeal sent the case back to Brown and in the 1997 retrial, he identified 15,000 acre feet available. He ruled that the Upper Gunnison River Basin is over-appropriated due to of the Aspinall (Blue Mesa, Morrow Point and Crystal dams) senior hydropower rights. Arapahoe County water lawyers recommended another appeal. The interested districts wasted little time in lining up the funding. Arguments presented at the trials by the opposition, including Gunnison County, the Colorado River Water Conservancy District, the USA, High Country Citizens' Alliance, the UGRWCD, the state of Colorado, and local ranchers and homeowners, were overwhelming. The project may be too expensive for the water they can get from it.

Gunnison Country Times 6/29/98

Douglas County towns grapple with water demands

With the realization that the water underneath Douglas County won't last forever, regulations designed to protect the county's water supply were approved by the planning commission. The measures are intended to secure enough water for 100 years and will be applied to new development and rezonings. Most of the area's water comes from the Denver and Dawson aquifers, a nonrenewable subterranean sea. Homeowners across Douglas County are experiencing falling well-water levels and are feeling the effects of continued development in the county. Before conditions become unbearable, commissioners are considering new development regulations to insure adequate water for the future. The plan includes requirements that 1) developers drill test wells and show the supply is adequate for 100 years, 2) provide .75 acre-feet of water per household and 2.5 acre-feet for parks and gold courses and 3) defer from mining aquifer water and allow supplies to replenish whenever possible. In addition, landowners will no longer be able to see the water rights off their lands. This is a drastic change to Colorado landowners, who have enjoyed liberal property and water rights for decades. The long-term goal is to provide residents the assurance that there will be a safe, sustainable source of water for at least 100 years.

Denver Post, 6/2/98, 6/7/98, 6/9/98, 6/14/98, 6/15/98; Douglas County New Press, 7/8/98

Dry wells not foreseen for Highlands Ranch

As Douglas County and other areas around the state begin to worry about the state of their water supply, those at Centennial do not. Property rights, location and forethought on the part of Centennial Water and Sanitation District have ensured that the wells of Highlands Ranch will never run dry. According to Centennial General Manager John Hendrick, the district owns the water rights to the aquifers lying below the community, to surface water rites on the South Platte River and has an exclusive 100-year contract with Englewood for a specific amount of water each year. Even in its driest year more than 27,000 acre-feet of water is available to the Highlands Ranch. At buildout, the most the area would require within a given year would be 21,000 to 22,000 acre-feet of water. Last year, Centennial provided Highlands Ranch with surface water, never once touching its supply in the aquifers. They took water from McLellan and injected it into the aquifers, thus increasing the reserve supply. State law provides that no more than 1 percent of total aquifer water can be extracted each year.

Douglas County News Press 5/27/98

Castle Rock's water plan to cost \$45 million

The town of Castle Rock is planning strategies for funding major fiscal improvements necessary to meet their growing water demand. Capital investments totaling \$45 million by the year 2010 are needed to meet water capacity demand requirements. The largest of the improvements is expansion of the Plum Creek and Meadows water treatment plants, which serve downtown. The Town Council and their

consultant, Black & Veatch, are considering a new water rate structure, a bond issue and a sales tax as potential sources of revenue. Other options include investing an initial \$31 million by 2001 or \$23 million for projects now viewed as critical. A random survey of Castle Rock voters reveals that most are uninformed about the major overhaul needed for the town's water system, and the measures being eyed to finance the improvements. The survey, presented to the town council at its meeting July 9, shows that more than half of town residents polled have seen, read or heard "not that much" or "nothing at all" about the town's water capital improvements plan.

Douglas County News-Press 5/13/98, 7/15/98



WEATHER

La Niña could mean Colorado changes

In the tropical Pacific Ocean this May, a normally deep plume of cold water exploded to the surface of the ocean at the equator, dramatically cooling the surface water and foreshadowing major climate shifts in weather patterns across the world. This was a spectacular entrance for La Niña, which has been dubbed as the "twisted sister" and "gentle cousin" to the now famous El Niño climate phenomenon. La Niña is by no means the antithesis of El Niño, but its characteristic markings — cool ocean surface waters in the tropical Pacific — are close to the opposite of its better known counterpart. In July, nearly 100 experts from a dozen countries gathered at the National Center for Atmospheric Research in southwest Boulder to discuss the causes and consequences of La Niña events. Conference participants said they hope their efforts will help countries prepare for the extra rain or dry air La Niña may blow their way. During the last three decades, La Niñas have developed in the tropical Pacific Ocean about half as frequently as El Niños. La Niñas develop when trade winds along the equator blow strongly, sweeping warm surface waters west and allowing cool, deeper water to emerge to the surface. In some parts of the globe, La Niña's cool waters spawn weather patterns opposite to those produced during El Niños. Colorado's Front Range tends to see experience greater weather variation during La Niña years. La Niña springs in the Front Range tend to be drier than average, and more pollution-clearing winds sweep the region in the winter.

The Daily Camera, 7/16/98



WETLANDS

Wetland banking emerges as real estate industry

The hottest trading in real estate development is not on Wall Street, its in wetlands. Private and public businesses are buying and selling wetland credits with the ultimate goals being profit and ecosystem maintenance. This concept, known as mitigation banking, is spreading and a bill to expand the process is gaining momentum in Congress. A "banker" will create, restore or enhance a wetland and sell the "credits" earned to developers as mitigation for filling or degrading wetlands somewhere else. It is based on the theory that a few large wetlands are better than many small ones. Some successful restoration has been accomplished using banking, but some fear that the program is simply intended to clear the way for developers to destroy wetlands. The bill currently being considered in congress would amend the Clean Water Act to create a mitigation banking system governed by federal standards.

Grand Junction Daily Sentinel 5/31/98

WESTERN WATER POLICY REVIEW ADVISORY COMMITTEE ISSUES FINAL REPORT

The Western Water Policy Review Advisory Commission issued its final report on June 25. The Commission's report proposes principles by which federal water programs should be guided or judged. These include: (1) ensure sustainable use of resources; (2) maintain national goals and standards; (3) emphasize local implementation, innovation and responsibility; (4) provide incentives; (5) respect existing rights; (6) promote social equity; (7) organize around hydrologic systems; (8) ensure measurable objectives; sound science, and adaptive management; (9) employ participatory decision making; and (10) provide innovative funding. After examining the potential of local watershed initiatives and councils, the Commission concludes that "from the bottom up, the new federal challenge is to establish policies which direct the federal resource agencies to coordinate their activities throughout hydrologic regions. The report calls for horizontal integration among federal agencies and vertical integration with state, tribal and local activities. The Commission finds that river basin forums should be created in which federal agencies state, tribal, and local governments and stakeholder groups could come together to set joint goals for basin improvements. The Commission's report includes recommendations that the federal government honor commitments to tribal governments respecting water resources, embark on a national program to restore river ecosystems, reconsider unsuccessful approaches being used to address water pollution from agricultural sources, and reexamine the effect of federal subsidies on the sustainable use of water.

The report is available to download at www.den.doi.gov/wwprac.

Printed copies of the report will be available in mid-August. Copies may be requested after August 24 from P>O. Box 25007, D-5001, Denver, CO 80225-0007; Phone 303/445-2100, FAX 445-6465.

Western States Water 6/26/98, 7/2/98

CALLS FOR PAPERS

BENCHMARKING IRRIGATION SYSTEM PERFORMANCE USING WATER MEASUREMENT AND WATER BALANCES

San Luis Obispo, California — March 10-13, 1999

The call for papers and abstract form are available on the USCID web site — www.uscid.org/~uscid, or contact Larry D. Stephens, The U.S. Committee on Irrigation and Drainage (USCID), Phone 303/628-5430, FAX 303/628-5431, E-mail stephens@uscid.org, or see the USCID web page at www.uscid.org/~uscid. The abstract deadline is September 1, 1998.

INTERNATIONAL CONFERENCE ON THE CHALLENGES FACING IRRIGATION AND DRAINAGE IN THE NEW MILLENIUM

Sponsored by U.S. Committee on Irrigation and Drainage

Colorado State University, Fort Collins, Colorado
June 20-24, 1999

The call for papers and the abstract form are available on the USCID web site — www.uscid.org/~uscid, or Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org. The abstract deadline is January 1, 1999.

MEETINGS



COLORADO WATER CONGRESS 1998 Summer Convention Program Snowmass Village at Aspen August 27-28, 1998

The morning session will include presentations by 12 keynoters on water issues and two panel discussions:

“A Divided or a United Water Community — What Do We Want?” with panelists John Porter, Manager, Dolores Water Conservancy District, Cortez; Ray Wright, President, Rio Grande Water Conservation District, Monte Vista; and Eric Wilkinson, Manager, Northern Colorado Water Conservancy District, Loveland; and “The 1999 Legislative Session” with panelists Senator Don Amant (R-Iliff) (Invited); Representative Russell George (R-Rifle); Representative Carl Miller (D-Leadville); and Representative Matt Smith (R-Grand Junction).

The luncheon address will be presented by Frank “Sam” Maynes, Maynes, Bradford, Shippy & Sheftel, Durango on “The Use of Fictional Facts and Compact Threats.”

The afternoon session will include the following presentations on pending water issues:

“Endangered Species and the Feds” — Tom Pitts, Water Consultant, Loveland

“HB98-1006 — Endangered Species Funding” — Julie McKenna, Trout & Raley, P.C., Denver

“HB98-1288 (Water Transfers) — The Next Step” — Stan Cazier, Baker, Cazier and McGowan, Granby

“Some Ideas on By-Pass Flows” — Sara Duncan, Intergovernmental Affairs Coordinator, Denver Water, Denver

CALL FOR ABSTRACTS

Second Annual Student Water Symposium
Colorado State University, November 3-6, 1998

All CSU graduate and undergraduate students are invited to present ongoing or completed water-related coursework or research projects. For more information or an abstract submittal form, see the website <http://lamar.colostate.edu/~watersym/> or send an E-mail to watersym@lamar.colostate.edu.

FIFTH BENCHMARK WORKSHOP ON NUMERICAL ANALYSIS OF DAMS Denver, Colorado — June 2-5, 1999

The U.S. Committee on Large Dams (USCOLD) has issued a call for papers for its 5th workshop. The workshop will provide an in-depth examination of the computational methods and software used for dam analysis, including concrete dams and embankment dams. The abstract deadline is September 30, 1998. For information contact Pasquale Palumbo, Technical Secretariat, Via Pastrengo, 9, 24068 Seriate (BG), Italy. Phone 39-35-307-111, FAX 39-35-302-999, E-mail ppalumbo@ismes.it.

See the U.S. Committee on Large Dams web page at www.uscold.org/~uscold.

- "Initiatives, Initiatives, Initiatives and More Initiatives" — Steve Leonhardt, Fairfield and Woods, P.C., Denver
 "SB96-74 (Groundwater Study) — Is There an End in Sight" — Mike Shimmin, Vranesh and Raisch, L.L.C., Boulder
 "Funding State Water Quality — What's Fair?" — Gene Megyesy, Dufford and Brown, P.C., Denver
 "Sharing the Pies of Pain" — David C. Hallford, General Counsel, Colorado River Water Conservation District
 "Uses of the Colorado Water Conservation Board Construction Funds" — Dialogue led by Peter Evans, CWCB Acting Director

August 28 will include a general session with presentations by Colorado agency directors (or their representatives); and "The 1998 Elections — An Overview" — by Fred Brown, Political Editor, The Denver Post, Denver.



Colorado Water Law Seminar
September 14-15, 1998
CWC Conference Room, Denver, Colorado

For information about the conference and seminar, contact the Colorado Water Congress, 1390 Logan Street, Suite 312, Denver, CO 80203. Phone 303/837-0812.



NOT IN MY WATERSHED!
Changes In Water and Land use In the South Platte Basin
The 9th Annual South Platte Forum — October 28-29, 1998
Raintree Plaza Conference Center, Longmont, Colorado

The management of growth issues in the South Platte Basin involves rapidly changing water and land uses. Can these changes in traditional uses be integrated in a way that satisfies the competing demands of various interest groups and water users? The 9th Annual South Platte Forum will continue its tradition of presenting multi-disciplinary dialogue on timely resource issues with a forum that addresses changing land and water uses from a variety of perspectives, including agricultural, environmental, municipal, and urban viewpoints. The conference will feature the following sessions and presenters:

Invited Keynote Speakers:

U.S. Representative David Skaggs
 Justice Gregg J. Hobbs, Jr.

Special Geographical Presentation

Dr. William Riebsame, University of Colorado
 Author of *Atlas of the New West*

Instream Flows...Coming Soon to a River Near You

Fred Anderson, Former Colorado Senator; Melinda Kassen, Colorado Trout Unlimited; Patty Wells, Denver Water

The Miracle of Fishes and Flows

Don Ament, Colorado State Senator; Jay Stafford, Colorado Division of Wildlife; Dale Strickland, Western EcoSystems Technology, Inc.

Models, Maps and Modems

Luis Garcia, Colorado State University; Donald Schrupp, GIS Department, Colorado Division of Wildlife; Tony Selle, GIS Department, U.S. EPA

Days of Swine and Roses

Tom Haren, Colorado Cattle Feeders; Dave Haywad, National Hog; Dave Holm, CO Water Quality Control Division

The ABCs of TMDLs

Ray Christiansen, Colorado Farm Bureau; Greg Parsons, CO Water Quality Control Division; Robert Wiygul, EarthJustice Legal Defense Fund

Can't We All Just Get Along?

Alan Covich, Colorado State University; Rob Sakata, Sakata Farms

To request information about the conference, contact:

Laurie Schmidt

Colorado Water Resources Research Institute

410N University Services Center

Fort Collins, CO 80523-2018

Phone: 970/226-0533 FAX: 970/491-2293 E-mail:

lschmidt@lamar.colostate.edu



MODFLOW '98

INTERNATIONAL GROUND WATER MODELING CENTER (IGWMC)
 COLORADO SCHOOL OF MINES, Golden, Colorado
 October 4-8, 1998

The IGWMC, in cooperation with the Office of Special Programs and Continuing Education of the Colorado School of Mines, is organizing its 3rd international conference, MODFLOW '98. The conference will bring together the users and developers of MODFLOW and related modeling programs to present the latest innovations in model applications, discuss the capabilities and limitations of MODFLOW, and explore the needs and directions for future developments. The conference will include a series of keynote presentations on topics ranging from the history of MODFLOW to the visions for groundwater modeling in the 21st Century, demonstrations of the latest MODFLOW-related software products, and participation in workshops, seminars and poster sessions. The conference will be held on the Colorado School of Mines campus in Golden, Colorado, October 4-8, 1998. Conference registration is \$545, which covers the conference proceedings, evening receptions, lunches and breaks. A reduction will be made for students registered for a degree. For more information, contact the Colorado School of Mines, Office of Special Programs and Continuing Education at 303/273-3321, FAX 303/273-3314, e-mail space@mines.edu. Co-sponsored by U.S. Geological Survey and Waterways Experiment Station, U.S. Army Corps of Engineers.

COURSES ASSOCIATED WITH MODFLOW98 CONFERENCE

Sept 29-Oct. 2 4.5 days 2@8am-5pm, 8am-8pm & 8am-60m	MODFLOW - Introduction to Numerical Modeling (Completely overlaps with UCODE course for calibration instruction)	Eileen Poeter William Wingle	\$1295 w/MOD98 \$1495 w/o
Oct. 1-2 1pm-8pm & 8am-6pm	UCODE - Universal Inversion Code - Automated Inversion of "Any" codes (Soon-to-be-released, jointly sponsored USDoD-IGWMC-USGS code)	Eileen Poeter William Wingle	\$795 w/MOD98 \$995 w/o
Oct. 4 8am-5pm	Applied Inverse Modeling: Why use anything less?	Evan Anderman	\$395 w/MOD98 \$495 w/o
Oct. 4 8am-5pm	MT3DMS WORKSHOP	Chunmiao Zheng	\$395 w/MOD98 \$495 w/o
Oct. 5 7:15-10pm	MODFLOW Trouble Shooting IGWMC via a panel of experts		\$99 w/MOD98 \$199 w/o
Oct. 8 8am-5pm	PEST - Parameter Estimation for "Any" Code (Automated Calibration of "Any" Code)	John Doherty	\$395 w/MOD98 \$495 w/o
Oct. 8-9 8am-5pm	SIMULATION/OPTIMIZATION (S/O) MODELING FOR OPTIMAL GROUNDWATER MANAGEMENT	Richard Peralta Aala Aly	\$945 w/MOD98 \$1045 w/o

Contact:

IGWMC - International Ground Water Modeling Center
 Colorado School of Mines
 Golden, CO 80401, USA

Phone: 303-273-3103 FAX: 303-384-2037

WWW URL: <http://www.mines.edu/igwmc/>

E-Mail: igwmc@mines.edu

CALENDAR

- Sept. 9-10 PRACTICAL APPROACHES TO BETTER GROUNDWATER MANAGEMENT, San Antonio, TX. Contact: The Groundwater Foundation, P.O. Box 22558, Lincoln, NE 68542-2558, FAX 402/434-2742, E-mail susan@groundwater.org.
- Sept. 20-23 1998 GROUNDWATER, SOURCE WATER, AND UNDERGROUND INJECTION FORUM AND TECHNICAL EXCHANGE EXPOSITION, Sacramento, CA. Contact: Ground Water Protection Council, Phone 405/848-0690, FAX 405/848-0722, E-mail ben@gwpc.site.net, WWW <http://gwpc.site.net/meetings.htm>.
- Sept. 27-30 PEAKS TO PRAIRIES: A CONFERENCE ON WATERSHED STEWARDSHIP, Rapid City, SD. Contact Thorne Ecological Institute by July 15. Phone 303/499-3647, FAX 303/499-8340, E-mail dir@thorneecoinst.org.
- Sept. 27-Oct. 2 GAMBLING WITH GROUNDWATER, Physical, Chemical, and Biological Aspects of Aquifer-Stream Relations, Las Vegas, NV. Contact: IAH/AIH Conference Las Vegas — Conference Headquarters, Attn: Helen Klose, 2499 Rice St., Suite 135, St. Paul, MN 55113-3724, Phone 612/484-8169, FAX 612/484-8357, E-mail AIHydro@aol.com.
- Sept. 28-30 SMART GROWTH IN COLORADO — Governor's Conference on Emergency Management, Breckenridge, CO. For conference information call 303/273-1622.
- Oct. 8-9 FOURTH WESTERN REGIONAL INSTEAM FLOW CONFERENCE, Water for Fish vs. Water for People: A Real Conflict? Copper Mountain Resort, CO. For more information regarding the conference program, contact conference director David Nickum at 303/837-9383.
- Oct. 11-14 DAM SAFETY '98, Las Vegas, NV. Contact: Assoc. of Dam Safety Officials, Phone 606/257-5140, FAX 606/323/1958, E-mail damsafety@aol.com.
- Oct. 28-31 CONFERENCE ON SHARED RIVERS, River Basin Management to Meet Competing Needs, Park City, UT. Contact: Larry D. Stephens, Phone 303/628-5430, FAX 303/628-5431, E-mail: stephens@uscid.org.
- Nov. 10-13 18TH INTERNATIONAL SYMPOSIUM, NORTH AMERICAN LAKE MANAGEMENT SOCIETY (NALMS), Cooperative Lake and Watershed Management: Linking Communities, Industry and Government, Banff, Alberta, Canada. Registration information can be found at the NALMS web site <http://www.biology.ualberta.ca/alms/1998/htm>.
- Nov. 15-19 34th ANNUAL CONFERENCE ON WATER RESOURCES 7 SYMPOSIUM ON APPLICATIONS OF WATER USE INFORMATION, Point Clear, AL. Contact American Water Resources Assoc., Phone 703/904-1225, FAX 703/904-1228, E-mail awrahq@aol.com

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

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