Colorado Water

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

WATER ITEMS AND ISSUES . . . *December 1992*

Dam safety overtopping facility in action

U.S. Bureau of Reclamation and Colorado State dedicate Dam Safety Overtopping Research Facility *(see page 18)*

UPCOMING MEETINGS

Colorado Water Conservation Board schedules January meeting on FRONT RANGE WATER COOPERATION AND WATER TRANSFERS ***(see page 3)***

Society of Wetland Scientists, Rocky Mountain Chapter, sponsors February meeting on WESTERN WATER LAW AND POLICY: IMPLICATIONS FOR WETLAND AND RIPARIAN SYSTEMS ***(see page 31)***

AWRA-Colorado Section presents a symposium on
BASIN PLANNING & MANAGEMENT:
WATER QUANTITY AND QUALITY

Plan to attend this full-day symposium on March 5, 1993 that will examine Colorado water supply and water-quality issues.

Contact: ***Dave Mueller, USGS-WRD, P.O. Box 25046-MS15, Lakewood, CO 80225. FAX: 303/236-4912***

Colorado State University

LET'S TALK!

Editorial by
Robert C. Ward

An evolving concern within water management today is the development of a more holistic, ecologically-based, management strategy. This subject was the focus of the 1992 South Platte Conference held in Fort Collins October 27-28, 1992. During the conference, I was struck by how much the participants, from a wide cross-section of disciplines and organizations, enjoyed the opportunity to voluntarily discuss, from the perspective of their individual disciplines, the water management concerns brought about by the introduction of an ecological integrity goal within the Clean Water Act. There seemed to be a consensus that such informal discussions allow us to address some of our water management problems and issues in the more integrated manner being demanded today.

For most of us, simply keeping up with advances in our own disciplines and the day-to-day operation of our own organization seems to consume all of our time. There is little time left to meet, informally, with water professionals from other disciplines, organizations, or segments of the water community to determine their views and concerns and seek mutually agreeable solutions.

How do all of the competing issues get integrated into a widely accepted Colorado water management strategy? I suggest the answer lies in better communication! Operationally, developing better communication begs further questions. What is the forum that would permit such voluntarily water discussions across disciplines and organizations? How do we get the time to devote to such a forum? Who will organize and lead us into these discussions?

The results of November 3 indicate to me that we may have to answer the above questions sooner rather than later. We are being asked by the voters to change the way we do business. We can no longer afford a narrow, discipline and/or organization-oriented view of water management. We must find a way to meet and informally discuss commonalities we share regarding water management in Colorado and seek solutions in those areas where we disagree.

CWRRI WATER RESEARCH PROGRAM
REQUEST FOR PREPROPOSALS
CLOSING DATE: February 1, 1993

Preproposals are invited for the Colorado Water Resources Research Institute FY1993-94 water research program. CWRRI is especially interested in projects that feature collaboration between university researchers and water management organizations. Demonstrating collaboration in the preproposal stage will enhance the possibility of an award. Highest priority will be given to projects that address Colorado's most critical water problems as identified by CWRRI's Research Planning Advisory Committee:

- Drought and runoff forecasting
- Water data collection and management
- Water transfer "costs" and alternatives
- Institutional arrangements for water management
- Conjunctive management of surface and groundwater
- Groundwater quality management
- Best management practices for irrigation
- Wetland management
- Defining "ecological integrity" of western streams
- Water rights administration
- Water education

Project Duration--Awards will be made for one year beginning September 1, 1993.

COLORADO WATER

Vol. 9, No. 6 Date: Dec. 1992

Editor
Shirley Miller

Writers
Denise Fisher
Jennifer Roberts
Greg Silkensen
Craig Woodring

Writer-Librarian - Mary DeMartini

COLORADO WATER is a publication of the Colorado Water Resources Research Institute. The scope of the newsletter is devoted to enhancing communication between Colorado water users and managers and faculty at the research universities in the state.

This newsletter was financed in part by the U.S. Department of the Interior, Geological Survey, through the Colorado Water Resources Research Institute. The contents of this publication do not necessarily reflect the views and policies of the U.S. Department of the Interior, nor does mention of trade names or commercial products constitute their endorsement by the United States Government.

Published by the Colorado Water Resources Research Institute, Colorado State University, Fort Collins, CO 80523. Phone: (303) 491-6308

Robert C. Ward, Director

Funds Available--For 1992-93 CWRRI awarded 12 projects with direct costs in the range of $10,000-20,000. Awards for 1993-94 will depend on CWRRI's receiving an appropriation from the Colorado Legislature.

Review Procedures--Preproposals will be evaluated by the Technical Advisory Committee (faculty of CU, CSM and CSU) and by the Research Program Advisory Committee (practitioners). Authors of preproposals judged to have a strong chance of final award will be invited to prepare full proposals. Criteria of selection include: (1) relevance of research product to priority Colorado water problems; (2) scientific merit; and (3) performance record of principal investigator.

Eligibility--Open to regular, full-time faculty of Colorado State University, the University of Colorado and the Colorado School of Mines. For additional information call the CWRRI office at 491-6308.

Preproposal Format--Submit one-page preproposal, resume (not to exceed three pages), and budget estimate (not to exceed $20,000) to the Colorado Water Resources Research Institute, 410N University Services Center, Colorado State University, Fort Collins, CO 80523.

RESEARCH OPPORTUNITIES

The Environmental Protection Agency (EPA) is seeking applicants for cooperative agreements or grants to support projects to design, demonstrate, or disseminate practices, methods, or techniques related to environmental education and training as specified in Section 6 of the National Environmental Education Act (Public Law 101-619). The pre-application deadline is **January 15, 1993.**

The U.S. Department of Agriculture, Cooperative State Research Service, invites applications for competitive grant awards under the Special Research Grants, Water Quality Program for FY1993. Deadline is **December 21, 1992.**

Contact your contracts and grants office for more information.

A Colorado Water Convention!

Governor Roy Romer, the Colorado Department of Natural Resources, the Colorado Water Conservation Board, the State Engineer and the Division of Water Resources are sponsoring a Colorado water meeting January 4 and 5, 1993, entitled:

FRONT RANGE WATER COOPERATION
AND
TRANSFER OF WATER FROM ONE AREA OF THE STATE TO ANOTHER

On the first day, the meeting will feature Governor Romer discussing the role of the State of Colorado in addressing Front Range water challenges as well as remarks by Front Range municipal leaders discussing cooperation among cities for developing future water supplies for the Front Range area. Lee Rozaklis, with Hydrosphere, will discuss the options for future Front Range water supply, to be followed by a number of presentations and panel discussions about specific options.

On the second day of the meeting, Legislators will discuss the transfer of water within Colorado. A panel of water leaders will discuss the topic: "Area of Origin Protection - Is there a need for statutory protection in out-of-basin transfers?" Another panel will then discuss alternative legislative proposals.

Meeting plans are currently being finalized. For additional information, please contact the offices of the Colorado Water Conservation Board at 303/866-3441.

WATER RESEARCH

WETLANDS DECONTAMINATE ACID MINE DRAINAGE, STUDY SHOWS

Wetlands that maintain a continually anaerobic environment can decontaminate acid mine pollution, say Professor Willard Lindsay and Mr. Edward Brennan of CSU's Department of Agronomy. Lindsay and Brennan recently completed a CWRRI-sponsored study on the fate of heavy metals in Colorado waters.

Oxidation causes ores that contain sulfides to significantly increase the acidity of mine drainage waters. The process also increases the solubility of metals in the ore and sediments contacted by these waters. Reversing this process, then, through removing the oxygen (chemical reduction), should precipitate (separate out) many heavy metals as sulfides and at the same time increase pH.

Anaerobes, which are microorganisms that can live and grow where there is no free oxygen, get oxygen from decomposing compounds that contain it. In the case of heavy metals, the decrease in oxygen results in metal sulfide precipitation, whereby the metals become insoluble once again.

Lindsay and Brennan conducted two long-term laboratory experiments - one on oxidation and the other on oxygen removal - using sediments collected from the area of Leadville, Colorado. The results confirm that wetlands can provide an effective medium through which acid mine pollution can be abated.

(The project completion report will soon be available).

WATER CLEANUP MAY NOT BE ENOUGH TO RESTORE BROWN TROUT

Remedial action at California Gulch may reduce concentrations of heavy metals in water, but levels present in contaminated sediments and underwater organisms may continue to impact the system, according to Dr. Will Clements. Clements, Professor of Fishery and Wildlife Biology at CSU, is studying the bioaccumulation of heavy metals by brown trout in the Arkansas River. His research indicates that the primary pathway for bioaccumulation of heavy metals by brown trout is:

water-->seaweed, underwater organisms-->
aquatic insects-->brown trout

Thus, although remedial action at California Gulch is expected to reduce concentrations of heavy metals in water, levels still present in contaminated sediments and underwater organisms may continue to affect the brown trout population.

Clements tested brown trout from two stations located upstream (AR1) and downstream (AR5) from California Gulch. Results indicated that the fish consumed prey that were highly contaminated with heavy metals. Metal concentrations in liver and kidney tissue were generally similar at stations AR1 and AR5. The similar levels of metals in fish from the two stations, despite greater exposure at AR5, suggest that the fish regulated metals in these storage tissues.

Metal concentrations in gill and gut tissue, however, were greater at the downstream station, indicating that brown trout consumed prey that were highly contaminated with heavy metals. Brown trout tissues that were directly exposed to metals in food (gut tissue) and water (gills) had higher levels of metals at station AR5 compared to AR1. Zinc, in particular, was significantly elevated in gill and gut tissue at AR5.

Clements' research was sponsored through a CWRRI project in 1990-91, and in 1992 he received a matching grant from the U.S. Geological Survey to continue his work.

RECREATIONISTS WILLING TO PAY MORE FOR SATISFACTORY WATER LEVELS IN RESERVOIRS

Initial findings of a CWRRI research project show that recreationists highly value reservoir-based recreation and are willing to pay a minimum of $2 more per visit to assure that water is available. The results also show that there is a significant recreation economic loss due to drawdown on reservoirs. Maintaining full reservoirs is preferred by most users; however, three-quarters full is acceptable to most.

Tourism, Colorado's number one industry, generates over $6 billion per year, and reservoirs are a significant recreation resource, both for tourists and for native Coloradans. The recently completed CWRRI study looked at the economic impact of drawdown due to loss of recreation opportunities, and also compared the recreation economic losses to the cost of water rights purchases that would mitigate these losses.

Using Boyd Lake as an example, Robert Aukerman, Principal Investigator on the project, said that with the $2 fee primary water rights could be purchased and paid for with user-fee revenues within a maximum of 50 years. Aukerman is a member of the Recreation Resources Department at CSU.

The Colorado Division of Parks and Outdoor Recreation cooperated in the study.

MUTUAL IRRIGATION COMPANIES CAN HELP FARMERS IMPROVE WATER QUALITY

Recent new environmental legislation, particularly the 1992 Farm Bill, has presented state and local government with the task of implementing water conservation and sustainable agriculture programs on a broad scale. In addition, the 1988 Colorado Non-Point Assessment Report outlined water quality goals that include reducing pollution in rivers and groundwater basins through the development of "Best Management Practices."

A 1991-92 CWRRI project looked at encouraging mutual irrigation companies, which have a unique role in the west, to participate in water quality management efforts. The New Cache la Poudre Irrigation Company, located in Northern Colorado, participated in the study. The company has two primary water supply sources: (1) river decrees along the Cache la Poudre River, all of which are quite old; and (2) individual grower water accounts in the Colorado-Big Thompson Project which are integrated into the overall company water management-delivery program.

The company divides its service into a "river season" of approximately seven weeks and a "reservoir season" of approximately 12 weeks. Traditional informal river exchanges and swaps in storage options between neighboring companies help move abundant supplies of water during the peak flow of the river season to later in the irrigation season when the river hydrograph drops drastically.

The company is investigating ways in which canal nitrate loading might be adjusted to better fit nitrate demand and risk curves. Using management options on how various water supplies (river and reservoirs) can be drawn and blended during the irrigation season, the company could physically manipulate nitrate loading to achieve a peak during the period of sidedressing application (applying nitrogen during period of greatest uptake by plant) and minimizing during high risk periods (a point when certain crops are at high risk from water-bearing nitrates).

Irrigation companies, which serve anywhere from 30 to 400 farmers that irrigate from 2500 to 50,000 acres of farmland, could provide a collective approach to better management practices. The study shows that farmers have great interest in how their water organization can facilitate the adoption of more sustainable agricultural practices. The New Cache la Poudre Irrigation Company, in response, has indicated a strong willingness to better serve its shareholders through an expanded water management program that includes water quality monitoring.

Project investigators are Professor David Freeman and Dr. John Wilkens-Wells, Department of Sociology, CSU.

(The project report, A Case Study on the Role of Mutual Irrigation Companies in Water Quality Management, is being printed and will soon be available).

MODELING WITHIN-STATE AND INTERSTATE MARKETS FOR COLORADO RIVER WATER RESOURCES

by J. F. Booker and R. A. Young

(The following is a summary of a paper that has been submitted for publication to the Journal of Environmental Economics and Management)

This paper reports on work that extends previous optimization models of market transfers and describes **CRIM**, The Colorado River Institutional Model. **CRIM** was developed to investigate the performance of alternative market institutions for river basins - in particular, to study the potential for increasing beneficial use of Colorado River water resources. An important objective was to estimate economic benefits of moving from existing allocations to those allowing transfers from expanded within-state and interstate consumptive use markets. A second objective was estimating the performance of consumptive use (one time only) water markets relative to efficient allocations which include additional values in nonconsumptive uses (multiple uses).

The model links river flows, salinity concentrations and demand sectors across river locations. It incorporates annual consumptive use benefits, hydropower benefits, and costs and benefits of salt discharges as integral model components. Fourteen nodes include sectors with economic demand for consumptive or nonconsumptive use, while an additional six nodes are used for significant sources or depletions of river water and salt loads, or for important geographical or institutional features.

The researchers applied **CRIM** to a study of the estimated impacts on Colorado River water users of six alternative institutional scenarios:

Scenario 1--*approximates the allocation of Colorado River water under the interstate and within-state priorities known as the "Law of the River," which includes state water law, federal legislation, two interstate compacts, a treaty with Mexico, and several court decisions.* Using flows of 12.99 maf/year at Lee's Ferry, most present requests for Basin water can be fully satisfied.

Scenario 2--*allows unrestricted within-state transfers based on water values in consumptive uses.* Removing barriers to water marketing within California would likely result in significant transfers between southern California municipal users and California agricultural water rights holders in the Imperial, Coachella, and Palo Verde Valleys. Model results indicate that with present demand and long-term flow levels, these municipal users would benefit from water transfers up to the Colorado River Aqueduct capacity if marginal opportunity costs (foregone benefits in alternative uses) are less than $300/acre-foot. Imperial Valley irrigators could benefit from such transactions at marginal opportunity costs as low as $20/acre-foot. The total benefit to southern California municipal users of eliminating the

260 thousand acre-foot shortfall (kaf) found under existing priorities and the long-term flow level is nearly $100 million annually. Distributed over the estimated 1990 Metropolitan Water District service area population of 15 million, annual benefits (not including costs paid to Imperial Valley irrigators, or salinity damages) are about $7 per capita.

Scenario 3--*considers unrestricted interstate (and within-state) transfers based on consumptive use values alone.* Upper Basin use declines by 150 kaf over the full request level, with the reductions distributed across agricultural areas whose existing requests total about 2,300 kaf. Lower Basin agricultural uses decrease by 110 kaf. The additional increase in net consumptive use benefits over that achieved with scenario 2 allowing within-state transfers is only 1%; total benefits (including values in nonconsumptive uses) increase by 22%, however. Foregone agricultural income is reduced 14% by distributing use reductions between Upper and Lower Basins.

> *Scenarios 4 and 5 include consumptive use values and economic values for hydropower production and salinity reduction. Scenario 6 includes all identified economic values and allows unrestricted transfers, theoretically equivalent to a comprehensive water resources bank.*

Scenarios 4-6--Inclusion of nonconsumptive use values in a water market would result in significant Upper to Lower Basin transfers. Model results confirm that large transfers are in fact economic efficiency improvements when more complete sets of values are considered. Inclusion of hydropower values results in reductions in Upper Basin use of 610 kaf, or 26% of modeled requests, while inclusion of salinity values gives 30% (690 kaf) reductions in Upper Basin modeled requests.

These results imply that down-river hydropower benefits and reductions in salinity damages by dilution each exceed marginal benefits in over one quarter of existing Upper Basin irrigation uses. Because significant salt discharges arise from Upper Basin irrigated agriculture outside the Grand Valley and are not included here, the estimated level of water transfer quantities and benefits represents an underestimate of those that could occur with an interstate market including salinity reduction values.

CONCLUSIONS--Consumptive use markets that exclude instream flow values achieve considerably smaller efficiency gains than are possible with allocations based on the full set of consumptive and nonconsumptive use values. Inclusion of nonconsumptive use values in Basin water allocation institutions is problematic, however, on technical grounds and for reasons of regional equity.

Because benefits of interstate markets over within-state markets are almost exclusively in nonconsumptive uses, any interstate transfers would likely be the result of constraints on Lower Basin within-state transfers, particularly in California. In the absence of such constraints, significant private incentives for interstate over within-state transfers might occur only if market institutions develop to include both consumptive and nonconsumptive use values.

NOTE--James F. Booker's Ph.D dissertation on this subject was selected for the Outstanding Water Resources Dissertation award in the category of Social and Behavioral Science by the Universities Council on Water Resources. Booker is now a Resource Economist at the Wyoming Water Resources Center, University of Wyoming, where he continues research on Colorado River issues as a member of a multi-state team studying impacts of severe and sustained drought in the basin. Booker obtained his Ph.D from the Department of Agricultural and Resource Economics, Colorado State University. Robert A. Young, Professor in the Department, was his faculty adviser.

This project was supported by Grant No. 14-08-0001-G1644 from the U.S. Geological Survey, with additional support by the Agricultural Experiment Station at Colorado State University.

USGS COMPILES PROJECT DESCRIPTIONS FOR 1991-92 MATCHING GRANTS

A report recently distributed by USGS provides information on the 36 projects funded in FY1991 by the U.S. Geological Survey's Water Resources Research Grant Program (Matching Grants) and on 41 projects completed during the year. Awards by area-of-interest are listed below.

Interest Area	No. of Proposals	No. of Awards	Federal Funds
Groundwater Flow and Transport	64	6	$ 651,990
Engineering	64	4	626,278
Water Quality	53	5	674,204
Biological Sciences	40	5	638,624
Social Sciences	40	8	895,304
Climate and Hydrologic Processes	54	8	871,600
Totals	315	36	$4,358,000

William Clements, Department of Fishery and Wildlife Biology at Colorado State, received a grant to continue his studies on the responses of benthic communities to heavy metals.

The projects-completed section includes abstracts of two Colorado research efforts.

Facilitating Voluntary Transfer of Bureau of Reclamation-Supplied Water, by Lawrence MacDonnell, Principal Investigator. MacDonnell examined the effect of federal law, policy and procedures on the transfer of water supplies from federal storage facilities to new users. The project completion report is available from the National Technical Information Service, Order Department, Springfield, VA 22161. Order No. PB92-102383; or contact Larry MacDonnell at the Natural

Resources Law Center, University of Colorado, Campus Box 401, Boulder, CO 80309-0401.

Climate and Streamflow Variability Related to Surface Water Supply in the Western United States, by Thomas B. McKee, Principal Investigator, and Nolan J. Doesken. The project investigated three primary hydroclimatic elements - total water-year streamflow, accumulated precipitation, and April 1 snowpack - to determine characteristics of the spatial and temporal climate variability in a five-state region of the northern Rocky Mountains. The study covered the 1951-1985 period. Order No. PB91-143115. The project completion report is available from the National Technical Information Service at the address above.

Water Resources Research Grant Program Project Descriptions, Fiscal Year 1991, Open-File Report 92-161, is available from the U.S. Geological Survey, Books and Open-File Reports Section, Box 25425, Federal Center, Denver, CO 80225.

CONGRESS PROVIDES FUNDING FOR 1992-93 STATE WATER INSTITUTES PROGRAM

In early October Congress passed and the President signed the Appropriations Bill for the Department of the Interior and Related Agencies. The bill included $5.529 million for the State Water Institutes Program. The figures provide for an 0.85 percent across-the-board reduction imposed by the Congress. The Section 105 Matching Grant Program was not funded.

WATER RESEARCH AWARDS

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

Colorado State University, Fort Collins, CO 80523

GLOBAL OPTIMIZATION FOR GEOPHYSICAL APPLICATIONS USING GENETIC ALGORITHMS, Darrell Whitley, Computer Sci.

INVESTIGATION OF NONPOINT TOXIC SITES IN THE DELAWARE WATER GAP NATIONAL RECREATION AREA..., Del Wayne Nimmo, Fishery and Wildlife Biology

MOISTURE MOVEMENT AND HEAVE BENEATH SIMULATED FOUNDATION SLABS ON EXPANSIVE SOIL, John Nelson, Civil Engineering

A GLOBAL DISTRIBUTION OF PRECIPITABLE WATER CONTENT FROM PRESENT DAY MICROWAVE SATELLITES..., Graeme Stephens, Soils Laboratory

BIOLOGICAL AND CHEMICAL MONITORING OF DDT AND METABOLITES WITHIN RIO DE LOS FRIJOLES CREEK..., Del Wayne Nimmo, Fishery and Wildlife Biology

POLLUTANTS IN THE CUYAHOGA RIVER NRA: TOXICITY ASSESSMENT OF TRIBUTARIES AND SEDIMENTS... Del Wayne Nimmo, Fishery and Wildlife Biology

INVESTIGATION OF NONPOINT TOXIC SITES IN NATIONAL PARKS: FRIENDSHIP HILL NATIONAL HISTORICAL SOCIETY..., Del Wayne Nimmo, Fishery and Wildlife Biology

RANGE ANALYSIS - DINOSAUR NATIONAL MONUMENT, Milton Trlica, Range Science

QUANTIFICATION OF FEDERAL RESERVED WATER RIGHTS FOR NATIONAL PARK PURPOSES, Tom Sanders, Civil Engineering

SAN FRANCISCO BAY CLIMATE CHANGE, Kenneth Wilson, Cooperative Fish & Wildlife Research Unit

NITROGEN AVAILABILITY EFFECTS ON COMPETITIVE REPLACEMENT OF GRASSES BY SHRUBS, Edward Redente, Range Science

IMPACT OF HISTORICAL LANDCOVER AND LANDUSE CHANGE ON WEATHER AND CLIMATE, Roger Pielke, Atmospheric Science

TESTING MODELS OF PLANT CANOPY STRUCTURE AND GAS EXCHANGE, William Parton, Natural Resources Ecology Lab

University of Colorado, Boulder, CO 80309

BRIDGE MANAGEMENT SYSTEMS, George Hearn, Civil, Environmental and Architectural Engineering (CEAE)

ATMOSPHERIC WATER VAPOR OVER THE ARCTIC AND ITS RELATIONSHIP WITH SYNOPTIC VARIABILITY AND SURFACE CONDITIONS, Mark Serreze, Cooperative Institute for Research in Environmental Sciences (CIRES)

THE EFFECTS OF CLIMATE VARIATION ON DISTURBANCE REGIMES AND THE DYNAMICS OF MONTANE FORESTS IN THE COLORADO FRONT RANGE, Thomas Veblen, Geography

USING WATER BANKS TO PROMOTE MORE FLEXIBLE WATER USE, Lawrence MacDonnell, Natural Resources Law Center

BROMIDE-OZONE INTERACTIONS IN WATER TREATMENT: BROMATE VS. ORGANO-BR DISINFECTION BY-PRODUCT (DBP) FORMATION, Gary Amy, CEAE

A HIERARCHIC GIS FOR STUDIES OF PROCESS, PATTERN AND SCALE IN ARCTIC ECOSYSTEMS, Donald Walker, CIRES

RESOURCE STORAGE IN ALPINE PLANTS, Steven Schmidt, Environmental, Population and Organismic Biology

ARCTIC SYSTEM SCIENCE LAND/ATMOSPHERE/ICE INTERACTIONS: A DATA MANAGEMENT PILOT STUDY, Claire Hanson, CIRES

PROTOTYPING EOS INTEGRATED DATA ANALYSIS TECHNIQUES USING AVIRIS AND AIRSAR DATA, Fred Kruse, CIRES

THE EFFECTS OF PREOXIDANTS AND CHEMICAL COAGULANTS ON THE COLLOIDAL STABILITY OF PARTICLES AND THEIR REMOVAL DURING WATER TREATMENT, Gary Amy, CEAE

CHEMICAL INVESTIGATION OF SYNTHESIZED STORMWATER, Gary Amy, CEAE

MEASUREMENT OF ATMOSPHERIC TRACE GASES AT C-1, NIWOT RIDGE, COLORADO, Mark Losleben, Institute of Arctic and Alpine Research

STUDY ON THE REQUIRED HTRW REMEDIAL ACTION WORK BREAKDOWN STRUCTURE (RA-WBS) FOR VARIOUS TYPES OF REMEDIATION TECHNOLOGY, James Diekmann, CEAE

IMPROVED CLIMATE DATA SETS FOR GLOBAL CHANGE RESEARCH: A LONG-TERM ARCHIVE OF OLS (visible and infrared) PRODUCTS FROM THE DEFENSE METEOROLOGICAL SATELLITE PROGRAM, Roger Barry, CIRES

MODELING OF CO2 IMPACT ON A GRASSLAND SYSTEM, William Parton, Natural Resources Ecology Lab

---

FEATURES

THE POLITICAL SOCIOLOGY OF DEFINING ECOLOGICAL INTEGRITY: WHY WE NEVER END UP WHERE WE INTEND

by David Freeman, Professor of Sociology, Colorado State University

(Presented at the South Platte Basin Conference, October 27-28, 1992)

In a very real sense, we know well what ecological integrity means, and we know that we are tethered very tightly to the ecosystem. If we abuse that ecosystem, human-choice opportunities are quickly destroyed.

There is another sense however, in which we don't know what ecological integrity means. It is the same sense in which we are not really sure what living in the middle means. On the one hand- if I may use the metaphor of an automobile, a filling station and a gas tank- if we insist that our gas tank remain absolutely full at all times, we will never run out of gas. We will be playing it very safely, but we will never get any potential out of that automobile; we will never go anywhere and we'll never do any work with it.

On the other hand, if we're careless about measuring the gas in the tank, we can easily put ourselves in positions where we are not going to make it back to the station before the machine stops functioning, and we don't want to move beyond those thresholds. So, obviously, anybody with an automobile, a gas tank, and access to a filling station wants to live in the middle somewhere. We don't want to live with just full tanks all the time, and we certainly don't want to experience the collapse in performance that comes with empty tanks.

> ***"...whatever ecological integrity means, it always means that it is a social and political concept."***

So the question is, "How do we live in the middle with tanks that are partially full and partially empty?" That's always the question, and that's the part of ecological integrity that is hard to define. Everyone says define ecological integrity in the middle somewhere--not pre-European impact, not pristine--but always include me in the middle with the least cost of making any change. So, since everyone wants to live in the middle and they want the middle to be defined in a way that will include them at the least possible cost, they always want others to bear the costs of maintaining and sustaining ecological integrity. I can stand here with absolute confidence and say that whatever ecological integrity means, it always means that it is a social and political concept. It will never be defined to anyone's satisfaction in a narrow, technical way.

I want to explore with you some implications of living in the middle. The first problem is that we all want to be rational. The problem, of course, is that rationality is not a single thing.

Rationality is multiple, and different meanings of rationality are in conflict with each other. So, everyone will come to the table and say, "But I am being reasonable and I am being rational; now will you please do the same?" Of course, what we really mean is: "Won't you be rational my way?"

Technical rationality is always the rationality of seeking one objective. We pick out an indicator species (or a keystone species) and our technical rationality focuses on how to create the habitat to make sure that the species doesn't go under in some period of time. Or technical rationality has one objective of how do we accomplish one goal at this place. Of course, what is good for a given indicator species in the short run is not necessarily what is best for its surrounding ecological community in the large run.

Economic rationality is very different. Economic rationality has to do with how economists tell us to make trade-offs among goals using market prices. If you want to have more butter, you're going to have to give up some guns. So, the economists are constantly going to the blackboard drawing a variety of production functions and indifference curves and telling us to move toward Pareto optimality.

Political rationality is a different thing. It has to do with how we build a winning coalition and how we sustain that coalition

so that we can get something done and it doesn't come apart on us as we start moving through our projects and programs.

And then there is legal rationality. If you get a group of lawyers in the room, they talk about reasoning from precedent: How did the courts rule over a period of years? What have been the recent interpretations?

Ecological rationality has no substance other than some mix of these other varieties. When we talk about ecological rationality, we may be talking about it in a technical sense, an economic, legal or political sense. And almost always we're talking about some unholy witch's brew of all of them. Everyone wants to make sure that the middle is defined to include them in ways that minimizes their costs and imposes burdens on others downstream or downwind.

The social and ecological environment within which we work, plan, gather our data, assess our data, and pull together our programs and our projects is an environment that has some very significant and profound social and political attributes about it. I want to point out a few.

There are no socially neutral users of information out there in that social and political environment within which we do our studies and within which we build our programs and projects. Let's look at that for just a moment. What do I mean? Can't we be neutral, can't we be objective, can't we know something about ecological integrity? By virtue of the fact that we are rational decision makers, that we do seek to get the most possible gain for the least possible cost, we are up against the logic of externality.

If a decision maker in the middle starts moving toward objectives, whether of a federal agency, a state agency, a private corporation, or a university research team, it can easily create spillover effects--if you will, externalities. There are repercussions that fall external to the decision makers. So, if we have negative externalities, those are things that get in the way of other decision makers- another firm, another company, another agency, or a farmer downstream. Negative externalities we do not like. We do not want to highlight negative externalities of our actions because they cost us allies; or to be more blunt about it, negative externalities create enemies. As I move toward my objectives and I create spillover affects that get in your way, I'm not making you a friend or an ally.

On the other hand, insofar as my actions create positive externalities, those are the nice things that happen as a consequence of my moving around in the environment and the ecosystem that helps you. None of us is a socially neutral user of information. There are no socially neutral decision makers out there--what we have is a variety of decision makers, each highlighting positive externalities, lowlighting the negative ones, and pushing to get into the middle so they'll be included and hold onto the least cost option for them and impose costs on others. We are doing this, not because we are irrational; we are doing it because we are quite rational and because it makes sense for us individually, even though it may not always make sense for the collectivity.

Second, we cannot predict through long chains of probabilistic events. The fact is, if you and I do our studies we are trying to find a few strategic things we can focus on. But the fact is, I have to hold aside all the confounding things that can intervene. And so we teach in the university a whole variety of research strategies about how to look at the key variables, x and y, while everything else is controlled. What that means is, if I go into my little niche and learn a great deal, I learn a great deal indeed. But now I have to bring my little niche into connection with all of your little niches. You've been studying another slice of reality and somebody else still another. But as soon as we start combining what I know with what you know, we increase uncertainty (.8)(.8)(8)(.8)=.41, we are down to less than 50-50 in knowing what the outcome will be in the real world. In other words, as we combine our knowledge, and put it together, we lose knowledge. That's the fundamental reality of science.

We're trying to do systems analysis, but we are constantly coming up against the fact that when we do probabilistic science and we combine our probabilities we multiply them, and when we multiply those probabilities we lose insight quickly. So, we come back then to a key point here: science gains knowledge by abstracting strategic slices from a complex whole and by studying these slices under conditions where confounding factors have been removed. But there are great difficulties that we must confront when we start reassembling our fragments into useful, accurate comprehensive pictures of the dynamic ecosystems. We don't do that well, because there are fundamental limits on how we can predict through long, probabilistic chains. And so we are going to have to be modest in our aspirations.

"...we have constituencies who are specialized in their particular area and therefore have less and less access to the reality of the whole..."

It turns out, then, that as we function in this environment where there are multiple and conflicting rationalities we recognize that we're all trying to center ourselves in the middle to get the other folks to bear the burden. The more we know, the more ignorant of some things we become; then we come to the fundamental reality that in the social and political environment of the planner, we each have our constituencies with whom we want to relate, and they have decreasing access to the reality of the whole.

At the same time that we have constituencies who are specialized in their particular area, and therefore, have less and less access to the reality of the whole, we have more and more issues flowing into the public sector for resolution than ever before. Not because we have tendencies toward socialism, but because we keep coming up with new technologies that generate

more and more externalities both positive and negative. And so just when we have less and less access to the reality of the whole, just when there are no socially neutral users, just when we can't predict through probabilistic chains, just at that time we have more and more things on our desk to look at.

And, finally small groups of people representing the tiniest factions can exercise veto power on the whole of the system. As an example, we see that when it comes to acts of terror; it doesn't take a big constituency to do that. A small number of people can exert veto power on the system as a whole even though they have only access to a very small fragment of that whole.

So how do we respond? I can't give you any easy recipe; there is no magic formula. Ecological integrity will always be highly social and highly political, there is no getting around that. I think I can say two things in passing that we must do, on a positive side, and that we must not do, on a negative side. After twenty-five years of working in this area, in our culture and some others, and getting into some pretty tight scrapes having to do with natural resource utilization, I do know that we all need to overcome two kinds of arrogance.

The first kind of arrogance has it that 'my discipline is better than your discipline.' I can simply say that if you let a sociologist loose to define the problem and come up with a solution without staying very close to what the engineers, agronomists, economists, and biologists are saying, you can get yourself into a great deal of trouble. But it is equally true that if you are an engineer and define the problems of ecological integrity and start designing solutions without the other disciplines, you will botch it up just as badly as any sociologist ever would.

The second kind of arrogance that we must overcome is the thought that we, who are codifiers of scientific knowledge and abstract principles, and who take pride in our respective disciplines, somehow have a superior form of knowledge. Those who work, possibly without college degrees but close to the land and the water, have a different kind of knowledge.

I am very proud of the things that I have been able to abstract out of a rich world and been able to publish, but although I know something different than farmers know, than herders know, or local people know, my knowledge is not inherently superior to their knowledge--it's a different kind of knowledge. All we have to do is overcome the kind of arrogance that says we, from the center, who have our Ph.D's, inherently have knowledge that they don't have and that they're to be manipulated according to our formulations. That does not work in this world, in our country, and it does not work in any other country.

What we have to do to overcome that kind of arrogance is to establish long term collegial relationships with those who are managing, working and serving in a whole variety of organizations that are typically off the map for those who work for the state and federal government and for universities.

When you look at ecological integrity or anything else, someone comes up with a policy--but policies have to be enacted into law sooner or later. Lawyers will codify that policy, but law is nothing more than ink in a book. It doesn't get anything done. Societies have been passing wonderful laws about wonderful things for a long time, but things begin happening only when you start getting human beings organized. I refer here to main system organization--the central bureaucracy. It could be the appropriate ministry in the capital city or in our cabinet departments in Washington D.C., or it could be the State Engineer's Office right here in Colorado. That would be main system. But main systems cannot manage any ecological piece of land and water from afar, from Washington D.C., or from Denver.

Always, if we are to have effective management, and do something sustainable to protect whatever ecological integrity turns out to be at a given point in history and in a given ecological patch, we have to turn that over to a local organization. In this case, since I do a lot of irrigation work, I will use as an example local irrigation organizations. What do I mean by local? It could be a conservancy district, but almost always conservancy districts are too big to manage the water down to the farmers' fields. So, you are going to turn it over to a second or possibly third tier below a conservancy district--you are going to move into the realm of what we, in Colorado, call mutual companies.

And again and again and again, when I go to the federal government, to EPA, to USAID, or to other agencies, they have a vague sense that there is an organizational complex out there running land and water. They barely may be aware that there are things called conservancy districts, but I have yet to find people at that level who even know what a mutual company is, what they do, and how they pick up water and how they deliver it. Of course, how they manage water, how they move it from reservoir to reservoir, how they pick it up and put it down again has everything to do with whether you are going to have any fish or not and whether the birds are going to have any habitat or not.

What I am saying here is this: not only must we overcome the arrogance that my discipline is inherently superior to yours, but we must overcome the arrogance that we who have PhDs and M.A.s, we who have processed knowledge out of the textbook, somehow know what they know. We simply do not know the kind of local, site-specific knowledge available to these local organizations. And there is only one way we are going to find out, and that is to enter the local organizational realm as colleagues. We have to enter that realm as colleagues for the long term--not for a week and not for a month--we are going to have to make commitments for many years to work in this realm. Then we can adjust our generalized principles down to a particular patch or a niche, but the local knowledge must come up and meet our generalized knowledge.

If we don't know that there are people already there on the water and land base who are managing it, and if we try to come in with our generalized averages and our central tendencies and

say manage on the basis of them, we'll always miss important realities; remember, statisticians always drown in lakes that average two feet deep. We tend to convert area generalized knowledge into central tendencies. We can quote an average flow of the Poudre River, but the Poudre River is never at the average; it is virtually always above it or below it. If you manage the river based on average you will always be missing the reality of the river, but that's what our science gives us--the knowledge of central tendencies. But central tendencies don't work when you are in a particular patch.

Ecological integrity is always going to happen patch by patch, and that means let's overcome our arrogance that we who are in civil service systems and university systems somehow know better. People in local organizations may need to know what we know; yes, they may, and I don't want to denigrate area processed disciplinary knowledge. But we need to know what they know about site-specific local conditions. That means entering into long-term, collegial relationships with these local organizations.

By way of conclusion, if we have any hope of moving toward increased ecological integrity, it is because we will have overcome these two kinds of arrogance and found ways to work together across disciplines and across the boundaries which separate the processed, generalized knowledge of the several sciences from the site-specific particulars of local people who manage the land and water.

GEOMORPHIC ASSESSMENT OF STREAM PHYSICAL HABITAT

by R. C. Averett and W.W. Emmett
Geological Survey, Water Resources Division

(presented at the South Platte Basin Conference, October 27-28, 1992)

The biological assessment of streams has its roots deep within North American aquatic ecology. Until the early 1970s most stream ecological investigations were assessments--an inventory of what was there and where it was found. Today, using the concepts of modern stream ecological theory, we can determine what is there, the amounts of each, and the trophic function (functional grouping) of each species in the ecosystem. Moreover, functional group ratios provide insight into the general flux concentrations of fine to coarse particulate organic matter and on the amount of organic matter in storage to that in transport. Biomass measurements provide insight to seasonal biological production and species shifts within a stream habitat area, as well as provide information on the impact of particular functional groups.

Even when provided with these modern concepts of organism community structure and function in aquatic systems, we still lack methods of physical habitat quantification. The tendency is to place most emphasis on the chemical rather than the physical stream habitat. Measuring the chemical habitat has been paramount in most studies since the early 1960s, and was fortified with the publication of **Silent Spring** in 1962. While important, the chemical habitat does not stand alone. Stream organisms need a physical habitat (gravel, cobble, boulders, woody debris, undercut banks, and so forth) to complete their life cycles. The physical habitat (substrate) is their structural "home," the chemical habitat (water and its contained materials) is their life medium. Both are vitally important, and of course water is essential. Should the chemical habitat become toxic or otherwise unfit for life, the organisms will die and be swept away by the current. Yet their homes (the physical habitat) remain, and when the chemical habitat is again non-toxic (as usually happens), repopulation or reinvasion is often rapid, and the community structure is usually the same. In contrast, when the physical habitat is disturbed, the "home" is destroyed and repopulation or reinvasion is usually long-delayed, and the community structure is often quite different.

There is much evidence of physical habitat alteration in the nation's streams, especially by channelization, timber removal by heavy machinery, and impoundments to name a few. Some of these activities have direct effects; others such as dams have indirect effects. The results are often the same--a disturbed and altered stream channel followed by a changed and often less productive flora and fauna.

Unfortunately, little recent attention has been given to evaluating and quantitatively measuring the physical habitat. Biologists have seemingly been content with somewhat general qualitative descriptions of the physical habitat, while at the same time urging chemists to lower the detection limits of chemical contaminants. This paradox in stream assessment thinking has been underway for at least three decades and has lessened research by biologists on evaluating the physical habitat. Qualitative descriptions of the physical stream habitat do not permit a clear understanding of its structure or permit accurate comparison after a stream channel disturbance. It is now time to derive techniques for the quantitative measurement of stream physical habitat.

There are few instances where fluvial geomorphologists and aquatic biologists have conducted joint studies. When they have collaborated the results have almost always led to better understanding of organism-physical habitat relations.

PREPARING U.S. AGRICULTURE FOR GLOBAL CLIMATE CHANGE

Part 2, Summary of a report produced by
the Council for Agricultural Science and Technology (CAST)
Task Force Report No. 199, June 1992

by Jennifer Roberts

THE WORLD MARKET, GRAIN RESERVES AND CROP INSURANCE--The world market serves as the central nervous system of the world's food supply. For example, when adverse weather cuts production of a crop in a major region of a world, market prices go up. This, in turn, encourages consumers to cut demand and farmers to increase supply. When climate disruptions are short-lived, price adjustments and trade can mitigate most of the negative effects. However, when the change in average climate reduces the supply of food, prices remain high and signal producers to search out new production techniques. Throughout history, grain stocks have been humanity's best defense against the ravages of drought and other shortfalls caused by weather. Like the irrigator's water reservoir, reserves of grain smooth variations in supply from good years to bad. The likelihood of a changing climate raises the need for more reserve, and coordinating the grain reserve policies of different countries becomes more important.

Crop insurance is another economic tool that has allowed the U.S. to adapt to climate changes. Since 1938, the U.S. has had a federally subsidized all-risk crop insurance program. Unaffected regions of the country provide the reserve to operate the insurance fund.

Overall, the world food market, grain reserves, and crop insurance form a strong arsenal of tools that can allow agriculture to adjust to the effects of weather. They are especially effective in prompting short-run adjustments to variations in weather.

HOW MIGHT FARMERS ADAPT TO CERTAIN CLIMATE CHANGES?--The CAST team focused on the crucial Corn Belt. A change in the midwestern U.S. to a moderately warmer and more arid climate would reduce yields of corn and soy beans. In time farmers would grow less of these crops and instead a mix of drought-tolerant crops. Irrigation needs would increase about 100 mm per year. However, there is not a practical potential for irrigation outside the river valleys, so dryland sorghum would likely replace corn.

If, instead, the Corn Belt became warmer but more humid, how would farmers change? They would likely keep the present mix of crops but use new varieties. They would likely need varieties with tolerance of corn virus diseases that are favored by a warmer, wetter environment.

By autonomous adaptation, U.S. farmers seem capable of mitigating the effects of considerable climate change by changing their crops, varieties, and farming systems. Continuation of this autonomous adaptation does depend, fundamentally, on vital and unfailing research and development that fulfills new needs.

So, we come to the crucial, final question. ***WHAT POLICIES OR REGULATIONS AND INCENTIVES SHOULD A PRUDENT NATION CHANGE?***

With so much uncertainty ahead, policymakers should assemble a portfolio of agricultural assets that is both diverse and flexible. U.S. agriculture has 10 assets for adapting to climate change that collectively provide a diversity of response and maximum probability that U.S. agriculture can adapt at minimum social cost.

LAND--Agriculture's cornerstone asset. U.S. agricultural land ranges across a diversity of climates, offering some built-in insurance against whatever changes in climate might occur. Policy changes are needed to fully utilize the land asset as the climate changes.

WATER--Farmers can more fully adopt proven technologies that improve water use efficiency. Water policies will need to be overhauled so that water prices reflect true social costs. That step will encourage better market allocation of water supplies. Agriculture needs both the incentive and the mechanism to move water from low-value to high-value use.

ENERGY--Although agriculture consumes less than 3% of the nation's total energy demand, a reliable supply will help adapt agriculture to climate change. So long as agriculture uses fossil fuels, getting more food from each unit of energy will lessen the emission of greenhouse gas.

INFRASTRUCTURE--One asset that should not be overlooked is the nation's physical infrastructure that supports agriculture production and trade. Examples include the grain handling, transportation, water storage and distribution systems.

GENETIC RESOURCES--A thorough description and cataloging of plant and animal genetic resources is essential if the U.S. is to make effective use of plant and animal breeding techniques.

FLEXIBLE INSTITUTIONS--Climate change will demand that our institutions become more flexible. For example, the water policy that settled the West in the late 19th century must obviously change if it is to cope with the potential climate of the future. Policy changes will be needed in many areas, but more flexible commodity programs and improved water allocation will be likely priorities.

AG RESEARCH--The nation's research capacity offers the most versatile, and perhaps the most valuable, asset in the nation's portfolio of climate change assets. The agricultural research system must carry out today's research agenda

while at the same time preparing agriculture for an uncertain future climate. To broaden the nation's research agenda, more funding will be needed.

INFORMATION--Information is vital to managing modern production agriculture. It is also the lifeblood of the world market, which sends the many price signals that bring forth the supply of food that consumers demand. Information is even more important in a world where climate may change.

CONTINUING EDUCATION--People manage the farms and invent the technology that will adapt to climate change. Agriculture's people clearly need to be well trained. Continuing education will be particularly important in helping rural communities cope with climate change.

WORLD MARKET--Perhaps the most overlooked asset in the U.S. portfolio is the world market. Today, the world market allows U.S. agriculture to sell its abundant production abroad, earning foreign exchange for the nation. But the world market is beset by a battery of trade barriers and subsidies that distort world prices. These distortions lead to wayward adaptations, wide of the target society intended to hit.

The climate seems likely to change; how much and how soon, we do not know. If climate does change, there will be a social cost to the nation, and the costs could be large. A prudent way to hedge the risk of those costs is to hold a diverse portfolio of agricultural climate change assets and assure the flexibility to use them.

ROCKY MOUNTAIN INSTITUTE FOCUSES ON ECOLOGICALLY SOUND SOCIETY

by Mary DeMartini

The Rocky Mountain Institute (RMI), a Colorado non-profit corporation, was founded in 1982 by energy analysts Hunter and Amory Lovins to serve the public interest. The Institute's mission is to "foster the efficient and sustainable use of resources as a path to global security." RMI conducts its efforts in five interrelated topic areas: energy, water, agriculture, security, and economic renewal.

The RMI believes that people can solve complex problems through collective action and the use of their own common sense. By understanding the interconnections between resource issues many problems can be solved at once, and the solutions can be beneficial both economically and ecologically. It is with this same philosophy that the RMI promotes the concepts of water efficiency and sustainable agriculture.

Water conservation often implies a curtailment of end-uses of water and changes in lifestyle. Water efficiency is the use of water efficient technologies (ie. low-flush toilets, efficient showerheads, faucet aerators, irrigation equipment, and innovative management strategies) without necessarily making changes in the quality of life. Water efficiency is thus more readily accepted and adopted in practice. For example, an application of water efficiency might be to evaluate water use and determine if an application requires high-quality water (i.e., gray (reused) water could be used to flush toilets and could significantly reduce residential water consumption).

Programs to encourage water efficiency have proven successful across the nation and already have been implemented in many communities using a combination of ordinances, financial incentives, and education. One particularly successful program involves the partnership of energy and water utilities in performing residential energy and water audits and retrofitting houses with water and energy-efficient technologies. This partnership is a recognition of the fact that saving water can save energy and vice versa, and that this type of program can be mutually beneficial to both the homeowner and the utilities involved.

The RMI advocates this type of relationship and describes its mutual benefits for water providers and individuals in the following way: "For water providers, reducing water demand through water-efficient technologies is often easier and cheaper to implement than increasing supplies. The use of water-efficient technologies can reduce capital and operating costs, increase reliability of supply in drought years, and buy time for long-term planning. For individuals, use of water-efficient technologies can reduce water, wastewater, and energy bills." The "saved" water is available for another use, such as enhancement of the environment or recreation. This is a win/win situation and its success is helping to spread the concept nation-wide.

Technologies are also available to provide more water-efficient irrigation. In the High Plains Underground Water Conservation District of Lubbock, Texas, a "ten-year, self-financed efficiency effort achieved a cutback in irrigation water use varying from 25-40% across the region. Area farmers employed such techniques as replacing unlined ditches with pipelines, shortening furrows and watering them in small surges, recirculating tailwater at a faster rate to reduce evaporation, using soil-moisture monitoring devices (gypsum blocks), and switching from high- to low- pressure drop-line sprinkler systems." (source: "Feedback and Irrigation Efficiency" RMI Water Efficiency Implementation Report #4, 1992).

The report also references a case study of water applications to crops and the water quality problems subsequently encountered with drainage waters. This is especially critical in the San Joaquin Valley where irrigation concentrates the naturally high quantities of salts and selenium, resulting in toxic drainage

waters. The Broadview Water District of Firebaugh, California confronted this situation in an innovative way, developing incentives for efficient irrigation practices. The District implemented tiered water pricing in which they set crop-specific tiers of water use. Farmers who applied more than the set amount for their field or crop were charged more for their water. The price difference was used by the District to manage excess drainage water. In the following year the District saw a decrease in drainage volumes of approximately 25%.

In the West, the water supply situation is critical. Growing cities are looking to agriculture in their search of more water. Farmland is drying up with recurring droughts and with the transfer of irrigation water to cities. Irrigation accounts for 80% of water use in the Western United States. Environmental water needs are also being recognized with granting of instream flow rights. In such a complex water-supply predicament, both cities and agriculture need to challenge themselves to use water more efficiently.

The RMI, attentive to the issues involved, seeks to provide the information that is needed for a more responsible, fiscally sound, and culturally and ecologically sustainable society. The Institute is located at 1739 Snowmass Creek Road, Snowmass, Colorado 81654-9199; Telephone 303/927-3851 or 303/927-3128.

UNIVERSITY WATER NEWS

FIRST-YEAR OVERVIEW--THE CCHE WATER RESOURCES PROGRAM OF EXCELLENCE AT CSU

Colorado State's Water Resources Program was designated as a program of excellence by the Colorado Commission on Higher Education in 1991, and received $250,000 per year for three years for the program. A program report covering July 1, 1991-June 30, 1992 has been compiled for CCHE, and program accomplishments are summarized below. The program emphasized the undergraduate scholarship program, the summer scholars program, graduate assistantships, collaboration with minority institutions, educational enhancements and faculty support.

Thirteen undergraduate scholarships for the 1991-92 academic year were awarded to outstanding students in engineering. The students were selected based on their academic and extracurricular achievements, with special attention paid to Colorado residents, women, and minorities. The goals were to introduce the students to water resources and CSU's outstanding program and encourage them to pursue careers in water and environmental resources. In addition, the CCHE funding helped provide funding for several students who participated in ongoing research activities.

1991-92 Recipients of Undergraduate Scholarships

Name	Class	Major	Hometown
Scott Andre	Junior	Engineering Science	Bellvue, CO
Kirsten Close	Sophomore	Agricultural Engineering	Arvada, CO
Mary DeMartini	Junior	Civil Engineering	Fort Collins, CO
Brian Foy	Junior	Civil Engineering	Grand Junction, CO
Samara Iodice	Senior	Agricultural/Environmental Engineering	Fort Myers, FL
Todd Lewis	Junior	Civil Engineering	Rye, CO
Trudy Olin	Senior	Civil Engineering	Cortez, CO
Lisa Poppenga	Senior	Civil Engineering	Lakewood, CO
Richard Pringle	Senior	Civil Engineering	Greeley, CO
Jennifer Roberts	Sophomore	Engineering Science	Fort Collins, CO
Carlos Sanchez	Sophomore	Civil Engineering	Brownsville, TX
Heath Stein	Senior	Civil Engineering	Otis, CO
Heather Trantham	Senior	Civil Engineering	Pueblo, CO

Laurel Saito, a graduate student funded partially by the Program of Excellence, was scholarship program coordinator and organized activities for the students. During the Fall semester, scholarship recipients participated in three seminars: the first featured the *Denver Water Game*, a computerized spreadsheet gaming simulation of the Denver/Metro area water supply developed by the University of Colorado at Denver. Neil Grigg, Civil Engineering Department Head, spoke to the students during the second seminar, offering insights into current important issues in water resources. For the third seminar, the students selected an on-campus seminar or conference of their choice. At least six hour-long seminar series are offered at CSU each semester with sessions pertaining to water resources, and students were asked to write a paper on the session they chose.

Each student also prepared a paper that highlighted an aspect of water resources that interested them - drawn from the projects included in the *Denver Metro Water Game.*

Spring semester activities included two hour-long seminars, a field trip, and the completion of a display on the Colorado River System for the *Children's Water Festival* held in Fort Collins in May, 1992. Dr. John Eckhardt of the Colorado State Engineer's Office spoke to the students about the Colorado River System during the first seminar early in the semester. Drawing upon his experience with the Northern Colorado Water Conservancy District, the Imperial Irrigation District in California and the Colorado State Engineer's Office, he introduced the students to a number of management concerns in the Colorado River Basin.

The second seminar focused on career options for engineers in water resources and featured a panel of three professional engineers: Julie Kraus of the Colorado State Engineer's Office; Mark Peterson of Resource Consultants and Engineers in Fort Collins; and Neil Grigg of Colorado State.

Instead of a third seminar, the students participated in a day-long field trip to Nebraska, led by Dr. Morris Skinner, Civil Engineering Department, Colorado State University. The trip featured guided tours of Kingsley Dam and its hydroelectric facilities, an inverted siphon, and a coal-fired steam-generating plant (described in *Colorado Water*, June 1992).

The final project of the scholarship program for the 1991-92 academic year was the preparation of a display on the Colorado River system for the *Fort Collins Children's Water Festival.*

ROBERT A. YOUNG RECEIVES AWRA'S ICKO IBEN AWARD FOR OUTSTANDING CONTRIBUTIONS IN WATER RESOURCES

For his "Outstanding contributions to the promotion of communications among the various disciplines of water resources...," Robert A. Young has received the 1992 Icko Iben Award from the American Water Resources Association. The award was presented at the Annual Awards Luncheon held in conjunction with AWRA's 28th Annual Conference and Symposium, November 4, 1992 in Reno, Nevada.

Young, Professor Emeritus in the Department of Agricultural and Resource Economics at CSU, has had a distinguished career in the study of the economics of water. His most recent work was the development of a Colorado River Basin model (CRIM--see article on page 5) that for the first time considers alternative water allocation institutions and economic values of water in the basin.

Dr. S. Lee Gray, Chairman of the Department of Agricultural and Resource Economics, cited Young's long and continuous contribution to state, national and international water research. He quoted comments from three outstanding professionals working in the area of water resources :

> *"I have long regarded Young as one of the country's premier analysts of the economics of water management, particularly in irrigated agriculture."* Pierre Crosson, Senior Fellow, Energy and Natural Resources, Resources for the Future, Inc.

> *"...I have always been impressed by Bob's ability to apply the tools of neoclassical economics to western water policy issues in a manner that is at once sound, imaginative and wise."* William B. Lord, Professor of Economics and Director of the Water Resources Research Center at the University of Arizona.

> *"His series of articles on water management in Egypt and Pakistan show how economics analysis can be used to select between alternative management strategies, whether it involves water allocation or investment in tubewell irrigation. His pathfinding research in Egypt shows that water pricing could be used, but would not work under existing agricultural prices...Bob's work in Pakistan breaks new ground in helping the government consider alternatives in tubewell investments and in measuring the effect of salinity on crop production."* K. William Easter, Professor of Agricultural and Applied Economics, University of Minnesota.

Gray also noted that Young's work on the economics of water use in the Ogallala Aquifer in Colorado won the American Agricultural Economics Association Award for Outstanding Extension Program. He has received several awards for Best Published Research and Outstanding Journal Article (Western Agricultural Economics Association and the American Agricultural Economics Association); and has twice received Honorable Mention in the AAEA Award for Outstanding Policy Research.

Young is past President of the Western Agricultural Economics Association; was a Fulbright-Hayes Senior Research Fellow at Lincoln College, Canterbury, New Zealand, and was Visiting Scholar at Resources for the Future, Inc., Washington, D.C. Since 1990 he has served on the National Research Council's Committee on Irrigation-Induced Water Quality.

Young received a B.S. in Animal Science from the University of California-Davis in 1954, and a B.S. in Agricultural Economics in 1958. He received his Ph.D from Michigan State University, East Lansing, Michigan in 1963. Young's career at Colorado State began in 1970. He retired from the Department of Agricultural and Resource Economics in 1992.

The Icko Iben award was established in 1971 to recognize persons who have made outstanding contributions in promoting communication among the various disciplines concerned with water resources issues. It honors the late Dr. Icko Iben, a co-founder of AWRA, who during his life contributed extensively toward improving the understanding and communication among those involved in the diverse disciplines related to water resources.

RETIREMENT CEREMONY HONORS J. E. FLACK

J. Ernest Flack, Professor of Civil Engineering at the University of Colorado and a long-time member of the CWRRI Technical Advisory Committee, has retired after 37 years of teaching and research. At a retirement colloquium on May 9 he was awarded a certificate of appreciation and proclaimed a FRIEND OF UCOWR by the Board of Directors of the Universities Council on Water Resources for his vision and leadership in the advancement of water resources education and research. Professor Flack has had numerous projects funded in part through the Institute and continues to be active in the areas of revegetation of formerly irrigated land and in water rights modeling. He was also a pioneering researcher on urban water conservation. He is a 1950 alumnus of Colorado State University with a degree in Civil Engineering.

Professor Flack was nominated for the award by James P. Heaney, Professor and Chair of the Civil, Environmental and Architectural Engineering Department, University of Colorado. "Ernie has been active in UCOWR for many years," said Heaney. "He was a member of the UCOWR Executive Board from 1973-76 and 1977-80. During his distinguished career at the University of Colorado he has taught and conducted research in hydraulics, hydrology, water economics and water law."

UCOWR, the Universities Council on Water Resources, is an organization that promotes education, research and public service in water resources.

UCOWR/USGS ESTABLISH ELECTRONIC INFORMATION NETWORK

An electronic information network has been established under the auspices of the U.S. Geological Survey and the Universities Council on Water Resources. It will provide a variety of information dissemination services for USGS and the water resources community.

> Critical water resources and related research information will be gathered at a control location and posted for 24-hour/day access by the water resources community.
>
> The staff and principal clients of USGS who are already using the USGS AViiON-based computer network will have automated access to the collected water information. Those not on the AViiON system will dial in by telephone or other networks for access.

UCOWR will establish an electronic bulletin board to provide current information on ongoing contracted research and brief abstracts of selected completed research within the academic community. It will also provide general information of interest to the water community. UCOWR will establish a micro-computer-based file server at UCOWR Headquarters at Carbondale, Illinois. USGS staff and personnel of state and other Federal agencies provide information concerning research in progress to UCOWR. The UCOWR staff will format the information on read-only bulletin boards. USGS staff and authorized users may then dial into UCOWR's computer using an 800 number, TELNET, BITNET, or commercial lines, review bulletin board information, and download the information to their own computers for further review or printing.

Individual UCOWR Memberships Approved

UCOWR has approved the establishment of individual memberships to UCOWR to include those academic personnel at non-member institutions who are engaged in teaching and research in water resources.Individual membership will be non-voting; dues will be $50 per year. Individual members will receive *Water Resources Update*, published four times per year, and free access to the Water Information Network.

For information contact Margery Robinson, UCOWR headquarters, 4543 Faner Hall, Southern Illinois Univ., Carbondale, IL 62901. Phone 618/536-7571; FAX 618/453-2671.

FIRST TRAVEL STOP FOR CSU GRAD IS EGYPT WATER RESEARCH CENTER

Laurel Saito, formerly based at CWRRI, is working temporarily at the Water Resources Center in Cairo, Egypt. Laurel received her MS degree in Civil Engineering from Colorado State University this year. Her research included a nationwide water quality data management survey as well as an assessment of water quality data management activities in Colorado.

Laurel writes: "I am doing well in Egypt. I survived the little earthquake here fine. I was actually impressed that the buildings and infrastructure held up so well because they hadn't been designed for earthquakes... Cairo is busy and noisy...moving from one place to another is hazardous...The key is not to hesitate. If you stop in the middle of the road you'll be killed for sure, but if you keep moving somehow everyone misses each other. I am working with the Water Research Center and gave a seminar last week on my thesis. It was a bit longer than my defense because I explained more things..."

Laurel's travel plans include stops in the Far East, Australia and New Zealand before she heads back to the United States.

PRESIDENT OF UCAR JOINS NASULGC EXECUTIVE COMMITTEE

Richard Anthes, the President of the University Corporation for Atmospheric Research (UCAR), has agreed to sit on the Executive Committee of the Board on Oceans and Atmosphere, National Association of State Universities and Land Grant Colleges, as the board continues to meet its mandate to include atmospheric sciences. In addition to managing and operating the National Center for Atmospheric Research, UCAR, based in Boulder, Colorado, coordinates international field programs and visiting scientist programs for the atmospheric sciences community.

Source: *NASULGC Newsline*, September 1992

EXTENSION AGENT AND USDA-ARS RESEARCHER HONORED

Congratulations to **James Feucht**, Cooperative Extension Specialist at Colorado State University, named Outstanding Volunteer by Community Resources Inc. in Denver. Feucht has presented 100 horticultural programs to Denver elementary school children in the past 20 years. Feucht is Cooperative Extension Agent for Jefferson County, Golden, Colorado.

Donn G. DeCoursey was honored by the Soil and Water Conservation Society recently. He was the recipient of an SWCS Fellow Award, the highest honor SWCS presents to its members. DeCoursey was honored for his research on soil and water conservation practices and for his service to SWCS. He is supervisory research hydraulic engineer with USDA-ARS in Fort Collins. Congratulations to Donn.

HENRY P. CAULFIELD, JR. ELECTED AWRA EMERITUS MEMBER

Professor Emeritus Henry Caulfield, Department of Political Science at Colorado State, has been elected an Emeritus Member of the American Water Resources Association. Caulfield graduated from Harvard College in 1940, received an MPA from the John F. Kennedy School of Government in 1949 and passed the comprehensive examination for the Ph.D in political economy and government there in 1950. He was a member of the Program Staff, Office of the Secretary, U.S. Department of the Interior from 1950 to 1961, and Assistant Director and then Director of the Resources Program Staff, Office of the Secretary. He was the Director of the U.S. Water Resources Council from April 1966 to August 1969. Caulfield was chairman of the committee that drafted the policies, standards and procedures for water resources planning that became known as "Senate Document 97." He also had a leading role in the early development of the Water Resources Council's principles and standards for planning that were promulgated in September, 1973. From August 1969 to July 1986 he was a Professor of Political Science at Colorado State University. He was also President of the Fort Collins Water Board for several years.

Source: *AWRA Newsletter*, September 1992

AGRICULTURAL FIELDS NEED COLLEGE GRADS

A 1990 Purdue University-USDA study concluded there will be 4,500 more openings in agricultural careers within the United States in the next five years than qualified college graduates to fill them. Most of these jobs will be in high tech fields such as agricultural engineering and food processing, offering high salaries, good advancement opportunities and benefits. A study commissioned by the **"Agriculture Is..." Foundation** also revealed that only 1% of the students planned to enter a career in agriculture, yet as many as 25% of the nation's jobs are related to agriculture and the food industry. As a result, the Foundation plans to launch a nationwide, multi-year, agricultural awareness campaign geared to junior and senior high school students to make them aware that "agriculture involves much more than farming," says Foundation president Elaine Hodel. For more information about the Foundation contact the **"Agriculture Is..." Foundation**, 320 Bradington Dr., P.O. Box 168, Columbia, IL 62236.

Source: *Within ASAE*, August 1992

INTERNATIONAL GROUND WATER MODELING CENTER

COLORADO SCHOOL OF MINES
Golden, Colorado 80401

Short Courses

Jan. 13-17	Introduction in Ground-Water Modeling (Poeter, Dawson, van der Heijde, Paschke) - Software: THWELLS, SOLUTE, PLASM, RANDOM WALK, ASM
Feb. 24-28	Statistical Methods in Ground-Water Pollution (Helsel, Gilroy) - Software: MINITAB (student edition)
March 23-27	Applied Ground-Water Modeling (Andersen, Konikow) - Software: MODFLOW, MODFLOW/EXT, MOC
April 20-24	Applied Ground-Water Modeling (Andersen, Konikow) - Software: MODFLOW, MODFLOW/EXT, MOC
May 18-22	Geographic Information Systems in Ground-Water Modeling (Turner, Kolm) - Software: Arc-Info (not distributed), MODFLOW (not distributed), and some public domain software
Summer	Geographic Information Systems in Ground-Water Modeling (Turner, Kolm) - Software: Arc-Info (not distributed), MODFLOW (not distributed), and some public domain software.

USBR/CSU DEDICATE DAM SAFETY OVERTOPPING RESEARCH FACILITY

by Jennifer Roberts

On October 29, 1992 the U.S. Bureau of Reclamation and Colorado State University held a dedication ceremony to announce the opening of the Dam Safety Overtopping Research Facility at the CSU Foothills Campus. The Bureau of Reclamation closely monitors two hundred and fifty eight dams as part of their Safety of Dams Program. Many embankment dams across the United States have been identified that could be seriously damaged or even fail as a result of overtopping. Therefore this cooperative research between U.S. Bureau of Reclamation and CSU is aimed at developing overtopping systems that would protect embankment dams from fail if overtopped.

Overtopping Facility Demonstration

In 1991 the U.S. Bureau of Reclamation and CSU signed an agreement to build and test a nearly full-scale overtopping model at CSU's Foothills Campus. The model facility is 50 feet wide, 10 feet high and has a 2:1 slope. The water for the facility is supplied by Horsetooth Reservoir. The findings thus far have been very promising and the overtopping facility may present a viable alternative to costly emergency spillways in the future.

Representatives from CSU, U.S. Bureau of Reclamation and Electric Power Research Institute (EPRI) spoke at the dedication ceremony. The project is funded through a joint venture among the three organizations. Frank A. Kulacki, the Dean of Engineering at CSU, emphasized CSU's hydraulic program as a classic strength over the years. Kulacki applauded CSU's dedication to physical modeling over programs founded entirely on computer modeling. This physical modeling is invaluable to the students, said Kulacki, and students in this program quickly learn that "water is WET!"

Joe Hall, Deputy Commissioner of the USBR, noted the agency's historical involvement with water and power. Hall feels that the agency is making the transition into today's world quite smoothly by actively pursuing this research and other projects as well. Hall likened the facility and program to overturning a large domino. The program will positively impact others including students, the hydropower industry, federal and state agencies, private builders and others in its "domino-chain reaction."

Dr. Frank Kulacki, Dean of Engineering CSU

Philip Burgi, USBR presents plaque to Dr. James Ruff

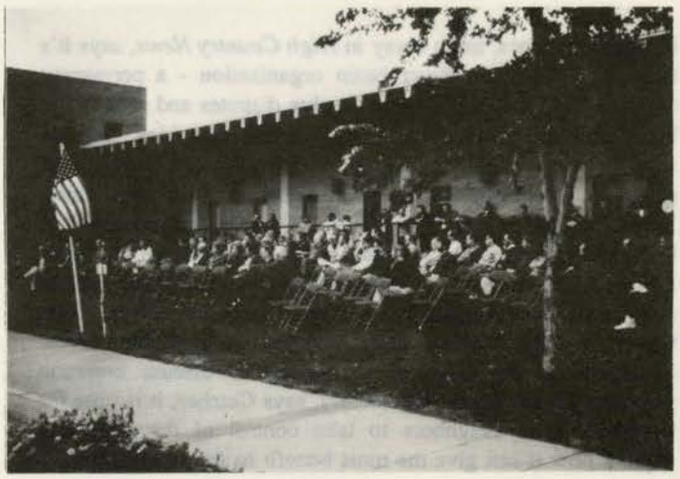
Douglas I. Morris, EPRI, said that the dam safety overtopping prototype offers an appealing low cost alternative to raising the height of dams or increasing spillways. He described the changes occurring in the role of electric utilities. Recent legislation has required that the utilities assume a water management role rather than a purely power production role. This project will help EPRI and others in their water management role.

Philip Burgi, Chief of the Hydraulics Branch at USBR, presented Dr. James Ruff with a plaque for his work on the project. Ruff is a Professor of Civil Engineering and is heading the efforts from the CSU Foothills Campus, along with Dr. Steven Abt, also from Civil Engineering. Dr. Ruff emphasized the group effort of the project which included many students and the shop staff at the ERC.

USGS WATER RESOURCES DIVISION HOLDS OPEN HOUSE

The Water Resources Division, U.S. Geological Survey, now occupies new lab facilities in Boulder. On October 9 the USGS held an Open House for potential collaborating scientists at the University of Colorado, Colorado State University, Colorado School of Mines, and private/government research institutes in the area. The event also allowed USGS colleagues from the Denver Federal Center to visit the new labs. (The Division formerly was located at the Denver Federal Center.)

Opening ceremonies were hosted by Robert C. Averett of the Boulder lab, and included a short address by Robert M. Hirsch, Assistant Chief Hydrologist for Research and External Coordination, Reston, Virginia. He spoke about the role of the Water Resources Division in water resources research at the national and regional levels and discussed opportunities for collaboration among agency and academic scientists.



Welcoming ceremonies, USGS Open House in Boulder

George Aiken (left), organic geochemist, discusses his project with visitor

James Corbridge, Chancellor of the University of Colorado, welcomed the Survey to Boulder and encouraged productive collaboration. Visitors spent the remainder of the day visiting the facilities and discussing water resources issues with USGS project personnel.

The National Research Program (NRP) of the Water Resources Division, U.S. Geological Survey has three regional facilities in the United States: Menlo park, California (western region); Reston, Virginia (eastern region); and Denver, Colorado (central region). The central region facility opened expanded laboratory space in Boulder in November 1991.

EDITOR'S IN-BASKET

NATIONAL ELECTION CHANGES WATER POLICY AND APPROPRIATIONS COMMITTEES

Western States Water, weekly newsletter of the Western States Water Council, reports that as a result of the elections there will be several important changes to committees with jurisdiction over water resources. The changes, it says, will impact formulation of water policy and appropriations for water projects.

SENATE--Western senators not running for re-election included Alan Cranston (D-CA), Tim Wirth (D-CO), Steve Symms (R-ID), Jake Garn (R-UT), and Brock Adams (D-WA). Senator Kent Conrad (D-ND) also left his seat, but with the recent death of Senator Quentin Burdick (D-ND) will run in a special election to fill his unexpired term. Senators Adams, Burdick and Garn held seats on the Appropriations Committee. Burdick chaired the Senate Environment and Public Works Committee, which also lost Symms. The Energy and Natural Resources Committee lost Garn, Wirth and John Seymour (R-CA, who lost to Diane Feinstein). Kent Conrad served as vice-chair of the Water and Power Subcommittee and also as a member of the Indian Affairs Committee.

HOUSE--Relatively few House incumbents lost re-election bids. House Committee Chairs won easily: Agriculture--Kiki de la Garza (D-TX), Appropriations--Jaimie Whitten (D-MS), Energy and Commerce--John Dingell (D-MI), Interior--George Miller (D-CA). Retiring are Public Works and Transportation Chair Robert Roe (D-NJ), Water Resources Subcommittee Chair Henry Nowak (D-NY.

REGIONAL ORGANIZATION PROPOSED FOR COLORADO RIVER BASIN

David H. Getches, in an essay in *High Country News*, says it's time for a Colorado River basin organization - a permanent regional body that could try to resolve disputes and seek better basin resource management. This isn't a new idea, Getches says. It was originally suggested by John Wesley Powell, who proposed governing the West according to river basin lines. Hoover suggested it in 1922. Gilbert White of the University of Colorado proposed a Colorado River basin forum in 1983. Former governors Richard Lamm of Colorado and Bruce Babbitt of Arizona both suggested a commission in the 1980s. And Governor Roy Romer, says Getches, invited his fellow governors in the basin to a meeting to discuss common problems. None came. But clearly, says Getches, it is time for Colorado River neighbors to take control of the river and explore how it can give the most benefit to the most people.

Source: "This Process is Out of Control," *High Country News* 11/16/92 (*David Getches is Professor of Law, CU School of Law)*

JOHN CARLSON DIES

John U. Carlson, prominent Denver water attorney, died October 17 in Denver. He was 52. Carlson's practice was devoted primarily to water rights law in the western United States. Carlson was born in Terry, Montana and graduated from the University of Montana. He received a bachelor's degree from Queens College of Oxford University, which he attended as a Rhodes scholar. After graduating from Yale University Law School Carlson began his law practice in Billings, Montana. In 1985 he founded the law firm of Carlson, Elliott and Land.

Source: *Denver Post* 10/20/92

AWWA TO ISSUE BIWEEKLY NEWSLETTER ON DRINKING WATER

Waterweek is the new source of drinking water news from the American Water Works Association (AWWA). It will deliver timely information about drinking water including what's happening in Congress and at the Environmental Protection Agency. It will cover environmental concerns, management strategies, technology, and more. Reports from all over the nation will be filed by a corps of nearly 100 journalists. *Waterweek* is free to AWWA "utility" members and is available by subscription for others. For more information contact the American Water Works Association at 6666 W. Quincy Ave., Denver, CO 80235 or call 1-800-92-ORDER.

DWD ANNOUNCES STAFF ADDITIONS

The Denver Water Department has announced several recent staff additions:

Ed Pokorney, previously manager of intergovernmental affairs and public relations, was named director of planning . He succeeds Ken Mitchell, who retired.

Replacing Pokorney is **Sara Duncan**, who returned to the department in August after serving as acting director of the Colorado Water Conservation Board.

Tina McGuire, who will handle media relations, joined the department in July.

Paul Hoskins, previously manager of the Department of General Services for the City and County of Denver, joined the department in June as director of internal relations.

WHAT IS THE NIE?

NIE, the National Institutes for the Environment, is a proposed new nonregulatory, extramural granting agency with the mission of increasing understanding of the environment and enhancing the ability to solve and prevent environmental problems. As the only science agency focused exclusively on the environment, the NIE would complement existing environmental research efforts. Its primary focus would be fundamental and applied research that encompasses engineering, natural and social sciences, and the humanities. In consultation with academic, environmental and industry groups, it would:

set priorities for environmental research, education and training;

award extramural funds to academic institutions, state research agencies, and other research and educational organizations;

assess research findings and describe their implications;
ease access to information about the environment (among NIE priorities is the establishment of a National Library for the Environment), and

provide the basis for development of environmentally appropriate technologies.

On July 23, Senator Terry Sanford (D-NC) introduced Senate Resolution 326 supporting the NIE, identical to House Resolution 153 sponsored by Congressman James Saxton (R-NJ). Saxton listed among his environmental concerns the following: How does the ecosystem function? What is its status (healthy, declining)? What is having an impact on it? What is the best method protecting it? Saxton said he and other decisionmakers need access to the science that exists and ways of facilitating additional research.

Legislation to authorize the NIE will be introduced again in the US House and Senate in early 1993. The Committee for the NIE consists of over 4000 individuals who support the concept. For more information and to get on the mailing list, send your name and address to: Committee for the NIE, 730 11th St., NW, Washington, DC 20001-4521. Phone 202/628-4303; FAX 202/628-4311.

Source: *NIE Network News*, Summer 1992

ASDSO ANNOUNCES NEW SCHOLARSHIP PROGRAM

The Association of State Dam Safety Officials (ASDSO) has announced a new scholarship program for undergraduate college students interested in dam safety engineering careers. Two scholarships, one each to a junior and a senior, will be awarded starting with the 1993 school year. For applications, which are due January 15, contact ASDSO at P.O. Box 55270, Lexington, KY, 40555; 606/257-5140.

TOGA FIELD OPERATIONS BEGIN

Field operations started on November 1 for TOGA/COARE (the Tropical Ocean Global Atmosphere program's Coupled Ocean-Atmosphere Response Experiment). The project will study ocean-atmosphere interactions in the western Pacific ocean, particularly in the equatorial "warm pool"--the largest single expanse of warm water on the earth's surface. The pool's sea-surface temperatures, the warmest on earth, are consistently higher than 82 degrees F., and the area receives nearly 195 inches of rainfall annually as part of a major convection process that releases large amounts of heat to the upper atmosphere. This pool is also where the westerly winds first develop that are associated with the onset of an El Nino. Research will include further study of tropical ocean mixing, measuring the ocean-atmosphere energy exchange near the equator, and monitoring westerly wind bursts that may contribute to El Nino.

TOGA was created in 1985 as part of the World Climate Research Program. It is a ten-year effort to understand the interactions between the tropical ocean and atmosphere and the effects on global climate. TOGA/COARE is an interagency project of NSF, NOAA, NASA, and the office of Naval Research. More than 750 scientists and support personnel will participate in the four-month study.

WATER SUPPLY

DROUGHT IN THE UNITED STATES
Mid-1992 Update and Historical Perspective

Nationwide, drought continually increased in coverage during late Spring to early Summer, when the percent area of the contiguous United States experiencing severe to extreme long-term drought rose from about 13% to a value in excess of 20% by the end of June.

On a short-term basis, April 1992 ranked as the 13th driest April in the 98-year period of record for the nation as a whole, with May ranking even drier, at 12th driest. More than a fourth of the country experienced a severely dry May, and at least a tenth of the country experienced severe short-term dryness during each month (April-July) of the review period.

A marked improvement for the nation occurred during June (11th wettest) and July (5th wettest). By the end of July, the areal percent of the nation experiencing severe to extreme drought had dropped back to around 14%. Spring 1992 (March through May) was the 16th driest on record for the nation, but a quick turnaround occurred for June and July, and these two months together ranked as the fourth wettest such period on record. January through July 1992 ranked in the middle third of the historical distribution as the 43rd wettest (56th driest) such year-to-date period.

Drought continued in portions of the west north central, northwest, and west regions. Spring and early summer also saw drought conditions present in the Ohio Valley, but a series of frontal zones extending east-west from the mid-Atlantic region to the central Rockies during July allowed ample amounts of precipitation to alleviate the drought situation in this area. The western regions were not as fortunate.

Unusually dry spells occurred on a regional basis throughout the period. Not only did the western regions have dry periods during this time, but portions of the rest of the country did as well. For the east north central region (as well as Ohio), May and June 1992 ranked among the top 10 driest such periods. The east north central region also had the driest January-July period on record in 1992. The northeast region was dry in April, May and June, but significant moisture in July made that month's ranking the 6th wettest since records began.

May was noticeably dry for every region except the southwest. Seven of the nine regions were in the bottom third of the historical distribution for precipitation, and four of these were within the top ten driest in the 98-year period of record. The pattern was much improved for June, when only three regions were in the lower third of the distribution and five placed in the upper third. By July, only one region was in the lower third of the distribution, and six appeared in the upper third of the historical distribution, including three in the top ten wettest.

Precipitation in California has been below normal for seven of the last 12 months. September-July 1991-92 marked the 6th consecutive September-July period with much below normal precipitation. Precipitation during seven of the last 12 months was below normal in the northwest region, which has experienced below-normal precipitation for six of the last eight September-July periods. For the year to date, Idaho suffered the most, ranking as the 6th driest such period on record, while the northwest region as a whole had the 12th driest January-July period since records began in 1895.

Source: *Drought Network News*, abstracted from article by Richard R. Heim, Jr. and William O. Brown, NOAA National Climatic Data Center, Global Climate Lab, Climate Perspectives Branch, Federal Bldg., 37 Battery Park Ave., Asheville, NC 28801

COLORADO WATER SUPPLY CONDITIONS UPDATE

From the State Engineer's Office--The beginning of the new water year saw stream flows below normal in most all areas of the state. Generally good reservoir storage and precipitation events assisted irrigators during the past summer. October precipitation was 67% of normal statewide. Snow has begun to accumulate and the Soil Conservation Service will begin to obtain snow course data at the end of November.

Statewide reservoir storage was 105% of average on October 31. The Dolores and Animas River basins have the highest storage rate at 188% of normal, while the Rio Grande basin has the lowest storage rate at 80% of normal. The National Weather Service 30-day forecast (Nov. 1) is for above normal temperatures statewide, and near-to-below normal precipitation over all but the extreme southwestern corner of the state where above normal precipitation is forecast. The 90-day forecast (Nov. 1) is for below normal temperatures over all but the extreme southwestern corner of the state and above normal precipitation statewide.

Basin	Nov 1, 1992 SWSI Value	Change From Previous Mo.	Change From Previous Yr.
South Platte	+1.8	-0.1	-0.1
Arkansas	+0.5	-0.6	+0.9
Rio Grande	+0.1	-0.9	+1.1
Gunnison	-0.7	+1.1	-0.7
Colorado	-2.5	-1.7	-1.8
Yampa/White	-2.4	-1.6	-0.2
San Juan/ Dolores	-1.5	-3.4	-0.0

SCALE

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

WATER EDUCATION

COLORADO WATER EDUCATION FOUNDATION DEVELOPS PROGRAMS

Esther Marie Capps, Executive Director of the Colorado Water Education Foundation, visited Director Robert Ward at the CWRRI office on October 29. The Foundation was incorporated in February, 1992 to develop and disseminate impartial water education programs in Colorado. Its objective is to provide various viewpoints, with no advocacy position taken on any issue, to foster a broader understanding of water challenges among the general population.

Foundation programs in progress include a Colorado Water Resource Map (to be available end of 1992), a Clearing House for Water Information (in developmental stage), and a Water Resource Guide for Schools (to be available in the near future).

The Foundation is governed by a 33-member Board of Trustees representing various facets of water from both the West and East Slopes. Financial support is provided by the business community, governmental agencies and the general public. CWEF is a non-profit organization. For additional information contact Esther Marie Capps, Colorado Water Education Foundation, 21593 Hill Gail Way, Parker, CO 80134-7427; Phone 303/840-2845, FAX 303/840-2846.

CWRRI Director Robert Ward said he hopes the water expertise available through CWRRI can help develop and implement the programs of the Colorado Water Education Foundation.

PROJECT WET (WATER EDUCATION FOR TEACHERS) CONDUCTS WORKSHOPS

Project WET has planned eight regional writing workshops throughout the United States. In these 3-1/2-day sessions, participants design innovative activities and lessons to be included in the Project WET Elementary Activity Guide (grades K-8) and Secondary Water Modules (grades 6-12). To date three workshops have been held with the involvement of 23 states and the District of Columbia.

The Mid-Atlantic Workshop was conducted at the Smith Mountain 4H Conference Center near Blacksburg, Virginia September 23-30. Thirty-one educators from Maryland, Delaware, District of Columbia, Virginia, Kentucky, Tennessee, North Carolina and West Virginia attended. The North-central Region Workshop was conducted at Custer State Park in the Black Hills of South Dakota October 21-24. Montana, Wyoming, North Dakota, South Dakota, Nebraska, Minnesota and Iowa were represented. The last workshop was November 2-5 at the Swope Conference Center in Woods Hole, Massachusetts. Elementary, middle and secondary teachers and water resource specialists from Maine, New Hampshire, Massachusetts, Vermont, Rhode Island, Connecticut, New York, New Jersey and Pennsylvania attended.

Approximately 130 activities and 15 secondary water modules have been produced. The remaining five workshops are scheduled for January through April, 1993 (including the western region). After an extensive program of writing, review, testing and rewriting, the Guide and Modules are scheduled for a September, 1994 publication.

In addition to the workshops, Project WET is moving ahead with several other programs. Work has begun on the book and calendar, WATER: A Force of Nature (THE STORY BEHIND THE SCENERY, a partnership between KC Publications and

National Project WET. The book will be available in Spring, 1993. Project WET is also working with the Denver Museum of Natural History on the first book in the Rainbow Series, THE WATER STORY. Anticipated publication is Fall, 1993.

The H20 model (the groundwater education program) is one of Project WET's most successful and sought-after teaching aids. For information about obtaining a model for classroom use, contact the National Project WET office. Not available for distribution at this time, The Trade-off Game (a water resources management software program) is still under development. For shipping and handling costs, Project WET's "rainbow poster" can be obtained from the National Project WET office.

Wonder: Where Learning Begins visually captures the purpose and goals of National Project WET--bring water, educators and young people together. "An Introduction To Project WET," a booklet outlining the philosophy, goals and programs of the project, will be available February, 1993.

For more information about National Project WET, call 406/994-5392 or write: National Project WET, 201 Culbertson Hall, Montana State University, Bozeman, MT 59717.

WATER PUBLICATIONS

CWRRI PUBLICATIONS

Contact the Bulletin Room, Aylesworth Hall, Colorado State University, Fort Collins, COP 80523 - 303/491-6198.

Proceedings: Colorado Water Workshop, July 21-23, 1991, "From the Dome to the Ditches: Translating Environmental Legislation Into Practice," Information Series No. 68. Price $30 (includes transcribing and printing costs). The 1991 Colorado Water Workshop was held July 21-23 at Western State College in Gunnison, Colorado. For 16 years this annual conference has provided a valuable forum for the frank discussions of water issues facing Colorado and the arid West. The 1991 Water Workshop focused on the progress and problems created by environmental regulations that affect water use. Topics include:

Reauthorization of the Clean Water Act
Integrating environmental values into western water law and policy
Colorado's non-point control program
Non-point pollution and agriculture in Colorado
Marketing salvaged agricultural water
Public policy and the management of western water
The CCWCD Sustainable Agriculture study
Grazing management and non-point control
California's 3-way water agreement group
Colorado River operations
Glen Canyon power generation and environmental protection
Endangered species and river operations
Implications of the reevaluation of river systems operations
Mitigation banking
Colorado wetlands
Endangered fish recovery program

Proceedings, Water Resources and the Environment: Education, Training and Research, Information Series No. 69. The conference was held July 13-17, 1992 for the purpose of generating new thinking about needed directions for education policy, programs and methods in water and environmental education. One workshop focused on the roles of minority institutions and another on international opportunities and needs. (This publication is available from Verdia Johnson, Dept. of Civil Engineering, Weber Building, Colorado State University, Fort Collins, CO 80523; 303/491-5247.) Price: TBA.

Proceedings, "South Platte River Basin: Uses, Values, Research and Management--Current and Future, by R. Craig Woodring, Editor, Information Series No. 70. Workshop papers include keynote speakers Donald Ament, State Senator, and David Harrison, Attorney, Moses, Wittemyer, Harrison and Woodruff. Session topics included an overview of the South Platte River Basin, Water quality aspects of the basin, water transfers, water administration, water education for water users, the South Platte as an agricultural resource, and the South Platte as an ecological and recreation resource. Price: $6

Proceedings, High Altitude Revegetation Workshop, Information Series No. 71. Presents papers of the 10th biannual workshop held in Fort Collins, Colorado March 4-6, 1992. Organized by the High Altitude Revegetation Committee comprised of volunteers from the mining and ski industries, revegetation/reclamation materials suppliers, consultants, various governmental agencies and universities. Price: $13.

Valuing Time in Travel Cost Demand Analysis by Visitors to Blue Mesa Reservoir, Technical Report No. 58. This publication evaluates a technique derived to find the value of time implicit in a travel cost model. Monetary costs and time are entered as separate arguments to explain trips per year and, under certain conditions, the ratio of partial effect of time cost to the partial effect of monetary cost reveals the implicit value of time. The often-used technique of assuming an opportunity time cost on the basis of income is examined using the implicit time cost approach of McConnell and Strand. Price: $5.

Water Quality Data Management, Technical Report No. 59. This report contains the Master's thesis on research that addressed water quality data management activities in the United States and Colorado, and incorporates the results of a water quality data management survey of 200 water quality agencies that was undertaken in 1991. The report is designed to provide background information to assist in the interpretation of the

survey results (contained in Chapter 4 and Appendix C). It includes a review of water quality legislation that resulted in the generation and management of water quality data in the United States and a description of data management technologies and their applications to water quality data. Price: $9.

COLORADO WATER: THE NEXT 100 YEARS

Final Report--This report provides an overview for program participants and others interested in the project. In 1990 the *Colorado Water: The Next 100 Years* project held public meetings in each of the following Colorado water divisions: Glenwood Springs (Jan.); Alamosa (Feb.); Pueblo (Mar.); Greeley (Mar.); Durango (Oct.); Montrose (Oct.); Steamboat Springs (Nov.); and an additional meeting in Fort Collins (Sept.). The history of water use and development in Colorado and important water issues were addressed at each of the meetings. The objective was to explore long-range water matters rather than resolve immediate problems. For information about the project or to request the report, contact Barbara J. Preskorn, Project Director, Humanities Dept., Front Range Community College, Westminster, CO 80030; Phone 303/466-8811, ext. 390.

An additional product of the *Colorado Water: The Next 100 Years* meetings was CWRRI Information Series No. 67, Colorado Citizen's Water Law Handbook (available from the CSU Bulletin Room, Phone 303/491-6198.

RURAL CLEAN WATER PROGRAM

National Rural Clean Water Program Symposium Proceedings, EPA, 1992, held in Orlando, FL Sept. 1992. General topics include water quality and land treatment monitoring, relating water quality to land treatment; land treatment and operation and maintenance of BMPs; project coordination and farmer participation, institutional arrangements, program administration and project spinoffs; information and education; socioeconomics, technology transfer, and lessons learned; and research needs and future vision. Available free from USEPA, CERI, Document Distribution (G-72), 26 Martin Luther King Dr., Cincinnati, OH 45268.

Rural Clean Water Program Evaluation Summary, Gale, J.A., D.E. Line, D.L. Osmond, S.W. Coffey, J. Spooner, and J.A. Arnold; 1992. Based on site evaluations of the 21 Rural Clean Water Program (RCWP) projects, a short answer questionnaire completed by project personnel, project ten-year and annual reports, and technical assistance provided by NWQEP to the RCWP projects. The report includes a summary of lessons learned from the RCWP divided into two sections: (1) program or national level topics; and (2) project or local level topics. Order from: Mrs. Janet Young, NCSU Water Quality Group, 615 Oberlin Rd., Suite 100, Raleigh, NC 27605-1126. Free while supply lasts.

FLOODPLAIN MANAGEMENT

Multiobjective Approaches to Floodplain Management, Proceedings of the 1992 Association of State Floodplain Managers Annual Conference. Includes national assessment of floodplain management in the U.S., flood hazard mitigation, dams, mitigation funding, hydrology and hydraulics, watershed management, multiobjective planning, geographic information systems and software applications, ice jam research, river conservation, water quality issues and the community rating system. $10.00. Available from Natural Hazards Information Center, Campus Box 482, University of Colorado, Boulder, CO 80309-0482; Phone 303/492-6819. Orders must be prepaid.

POSITIONS AVAILABLE

Natural Hazards Center, Boulder--The University of Colorado at Boulder has approved a new senior-level faculty position in the Department of Geography whose responsibilities will include the half-time directorship of the Natural Hazards Research and Applications Information Center. For more information contact Tom Veblen, Chair, Dept. of Geography, Campus Box 260, University of Colorado, Boulder, CO 80309-0260; 303/492-8310; FAX 303/492-7501; e-mail Veblen_T@cubldr.colorado.edu. Deadline: January 24, 1993.

Department of Civil Engineering, University of the Pacific--The Department of Civil Engineering, University of the Pacific, invites applications for a tenure track position in the area of environmental engineering. The position, beginning in Fall 1993, is at the Assistant Professor level, although exceptionally well-qualified candidates will be considered for higher ranks. The primary responsibility will be teaching undergraduates; however, faculty are expected to be engaged in both scholarly and professional activities. The department is currently reorganizing the curriculum to emphasize environmental topics. Candidates should have an earned Ph.D in Civil or Environmental Engineering, although applicants with an M.S. and extensive professional experience will also be considered. Submit resume, professional experience, list of publications and names of three references to: David Q. Fletcher, Chairman, Department of Civil Engineering, University of the Pacific, Stockton, CA 95211. Deadline: Feb. 15, 1993.

Director, Universities Water Information Network, Southern Illinois University at Carbondale--12-month position to be filled by the end of calendar year 1992 at the rank of Researcher III. The Universities Council on Water Resources (UCOWR) seeks an individual to coordinate and manage a newly created Water Information Network at the Executive Director's office on

the campus of Southern Illinois University at Carbondale. The new Water Information Network, funded in part by the U.S. Geological Survey (USGS), will provide a variety of information dissemination services for the water resources community. A mini-computer-based file server located at UCOWR will be accessible through INTERNET, BITNET, an 800 number and commercial lines.

The Director will develop, coordinate and manage the Water Information Network. The individual should have an interest, background, and working knowledge of water resources, environmental terminology, and familiarity with computer networks, database management, the use of computer bulletin boards, and computer conferencing. Must have a Master's degree in one of the fields of the natural sciences, water resources, environmental sciences, geography or hydrology; related work experience will also be considered. Applications accepted until position is filled. Send resume and list of three references to the Chair of the Search Committee, Duane Baumann, Executive Director, UCOWR, 4543 Faner Hall, Southern Illinois University at Carbondale, Carbondale, IL 62901. Phone 618/536-7571.

United Science Industries, an environmental consulting and remediation firm located near Mt. Vernon, Illinois, has employment opportunities for geologic engineers and hydrogeologists. M.S. required. Apply by mail only to: Daniel R. Ruark, Manager, Environmental Services Division, United Science Industries, Rural Route 1, Box 207, Woodlawn, IL 62898.

WATER NEWS DIGEST

WATER ALLOCATION

Forest Service Reverses Stand on Reservoirs

The U.S. Forest Service has reversed plans to demand water from Colorado municipalities in return for new permits for reservoirs on Forest Service land. Last spring the Forest Service had suggested that Front Range cities surrender to the federal government a portion of their reservoir water as a condition for renewing reservoir permits. Greeley was asked to give up 25-50% of reservoir water with a 1923 priority; Boulder was asked to surrender 42% of the water in a reservoir built in 1905. As of this Fall the Forest Service had not made similar suggestions to western slope communities with reservoirs all or partially on Forest Service land.

Grand Junction *Daily Sentinel* 10/28/92

Mountain Towns Buy Back Water Rights

Once seen as an economic boon for the selling, small mountain towns are now trying to buy back water rights as more people move into the state. The Fairplay-based Upper South Platte Water Conservancy District recently bought 37 acre-feet of water for $18,000 from the Resolution Trust Corp., the federal agency selling holdings of failed savings and loans. That much water normally costs about $100,000. The district plans to use the water rights as collateral to buy additional water, which local users would share to reduce development costs. While mine and ranch closings have eroded Fairplay's population to about 450, Californians have begun to invade Park County, spurring a construction boom. Building permits and real estate transactions have doubled since last year. In Park County, most water comes from wells. But a 1972 state law requires people to buy rights to surface water elsewhere as compensation for water taken out of the ground. Thus, developers must file augmentation plans, explaining how groundwater will be compensated.

Grand Junction *Daily Sentinel* 10/19/92

River District Budgets Funds for Orchard Mesa Water Right

The Colorado River Water Conservation District budgeted $10,000 for Grand Valley irrigators seeking an official water right for the longstanding Orchard Mesa check dam. The money would be used to reimburse half of the Grand Valley Water Users' Association's legal costs in formalizing the check dam operation in water court. Bob Child, Pitkin County's representative, suggested the $10,000 be taken from the River District's $318,000 contingency budget, a move approved by the board. The District's 1993 budget is expected to be approved at a special board meeting Nov. 19 in Glenwood Springs.

Grand Junction *Daily Sentinel* 10/21/92

WATER PROJECTS

Environmentalists Join EPA in Fight to Kill Two Forks

Four environmental groups are siding with the Environmental Protection Agency's decision to kill the Two Forks dam project on the South Platte River. The Environmental Defense Fund, Colorado Environmental Caucus, National Audubon Society, and American Rivers filed statements to support the EPA's veto of the project. The EPA and the four groups are fighting eight small Denver-area water districts who filed suit last year in an attempt to overturn the 1990 veto. A spokeswoman for the eight water districts maintains that the EPA veto was improper on several technical points, and that the veto was improperly based on Clean Water Act rules, when water quality was not a problem.

Grand Junction *Daily Sentinel* 10/26/92

Project Draft Review Released

The U.S. Bureau of Reclamation (USBR) has released a draft of an updated environmental review of the Animas-La Plata water project, and scheduled three hearings on the document. The

USBR agreed to the review this spring after the Sierra Club Legal Defense Fund filed suit, saying the USBR broke federal law by failing to update 1980 studies of the water project. The draft review addresses new environmental impacts of the project and the USBR's intent to seek an exemption from a permit to destroy wetlands. Hearings on the new review are scheduled Nov. 30 in Durango, Dec. 1 in Farmington, N.M., and Dec. 2 in Denver.

Montrose Daily Press 10/21/92

WATER QUALITY

Grand Junction Plans May Cost Water District $20 Million

Expansion plans by the city of Grand Junction could cost Ute Water Conservancy District ratepayers $20 million, although that figure is disputed by the city. The $20 million figure is based on the city's stated goal of annexation to the boundaries of the valley-wide sewer service area within 20 years, district officials say. At issue is a city requirement, upheld by a Mesa County District judge, that Ute is responsible to install fire lines that meet city codes in land when the city annexes territory served by Ute. Grand Junction mayor Redford Theobold said Ute's cost estimate is too high. However, city officials have agreed to help, and have met in the last month to begin negotiating. There is hope a cost-share arrangement can be worked out.

Grand Junction *Daily Sentinel* 10/24/92

USBR and UVWUA Negotiations Slated

The Uncompahgre Valley Water Users Association (UVWUA) and the U.S. Bureau of Reclamation (USBR) are beginning negotiations on a contract to provide for the long-term operation and maintenance of salinity improvements to be developed as part of the East Side Laterals, Lower Gunnison Basin Unit of the Colorado River Water Quality Improvement Program. The improvements consist of replacing approximately 195 miles of existing earth laterals (east of the Uncompahgre River in Montrose and Delta Counties) with underground concrete or PVC pipe. For additional information about the negotiations, interested persons may telephone Fred Crabtree, Grand Junction Projects Office, USBR, (303) 248-0655.

Montrose Daily Press 10/20/92

Ft. Collins Drinking Water Meets New EPA Standards

A recent round of testing has found Fort Collins' drinking water within new standards set by the EPA. City water from 110 household taps contained three times below the new standard for lead and seven times below the new copper standard. EPA is requiring all water utilities to demonstrate new lower limits on the amount of lead and copper in drinking water. Homes tested were built between 1983 and 1986 and contain copper plumbing joined with lead-based solder.

Fort Collins Coloradoan 10/30/92

ENVIRONMENT

Governor to Request Funds for Mill Tailings Cleanup

Governor Roy Romer indicated he will ask the state legislature to allocate $15 million as the state's share of funding for uranium mill tailings cleanup projects around the state. Projects slated for 1993 in the U.S. Department of Energy's Uranium Mill Tailing Remedial Action program include continuation of the Grand Junction project. The federal government pays 90 percent of the cost of the projects with the state required to pay 10 percent. The $15 million would come from $96 million in "one-time money" the state unexpectedly has from several sources.

Grand Junction *Daily Sentinel* 10/15/92

Hotchkiss Wants to Use Sludge to Condition Soil

The town of Hotchkiss plans to follow the lead of other western slope cities and spread its waste sludge from its sewer plant on land as a soil conditioner. The town hasn't settled on a site, and is looking at two parcels of pastureland east of town. Though the practice is routine, with cities such as Montrose and Delta using it, the idea has garnered some concern around Hotchkiss. Because Hotchkiss doesn't have any major industry, a state health official said the sludge could serve as an excellent soil conditioner. The town must submit an application to the state health department before applying the sludge to the land.

Grand Junction *Daily Sentinel* 10/14/92

Weld County Agrees to Halt Nitrate Testing

The Weld County Health Department has agreed to halt tests designed to monitor nitrate accumulations near the National Hog Farms east of Kersey at the company's request. Greg Gilsdorf, National Farms Inc., said soil and lysimeter testing, which measure chemical composition in water as deep as 10 feet below the ground, were never agreed upon. He asked that the tests be stopped, but that the county and National Farms continue to sample monitoring wells and production wells on the site and near the boundaries. Soil and lysimeter testing indicate to Weld County Health Department officials that nitrate contamination of ground water used for drinking water in Kersey might become a problem. Monitoring wells at the National Farms boundaries have not picked up nitrate contamination that would alarm the health department. But the department is worried that by the time nitrate contamination is picked up in monitoring wells, it will be too late to keep contamination from reaching groundwater and the nearby South Platte River.

Fort Collins Coloradoan 11/12/92

Gravel Pit Conversion a Possibility

The Denver area and much of the Front Range is geologically blessed with thick deposits of sand and gravel along its waterways. Historically the site of abandoned gravel pits, these

waterways are increasingly being seen as a public amenity for use as valuable water storage, wildlife habitat, and recreation sites. In the past abandoned gravel pits have filled with groundwater and precipitation, much of it wasted through evaporation and seepage. While the leaking old gravel pits are a liability, those sealed with a compacted shale lining or a "slurry wall" can be an asset. A slurry wall is a narrow trench dug to bedrock surrounding the pit. It is filled with slurry -- a mixture of clay and water--that dries to form an underground dam stopping the migration of groundwater. The city of Thornton presently stores one third of its drinking water in seven lakes that were former gravel pits.

Rocky Mountain News 11/19/992

WILDLIFE

Thousands of Fish Die After Reservoir Drained

Tens of thousands of dead fish turned up along Grape Creek in Fremont County after DeWeese Reservoir was drained for repairs, according to the Colorado Division of Wildlife. DeWeese-Dye Irrigation Co., which operates the reservoir south of Canon City, said it was ordered by the state Division of Water Resources to drain the reservoir. State biologists are assessing the damage to Grape Creek, where thousands of trout, bass, and sucker fish may have been killed. The reservoir is stocked annually with 70,000 trout. Evidently the Division of Wildlife knew the reservoir was to be drained, but not completely. Concentrated nutrients at the bottom of the reservoir washed into Grape Creek and also may poison fish all the way to the Arkansas River. The reservoir was drained in September to repair a valve that hadn't worked for 50 years.

Rocky Mountain News 10/16/92

Fish Kill Mystery Remains

After a six-week investigation, officials still don't know what caused thousands of fish to die suddenly in the Big Thompson River. About 2,000 trout died suddenly on Aug. 28 after a toxic substance entered the river. However, officials from the Colorado Division of Wildlife, the Colorado Department of Health, and the Larimer County Health Department have been unable to determine what the substance was and where it entered the river. The fish died along a mile-long stretch of river near the Sylvan Dale Ranch west of Loveland near Highway 34. Water and fish samples which were collected gave conflicting evidence on Ph level of the water. Also suspected was a chemical put into canals by the Northern Colorado Water Conservancy District. Copper sulfate is used to control algae in canals and was used the day of the fish kill. However, no fish died in the canals, and samples of fish tissue showed no unusually high levels of copper. More recent fish tissue samples showed extremely high levels of aluminum in the gills. The aluminum might have killed the fish, but officials have no idea where the aluminum might have originated.

Fort Collins Coloradoan 10/18/92

Waterfowl Stamp Sales Help Habitat

Over the last two years, more than 7,500 acres of Colorado waterfowl habitat were improved thanks to duck and goose hunters who purchased the state's waterfowl stamp. Plans call for improving another 3,500 acres this year, which will bring the total to 11,000 acres at 52 sites since creation of the stamp in 1990. The Colorado stamp program has generated nearly $1.2 million in revenues in the last two years. Matched by other private, state, and federal funds, those revenues have made more than $5 million available for habitat improvement projects. This year work is under way to improve wetlands at the South Republican State Wildlife Area at Bonny Reservoir near Idalia, to provide nesting structures and protective fencing near Kenosha Pass west of Denver, to build ponds at Confluence Park near Delta, and to provide an aeration system for Lynda Ann Reservoir near Pueblo.

Montrose Daily Press 11/9/92

Squawfish Recovery Program Approved

The federal government has approved an agreement that will activate the San Juan River Basin Recovery Implementation Program for the endangered squawfish. An agreement signed a year ago requires the recovery program, and allows parts of the Animas-La Plata water project to be constructed, while simultaneously the recovery program seeks to improve habitat for the endangered fish. Negotiations leading to the agreement began in May 1990 after the U.S. Fish and Wildlife Service issued an opinion that the Animas-La Plata project would jeopardize the squawfish in the San Juan River.

Grand Junction *Daily Sentinel* 10/30/92

Court Order Designates Razorback Habitat

A federal judge has ordered the U.S. Fish and Wildlife Service to designate within 90 days critical habitat for the endangered razorback sucker in the Colorado River Basin. The ruling results from a lawsuit filed earlier this year by a coalition of environmental groups led by the Sierra Club. The groups said immediate action is needed to save the razorback sucker from extinction. U.S. District Judge Sherman Finesilver said the U.S. Fish and Wildlife Service's failure to declare critical habitat for the fish violates the Endangered Species Act, and ordered the agency to publish a proposed rule designating habitat for the razorback sucker within 90 days. The largest remaining population of razorback suckers is in Lake Mojave along the Arizona-California border, where about 30,000 exist.

Grand Junction *Daily Sentinel* 10/31/92

WILDERNESS

Colorado Wilderness Bill Dies

A plan to protect 744,000 additional acres in Colorado as wilderness died when it was blocked by Republican Rep.

William Dannemeyer of California in the U.S. House of Representatives. A compromise on the issue of water rights broke a longstanding deadlock, allowing the Senate to act just minutes before it adjourned for the year, but the House was unable to act on the wilderness bill because Dannemeyer vowed to block any legislation regardless of its merits. Despite the setback, the bill's backers were surprisingly upbeat, saying the measure could be resurrected and passed early next year.

Denver Post 10/10/92

PEOPLE

Water Commissioner Retires

After serving 55 years as water commissioner for District 70 on Roan Creek, George Anderson has retired. Anderson was born in Collbran in 1915, and grew up in De Beque. Governor Ed Johnson appointed Anderson water commissioner to replace his grandfather.

Grand Junction *Daily Sentinel* 11/1/92

Water Official of the Year Named

Kannah Creek Water Commissioner Jack Carter has been named Water Official of the Year by the Colorado Division of Water Resources. Since 1984, Carter has administered water in the Kannah Creek drainage and served as deputy in the East Creek drainage. He serves as deputy water commissioner in water districts 42, 63, and 73. The city of Grand Junction gets most of its water from the Kannah Creek drainage. Carter previously served 30 years with the U.S. Geological Survey as a hydrologist and engineer both in Kansas and Denver. Water Division IV Engineer Keith Kelper cited Carter's knowledge, precision, and ability to settle disputes as reasons for the Colorado Division of Water Resources award. Colorado Water Division IV consists of the Gunnison River Basin plus the San Miguel River and the lower end of the Dolores River basins.

Grand Junction *Daily Sentinel* 11/12/92

CONSERVATION

Denver Metering Program Complete

The Denver Water Department's program to install water meters in nearly every home will finish eight years ahead of schedule and $3 million under the projected $40 million cost. Prior to meter installation, Denver residents paid a low, flat, bi-monthly water bill based only on the size of their lawn and the number of bathrooms and sinks in the house. Now, the price of only the first 30,000 gallons will be at a low rate, while the next 30,000 gallons will cost an additional 25 percent. Metering should save 10,000 acre-feet of water per year, enough to meet the annual needs of 40,000 city residents.

Rocky Mountain News 10/29/92

Fort Collins Water Meters Pose Catch 22

The recent rate increase proposed for the Fort Collins Water and Wastewater Utility illustrates how conservation helps and hurts at the same time. As the city's water metering program gradually expands during the next 15 years, along with a growing environmental ethic, the trend will be less water usage - which leaves the utility company with the problem of less revenue. Residents are increasingly volunteering to have meters installed in their homes with the idea of saving money and saving water. Metering is voluntary at present, but eventually will be the law. Fort Collins' push toward meters is still fairly new, starting in December 1990 and offering free installation since July 1991. Eventually every house in Fort Collins must be metered in order to meet a mandatory state deadline of 2009.

Fort Collins Coloradoan 11/16/92

LITIGATION

Water Case Fees Decision Set

The U.S. Supreme Court has agreed to use an Idaho case to decide whether the federal government must pay state court filing fees in water rights disputes. The court will hear the Bush Administration's argument that the federal government is immune from having to pay such costs, estimated at more than $10 million. The Idaho case involves a 1987 Idaho Department of Water Resources suit to determine water rights in the Snake River Basin, which includes 72,694 square miles -- approximately 87 percent of the entire state. Half of the land in the river basin is owned by the federal government. Idaho law requires both sides in water rights lawsuits to pay filing fees to finance the state's cost of gathering and investigating claims and making recommendations to a court. The federal government has refused to pay, saying it has not waived its immunity from having to pay. Administration lawyers say the 1952 McCarran Amendment, which allowed the federal government to be named as a defendant in water rights disputes, also said the government could not be forced to pay any "judgment for costs." An Idaho state court ruled against the federal government, and the Idaho Supreme Court agreed, saying that "costs" and "fees" are two different things (U.S. vs. Idaho, 92-190).

Montrose Daily Press 10/26/92

Judge Upholds Protection for Taylor River

The Colorado Supreme Court has upheld a 1990 Gunnison water court ruling protecting the Taylor River from Arapahoe County's proposed transmountain diversion. The court's unanimous decision backs 7th District Judge Robert A. Brown's ruling granting the Upper Gunnison Water Conservancy District a second filling of Taylor Reservoir. The ruling comes on the heels of another state Supreme Court decision upholding Brown's earlier ruling to allow the so-called vader instream flows of 400 cubic feet per second on the Taylor River. The flows go far beyond the state's minimum streamflow program, keeping the Taylor River flowing with enough water to support

a healthy trout fishery and a thriving local boating industry. Together, the court-affirmed rights in the two cases absorb all Taylor River flows except in very wet years. A state Supreme Court ruling on Arapahoe County's actual claim to Taylor River water is at least two years away.

Grand Junction *Daily Sentinel* 10/23/92

Court to hear North Platte Arguments

The U.S. Supreme Court ordered a new round of courtroom arguments in a longstanding dispute over use of the North Platte River's water. Lawyers for Nebraska, Colorado, Wyoming, and the federal government are to appear before the court during the 1992-93 term to discuss recommendations of a "special master" the court appointed five years ago to help resolve the dispute. The fight over use of the North Platte has been going on for most of this century. The Supreme Court, after hearing the new round of arguments, is likely to issue a decision by July resolving some or all of the remaining points of contention. The case is Neb. vs. Wyo., 108 Original.

Montrose Daily Press 10/6/92

Sierra Club Defense Fund bills USBR

The Sierra Club Legal Defense Fund has billed the U.S. Bureau of Reclamation (USBR) $178,000 for costs and legal fees incurred fighting the Animas-La Plata water project. The Defense Fund will sue for the fees in U.S. District Court if the USBR does not pay the bill. Federal law allows attorneys to recover fees from governmental defendants who lose the lawsuit.

Grand Junction *Daily Sentinel* 11/15/92

AWDI Files Motion to keep Files Secret

American Water Development Inc. has filed a motion to keep confidential some portions of vice chairman Alexander Crutchfield Jr.'s deposition. AWDI filed the motion for confidentiality with the entire deposition of several hundred pages with underlined portions, attachments and exhibits along with a legal brief. The documents are under seal and can be reviewed only by designated parties and the judge. In September, SLV Publishing, Monte Vista, filed a motion asking Water Judge Robert Ogburn to rescind his order sealing portions of the AWDI file. AWDI is a Denver-based company which has been trying since 1986 to obtain San Luis Valley water for shipment to the front range or southern California.

Pueblo Chieftain 11/13/92

LEGISLATION

Water Bill may slow AWDI Project

A water bill (H.R. 429) signed by President Bush contains a provision that may hinder a controversial San Luis Valley water project. The provision bans permits to transport water across federal lands unless the interior secretary declares it won't harm U.S. activities in the valley. The restriction doesn't mention any project by name, but it clearly targets the American Water Development Inc. Baca Project. That project would sink about 100 deep wells and pipe the water to municipal customers on the front range. The project is on indefinite hold while AWDI awaits a Colorado Supreme Court ruling. Last November, a state water court denied AWDI's application for water rights to drill the wells and AWDI appealed.

The bill also gives California farmers the right to sell their water to cities, which could in turn reduce southern California's urban demand for Colorado River water. H.R. 429 also adds fish and wildlife as a specific purpose of the Central Valley Project (a federally operated water project in California), and allocates 800,000 acre-feet of water for fish and wildlife in normal years, with a reduction of up to 25 percent in dryer years.

Grand Junction *Daily Sentinel* 11/7/92, *Rocky Mountain News* 10/9/92, *U.S. Water News* 11/92, *Western States Water* 10/16/92

WEATHER

Water District Plans Cloud Seeding

Faced with five consecutive years of below-average snowfall, the Northern Colorado Water Conservancy District (NCWCD) will try to shake more moisture from the clouds this winter. Studies show the weather modification could increase snowfall by 10 percent. Granby Reservoir, the district's major storage facility on the Western Slope, has not filled to capacity since 1986. The reservoir can hold 540,000 acre feet of water and reached only 60 percent of capacity this year. The cloud seeding program will cost $80,000 in the first year. Beginning in late November, silver iodide crystals will be shot into clouds that show potential for producing snow by fifteen generators located near Willow Creek Reservoir. Officials hope the technique will cause more snow to accumulate in the Willow Creek drainage. Colorado Division of Wildlife officials have expressed concern that additional snow could be detrimental to wildlife. The conservancy district has agreed to stop cloud seeding if snowpack reaches 200% of average.

Fort Collins Coloradoan 11/8/92

WATER RATES

Pueblo to Face Hike in Water Rates

A proposed 2.5 percent water rate hike has drawn no objections from the Pueblo Board of Water Works. The estimated $340,000 the rate increase would generate would keep the utility from dipping further into its cash reserves. Even with the increase, the utility expects to tap into about $1.1 million of reserves. The utility proposes a 1993 operating budget of $15.8 million, about $500,000 less than its current-year budget of $16.3 million.

Pueblo Chieftain 11/18/92

Grand Junction May See Water Rates Increase

Grand Junction residents may see monthly water bills boosted by just under 5% under a proposal being considered by the city council. This is in response to requests that the city abandon its program of instituting substantial fee increases every three years and increase them slightly every year. The increase is projected to bring in $141,128.

Grand Junction *Daily Sentinel* 11/3/92

CONFERENCES, WORKSHOPS, SHORT COURSES

1992 SOUTH PLATTE CONFERENCE A SUCCESS

by Craig Woodring, Conference Coordinator

Over 150 attendees and a full slate of water related papers revolving around the South Platte River System combined to make the third annual conference the best yet. Attendees from agricultural, urban, wildlife, recreation, environmental, and research sectors came together at the University Park Holiday Inn in Fort Collins on October 27-28 to discuss the multitude of issues on the South Platte Basin revolving around ecological integrity. This year's theme was "Ecological and sociological integrity of the South Platte River Basin." Papers were presented on historical water use, riparian vegetation, avian life, political/sociological aspects, federal legislation and regulation, the media, agricultural water use, water quality, fisheries, bio-assessment, climate, water transfer economics, and urban design of river corridors. While the spectrum was broad in topics, the discussions came together into a cohesive but broad view of the importance of the South Platte to the ecological and sociological makeup of the river basin.

A primary concern of the conference was the term "ecological integrity" as found in impending federal legislation on re-authorization of the Clean Water Act. The current Act is up for reauthorization and modifications are being debated. Proposed new terminology in the Act's purpose brings into question the phrase "ecological integrity." This term is ill-defined, and a purpose of the conference was to determine input on a specific South Platte River-oriented definition. Progress was made through the many views expressed, though a full definition is yet to be determined. This conference at least began a dialogue among many interested but divergent groups.

Attendee reviews were positive. A majority noted as highlights the round-table discussions, the informal nature of the conference, and the keynote speakers - Ed Marston of *High Country News* and David Freeman, noted rural sociologist and expert on societal change through water development and environmental alteration. For those who missed the conference, a proceedings should be available by January 1 through the Colorado Water Resources Research Institute. Contact CWRRI at 491-6308 for copies.

The conference was sponsored by the Colorado Division of Wildlife, the Denver Water Department, the Northern Colorado Water Conservancy District, the U.S. Environmental Protection Agency, the U.S. Fish and Wildlife Service and the US Geological Survey with assistance from CWRRI. Next year's conference is already in the planning stages. Possible topics under consideration for 1993 are augmentation or non-point source pollution. A suggested change is to move the conference to a late summer or early spring timing to avoid scheduling conflicts. If anyone has specific input for directions please contact Craig Woodring at CWRRI (491-6308).

FOUR STATES IRRIGATION COUNCIL ANNUAL MEETING Scheduled for January 6-8, 1993 in Fort Collins

The theme of the meeting is **Water Partners for Tomorrow**. The first day will be devoted to meetings between water users/districts and USBR Regional Director and staff and concurrent workshops on irrigation project improvements. For early arrivals there will be a slide show and overview of a coalition formed between irrigators and business to promote the benefits of water by the North Platte Valley Coalition.

The general session on January 7 (morning) will feature a **USBR Update** by Neil Stessman, Regional Director, Great Plains Region, Billings, Montana; **Dam Inspections/SEED Program -What Irrigators Need to Know** by John Van Sciver, State Engineer's Office, and Chris Veesaert, USBR, Denver; and **Agricultural Education - What's Being Done Today?** by Betty Blinde, Director, Colorado Foundation for Agriculture.

Keynote speaker at the January 7 luncheon will be Dennis Underwood, Commissioner, Bureau of Reclamation. The afternoon session is dedicated to concurrent workshops - **Estate Planning, Procurement Procedures,** and **NCWCD Concrete Lining Program.** January 8 will include a viewing of commercial exhibits, the annual business meeting and election of officers, and an **Update on National Water Issues** by Tom Knutson, Nebraska Four States Director, Farwell NE and Bennett Raley, Hobbs, Trout & Raley, Denver.

Established in 1952, the Four States Council is a forum for irrigators to exchange ideas and information and to discuss specific irrigation-related problems. Member states are Colorado, Kansas, Nebraska and Wyoming, and membership is open to anyone interested in irrigation system operations or irrigated agriculture. There are no annual dues or fees.

UNIVERSITIES COUNCIL ON WATER RESOURCES ANNUAL MEETING, Aug. 3-6, 1993, San Francisco, CA. The theme will be education in the water sciences and the program will focus on academic programs in the US and abroad. Contact: Dr. Howard S. Peavy, Dept. of Civil Engr., Montana State University, Bozeman, Mt 59717; 406/994-6690.

Second STORET Modernization Conference--Presentation of Proposed System Design, Feb. 2-4, 1993, Dallas, TX. Sponsored by EPA, Office of Water, and Office of Administration and Resources Management. For Technical Information contact: Louie Hoelman, U.S. EPA Office of Water, 401 M St., SW (WH-553), Washington, DC 20460; 202/260-7050. For Logistical Information contact: Karen Helm, American Management Systems, Inc., 1525 Wilson Blvd., 7th Fl., Arlington, VA 22209; 703/908-5093.

CALLS FOR PAPERS

CONFERENCE ON TAILINGS & MINE WASTE '93

November 29-December 1, 1993
Colorado State University - Fort Collins, CO

This conference will cover the latest information on mine and mill tailings and waste, as well as provide a forum for discussion of current and future mining and environmental issues. The program will include issues related to: tailings and mine waste management, reclamation and remediation, regulatory framework, and public awareness. Authors are requested to submit a short abstract (250 words) byFeb. 15, 1993. To submit an abstract or for information, contact: Janet Lee Montera, Dept. of Civil Engr., Colorado State University, Fort Collins, CO 80523; Phone 303/491-7425; FAX 303/491-7727.

13TH ANNUAL HYDROLOGY DAYS

March 30-April 2, 1993
Colorado State University - Fort Collins, CO

Hydrology Days provides a forum for hydrology professionals and students to get acquainted and share problems, analyses and solutions. Special keynote addresses will be given by recognized hydrologists. Besides general hydrology, there will be several special sessions. Early professional registration is $120 and early student registration is free. Deadline is January 8, 1993, for two copies (original plus one) of abstract. Deadline for final written paper is February 24, 1993. Contact: Janet Lee Montera, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523, Phone 303/491-7425, FAX 303/491-7727.

ENVIRONMENTAL AND SOCIO-ECONOMIC CONSEQUENCES OF THE DEVELOPMENT OF WATER PROJECTS

(date to be announced)

Jointly organized by the Russian IHP National Committee, UNESCO and IAHS, and sponsored by UNEP, IAHR and IFIAS. If you intend to present a paper please submit a 1-2 page abstract in English by Dec. 31, 1992. For information contact: International Water Resources Association, 205 North Mathews Ave., Urbana, IL 61801-2352; Phone 217/333-6275; FAX 217/244-6633.

SYMPOSIUM ON WESTERN WATER LAW AND POLICY: IMPLICATIONS FOR WETLAND AND RIPARIAN SYSTEMS

February 24-26, 1993 at the Sheraton Denver West, Lakewood, Colorado

SPONSORED BY:
THE SOCIETY OF WETLAND SCIENTISTS, ROCKY MOUNTAIN CHAPTER

Topics will include:

- History of Western Water Law
- Forces That Have Shaped Western Water Law and Policy
- Traditional Water Use Values--Threats to Traditional Uses
- Can the Prior Appropriations Doctrine Adapt to New Realities
- Law and Policy Relevant to Wetland and Riparian Ecosystems
- Balancing Traditional and Non-Traditional Uses of Western Water - Agricultural, Municipal, Hydropower
- State Government Policies
- Biological Resources
- Case Study 1, Forest Service Water Rights for Channel Maintenance; and Case Study 2, San Luis Valley Trans-Basin Water Transfer - Legal Issues, Hydrologic Issues
- The Future of Western Water: Science, Law and Policy Balancing - Competing Uses

For information contact Mike Scott, U.S. Fish and Wildlife Service, National Ecology Research Center, 4512 McMurry Ave., Fort Collins, CO 805225-3400. FAX 303/226-9230.

MEETING CALENDAR

Jan. 6-8 **1993 ANNUAL MEETING OF FOUR STATES IRRIGATION COUNCIL**, Fort Collins, CO. Contact: Rich Johansen at 402/466-9517.

Feb. 4-6 **MANAGING RIPARIAN AREAS: COMMON THREADS AND SHARED INTERESTS--A Western Regional Conference on River Management Strategies**, Albuquerque, NM. Contact: Water Resources Research Center, University of Arizona, 350 N. Campbell, Tucson, AZ 85721, 602/792-9591.

Feb. 21-24 **AGRICULTURAL RESEARCH TO PROTECT WATER QUALITY**, Minneapolis, MN. Contact: Soil and Water Conservation Society, 7515 NE Ankeny Rd., Ankeny, IA 50021-9764; Phone 515/289-2331, FAX 515/289-1227.

Feb. 26-27 **SUSTAINABLE AGRICULTURE CONFERENCE**, Greeley, CO. Contact: Central Colorado Water Conservancy District at 330-4540.

Mar. 14-18 **SYMPOSIUM ON GEOGRAPHIC INFORMATION SYSTEMS AND WATER RESOURCES**, Mobile, AL. Contact: AWRA, 5410 Grosvenor Lane, Suite 220, Bethesda, MD 20814-2192; Phone 301/493-8600.

Mar. 30-Apr. 2 **13TH ANNUAL HYDROLOGY DAYS**, Colorado State University, Fort Collins, CO. Contact: Janet Lee Montera, Department of Civil Engineering, Colorado State University, Fort Collins, CO 80523, Phone 303/491-7425, FAX 303/491-7727.

May 3-5 **WATER MANAGEMENT IN THE '90s: A Time for Innovation**, Seattle, WA. Contact: ASCE, 345 E. 47th St., New York, NY 10017-2398.

June 6-10 **AMERICAN WATER WORKS ASSOCIATION ANNUAL CONFERENCE AND EXPOSITION, San Antonio, TX.** Contact AWWA, 6666 W. Quincy Ave., Denver, CO 80235.

June 18-19 **APPLICATION OF ADVANCED INFORMATION TECHNOLOGIES: EFFECTIVE MANAGEMENT OF NATURAL RESOURCES**, Spokane, WA. Contact: ASAE, 2950 Niles Rd., St. Joseph, MI 49085-9916; Phone 616-429-0300, FAX 616/429-3852.

June 20-23 **JOINT INTERNATIONAL SUMMER MEETING OF THE AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS AND THE CANADIAN SOCIETY OF AGRICULTURAL ENGINEERING**, Spokane, WA. Contact: American Society of Agricultural Engineers, 2950 Niles Rd., St. Joseph, MI 49085-9659; Phone 616/429-0300.

COLORADO WATER CONGRESS ANNUAL CONVENTION - January 21-22, 1993
Holiday Inn - Northglenn, I-25 & 120th Ave., Northglenn

Topics for General Sessions will include what the Clinton Administration means for Colorado water interests; upcoming federal legislation - reauthorization of the Clean Water Act, the Safe Drinking Water Act, and the Endangered Species Act; the 1993 Colorado Wilderness Act. Also scheduled are concurrent workshops on a variety of water topics. A special feature of the CWC 35th Anniversary Banquet will be a Melodrama -"Should the Water Buffalo be Listed as an Endangered Species?"

For information contact: Colorado Water Congress, 1390 Logan St., #312, Denver, CO 80203

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

Mr. James L. Ogilvie, P.E.
3312 South Oneida Way
Denver, CO 80224