



# COLORADO WATER

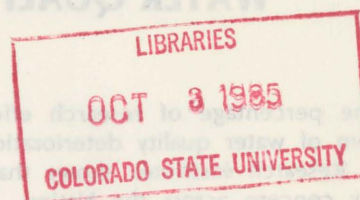
Colorado Water Resources Research Institute

Colorado State University

Fort Collins, Colorado 80523

424  
C6C63  
PERIOD  
ARCHIVE

July-September, 1985



## HIGH TECH COMES TO COLORADO WATER PROBLEMS

Colorado water users and managers now have access to high-tech computer simulation models that can be used to evaluate water management strategies and improve water supply availability. The advanced technology is the product of the Institute's ten-year research commitment to develop technology that can be used to test basinwide impacts of proposed new projects and management changes. Basin water systems have become so complex that the old methods are inadequate. Water managers have seen the need for more than a decade and the Institute has been able to sustain the research program necessary to produce the new technology.

### SAMSON

Dr. Hubert J. Morel-Seytoux, Civil Engineering Department, CSU, has completed program development of SAMSON for the entire South Platte River Basin. The model will be calibrated and ready for use in September. Many water management questions can be answered with the model, such as day-by-day basinwide impacts of (1) water right exchanges, (2) well permits, (3) aquifer recharge, (4) augmentation plans, (5) change in point of diversion, (6) changes in place or amount of effluent discharge to stream, and (7) recycle and reuse plans for transbasin imports.

An appropriation of \$130,000 by the Colorado General Assembly in 1983 provided for completion of the model from Denver to the Nebraska State line. Federal funds of more than \$300,000 were invested in developing the advanced technology for this model.

### MODSIM/CONSIM

MODSIM is being used routinely by City of Fort Collins water resource engineers to manage the City's water

supply system and to plan for future supply. Fort Collins is currently undertaking a drought study to develop emergency plans for an extreme drought or a major component failure during a critical drought year. MODSIM's computer model of the water supply system makes it possible to plan and test the City's water management options for practicability and reliability. A sophisticated hydrologic analysis of water supply data produced a synthesized 50,000-year runoff record for three basins from which the City takes water. From this record droughts of various intensity and duration were found. For example, the one in 100-year drought was found to be typically eight years in duration; the one in 500-year occurrence was 11 years in duration. (Tree-ring records verified that the synthesized runoff record is realistic.)

The operation of the city supply system was then simulated on MODSIM for the several drought scenarios to assess the reliability of the city's current supply and to project the water supply necessary to avoid a drought crisis in the coming 50 years. MODSIM proved an invaluable asset to the city in making this analysis.

The planning model was developed by Dr. John Labadie, Civil Engineering Department, CSU, and is available to water managers in two versions, MODSIM and CONSIM. It is capable of assuring on a monthly basis that existing water right priorities are satisfied, and can predict effects of exchanges of water rights within a basin. The model takes account of reservoirs, transport and distribution systems, return flow, evapotranspiration, water right priorities and exchange agreements.

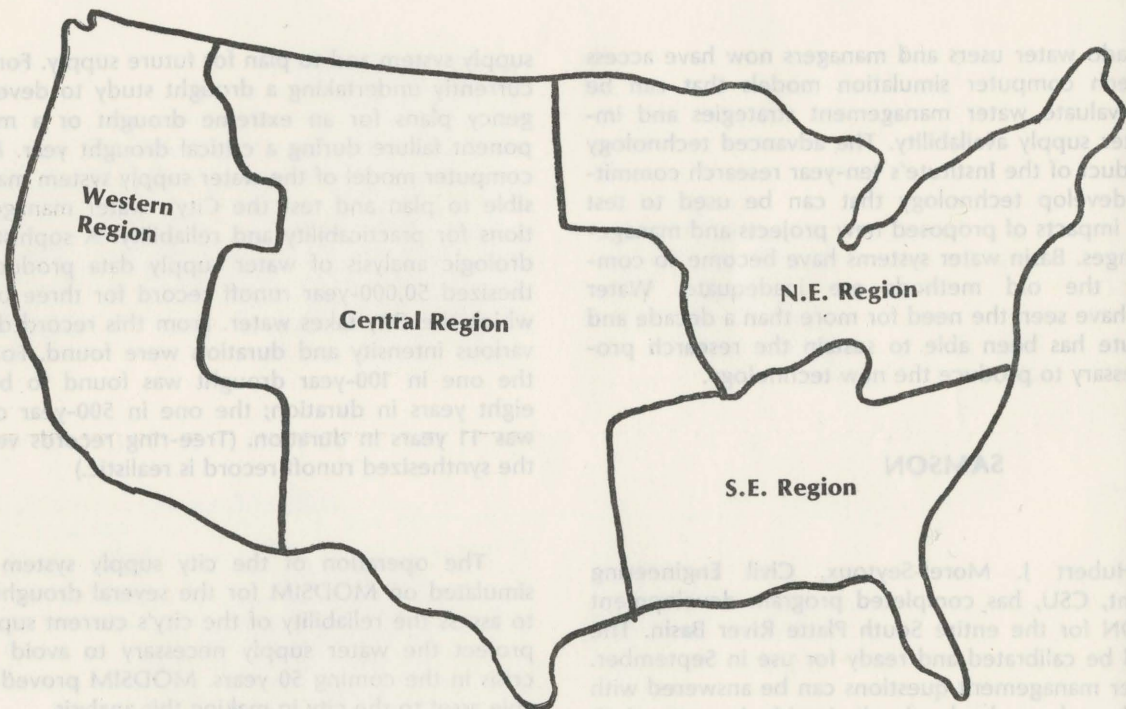
MODSIM has been used by the Northern Colorado Water Conservancy District, Denver Water Department, Western Area Power Administration, Bureau of Reclamation, Corps of Engineers and private engineering firms. It also has been used to plan complex water systems in the Philippines and Cyprus.



## WATER QUALITY DETERIORATION IS PRIORITY CONCERN

The percentage of research effort applied to the problem of water quality deterioration by the 54 State Water Research Institutes shows that this issue is the priority concern across the Nation. The distribution of

FY1985 State Water Institute Program funds by research problem area is shown below. Institutes are grouped geographically by the four regions of the USGS Water Resources Division.\*



### Problem

### Percent of Effort

	Western Region	Central Region	S.E. Region	N.E. Region	Total (54 Institutes)
Water Quality Deterioration	51%	52%	65%	88%	67%
Water Shortages	35%	37%	14%	5%	21%
Flooding or Erosion	11%	4%	18%	4%	8%
Management Conflicts	3%	7%	3%	3%	4%

\*Regions of the Continental United States include Alaska, Guam, Hawaii, Puerto Rico and the Virgin Islands.



## WATER ISSUES CONFERENCE SET FOR OCTOBER 8-9

*Colorado Water Issues and Options: The 90s and Beyond* is the theme of a two-day conference to be held in Denver in October. The Institute and the Natural Resources Law Center, University of Colorado, are co-sponsors of the conference, which will provide a forum to discuss Colorado's water law system and its administration. It will be held at the Regency Hotel in Denver on October 8-9, 1985.

Conference speakers and presentation titles are listed below. Concurrent workshops held each day at mid-afternoon will provide the opportunity to discuss each topic.

**Factual Issues in Water Right Changes and Augmentation Plans** — Leonard Rice, Leonard Rice Consulting Water Engineers, Denver

**Interstate Transfers of Water** — John U. Carlson, Carlson, Elliott and Land, Denver

---

For additional information call the Institute at 6309.

## COLORADO WATER ISSUES PUBLIC FORUM

**Nontributary Groundwater** — William A. Paddock, Mathis, Koonce & Reed, Montrose

**Plans for Augmentation: Are They Really a License to Steal?** — Jeris A. Danielson, Colorado State Engineer

**Innovative Transfer and Exchange Plans** — Glenn E. Porzak, Holme Roberts & Owen, Boulder

**Voluntary Approaches to Basinwide Water Management** — Neil S. Grigg, Colorado State University

**The Judicial Role in Colorado Water Law** — Justice George E. Lohr, Colorado Supreme Court

**The Problems and Promise of Improving Efficiency Under Colorado Water Law** — Steven J. Shupe, Consultant and Water Attorney, Denver

**Meeting Colorado's Water Requirements: An Overview of the Issues** — David H. Getches, Executive Director, Colorado Department of Natural Resources

**Administering Colorado's Water: A Critique of Alternatives** — Clyde O. Martz, Davis, Graham & Stubbs, Denver

**A Market-Based Approach to Water Rights: Evaluating Colorado's System** — Stephen F. Williams, University of Colorado School of Law

**The Development of Colorado's Water Law** — Raphael Moses, Moses, Wittemyer, Harrison & Woodruff, Boulder

The 1985-86 Forum Season continues the tradition of informing the public on key statewide water issues. Each luncheon, the **3rd Tuesday of each month**, features an expert on a timely topic. As in the past, **the public is invited and no reservations are required.**

**TIME:** 11:45 a.m.-1:30 p.m.

**NEW LOCATION:** Wyatt's Cafeteria — LAKESIDE SHOPPING CENTER, Sheridan and 44th Avenue.

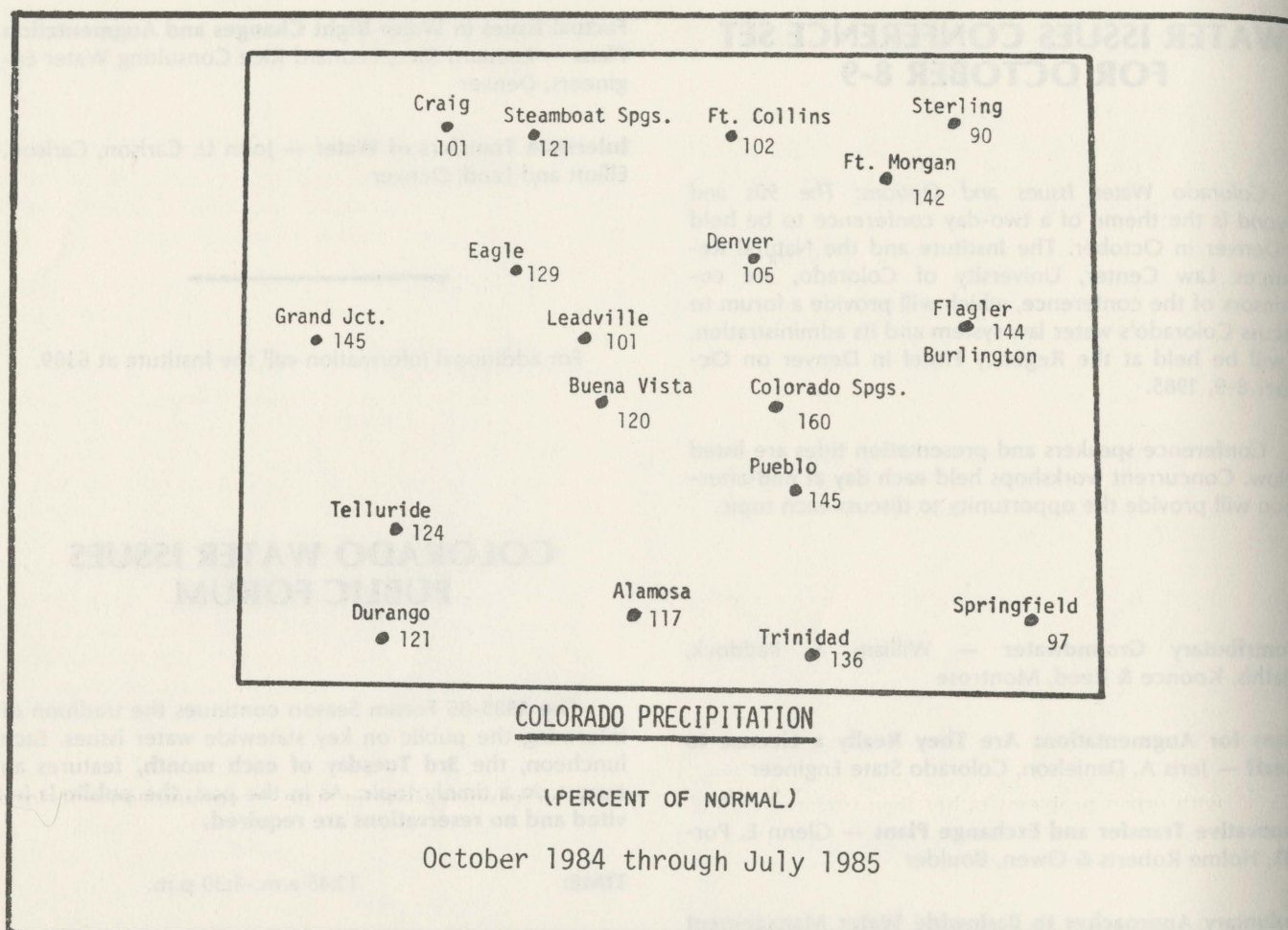
### UPCOMING TOPICS:

**October 15 —** Advanced Technology for Testing Basinwide Impacts of Proposed Water Storage or Management Changes; Hubert Morel-Seytoux, Colorado Water Resource Research Institute

**November 19 —** Progress in Colorado Water Management; Uli Kappus, Executive Director, Colorado Water and Power Resources Development Authority

Please mark your calendar for the **3rd Tuesday of each month** through June 1986.





## USCID FORMS AFFILIATE — AMERICAN WATER FOUNDATION

The U.S. Committee on Irrigation and Drainage has formed an affiliate organization, the American Water Foundation, to promote U.S. interests overseas and further dialogue with other nations. Marcel Bitoun, president of USCID, said, "The American Water Foundation will encourage and facilitate the transfer of U.S. water resources technology to nations worldwide. The Foundation's programs and activities will benefit American agricultural and water resources interests while also helping nations around the world improve resource utilization through increased training and the use of advanced technology."

AWF will help establish U.S.-based training and educational programs for foreign personnel and organize U.S. technical teams for on-site training and assistance over-

seas. The Foundation's programs and objectives complement those of the USCID and the 73 other member nations of the International Commission on Irrigation and Drainage.

CSU faculty members Maurice Albertson and Everett Richardson, Department of Civil Engineering, are members of the Board of Directors. The Foundation recently announced that E. Gordon Kruse, USDA/ARS, CSU has also been appointed to the Board. The American Water Foundation is headquartered in Denver with offices in Washington, D.C. and Fort Collins. Its Executive Director is Larry Stephens, a CSU alumnus in Agricultural Engineering.



## NATIONAL WATER POLICY IS ELUSIVE

Professor Henry P. Caulfield, Jr., analyzing the political climate and prospects for a Federal water resources development program, told participants at a recent conference:

*"In the Carter Administration, and so far in the Reagan Administration, the Executive Branch and the Congress have refused to deal head on with the fundamental policy problem of redetermining the national interest in water resources. They and the Congress have chosen to see it only as a cost-sharing and finance-sharing issue. If and when an Administration does choose to deal with this fundamental problem, it will need to come to grips with this basic question: WHAT IS THE FUTURE NATIONAL INTEREST IN FEDERAL WATER RESOURCES DEVELOPMENT, OPERATION, MAINTENANCE, REHABILITATION AND CONSERVATION?"*

Caulfield attributes the waning Federal interest in water development programs to several causes:

- (1) Major river basin development in the United States has been largely accomplished.
- (2) The concerns of the national urban majority are with urban problems rather than irrigated agriculture and other traditional Federal resource development concerns.
- (3) Dependence on reservoir storage as the primary means of flood control has been replaced by measures such as flood insurance, flood plan zoning, warning systems, and floodproofing of buildings.
- (4) Continuing agricultural surpluses argue against further Federal irrigation development.

"There is no question, however," said Caulfield, "that there is much land . . . that could be developed for irrigation if water were available. Also, there is no question that the Ogallala aquifer . . . will be largely depleted in the next century."

Caulfield does see a Federal role for some areas of potential national interest, including commercial navigable inland waterways, major flood control, and major water resources development or redevelopment projects that directly impact a multistate region. He said the national interest might also include block grants to states for intra-state water resource development and redevelopment, either singly or as part of a general public works infrastructure program which might also include sewage treatment grants.

Western states are reluctant to give up hope for funding of currently authorized Federal projects, but Caulfield described how the States of Montana, Oregon, Wyoming and California are taking their own actions for financing water resources development.

Caulfield said Colorado water leaders appear to believe increasingly that the State, in cooperation with local public bodies, should finance the development of Colorado's remaining water supplies sooner rather than later.

*Henry P. Caulfield, Jr. is Professor of Political Science at CSU and former Director of the U.S. Water Resources Council. His paper, "Financing Water Projects: Where Do We Go From Here?" was presented at the Western Water Law in Transition Conference held June 3-5 in Boulder. The Natural Resources Law Center sponsored the conference.*

## MATCHING GRANT PROJECT ON SURGE IRRIGATION AWARDED

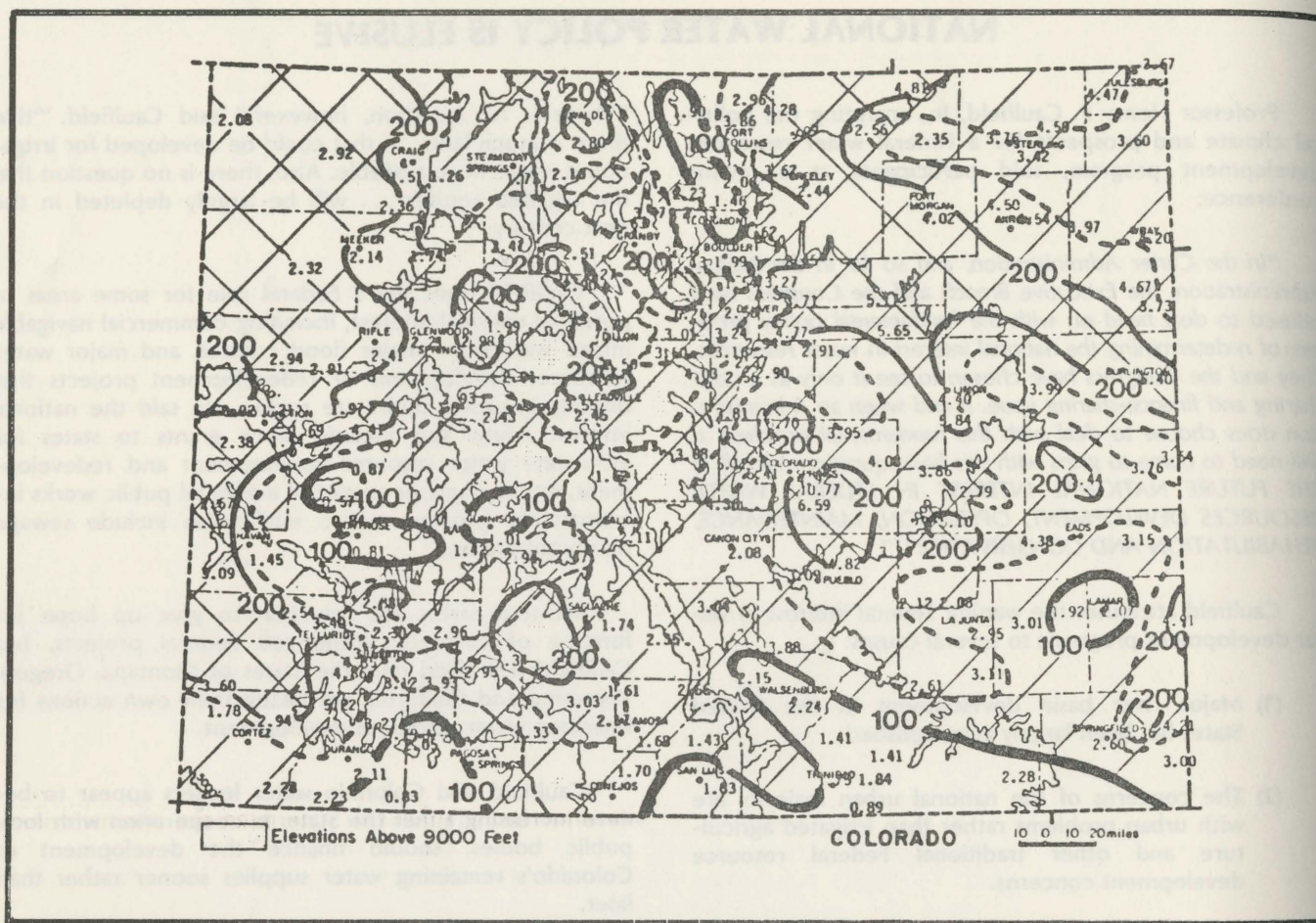
Management of Surge Irrigation Systems will be studied under a recently announced Water Research Act Matching Grant award. The principal investigator is Dr. Terry Podmore, Agricultural and Chemical Engineering Department, CSU.

Many farmers in the Western States are investigating, purchasing and installing surge irrigation systems, accord-

ing to the 1984 *Irrigation Journal*. Surge or intermittent-flow irrigation shows water use efficiency of 80 to 90 percent compared with the 40 to 60 percent efficiency of conventional furrow irrigation.

Dr. Podmore will conduct field experiments to test surge irrigation management strategies and formulate operational guidelines for surge systems.





Precipitation amounts (inches) for July 1985 and contours of precipitation as a percent of the 1961-1980 average. The dashed line is the 150% contour.

## RESERVOIR STORAGE/FLOOD CONTROL MAP AVAILABLE

A newly available Geological Survey map shows the location, size and ownership of 2,800 major multi-purpose and flood control dams in the United States including the Nation's reservoir storage and flood control capacity. The 38" x 62" map is in eight colors. It also shows Bureau of Reclamation surface water irrigation projects, Soil Conservation Service watershed protection projects, hydroelectric powerplants, wild and scenic rivers, and Corps of En-

gineers navigation and flood damage reduction projects. Titled *Surface Water and Related Land Resources Development in the United States and Puerto Rico*, the map is available from: Western Distribution Branch, USGS, Box 25286, Federal Center, Denver, Colorado 80225. Price: \$4.00. Make check payable to the Department of the Interior-USGS.



## CSU WATER EDUCATIONAL-TECHNICAL ASSISTANCE PROGRAMS SPAN THE GLOBE (Part 2)

The January-March issue of *COLORADO WATER* described the involvement of Colorado State University water scientists in international technical and educational assistance programs throughout the world. The Egypt Water Use and Management Project was highlighted. That four-year project, now completed, provided the knowledge base for on-farm irrigation improvement in Egypt. As a result Egypt's most recent Five-Year Plan includes a *National Irrigation Improvement Program*. CSU has agreed to manage a second four-year project to improve the operating efficiency of Egypt's *total irrigation system*.

The objective is to achieve effective control of the River Nile and assure that water for crop production reaches Egypt's farmers when it is needed and in the amount that is needed. Operating efficiency means, as well, that water is not wasted by unproductive flows from the irrigation system into the drainage system, and that excess water availability does not encourage farmers to overirrigate and thus contribute to deterioration of the land through waterlogging and salinity associated with rising water tables.

The technical assistance program also includes strengthening the Ministry of Irrigation's operation, maintenance, research and planning capabilities. The CSU team of 25 professionals, working with Egyptian water agencies, will study the operating efficiency of the total

irrigation system and make field tests to find and verify improvements.

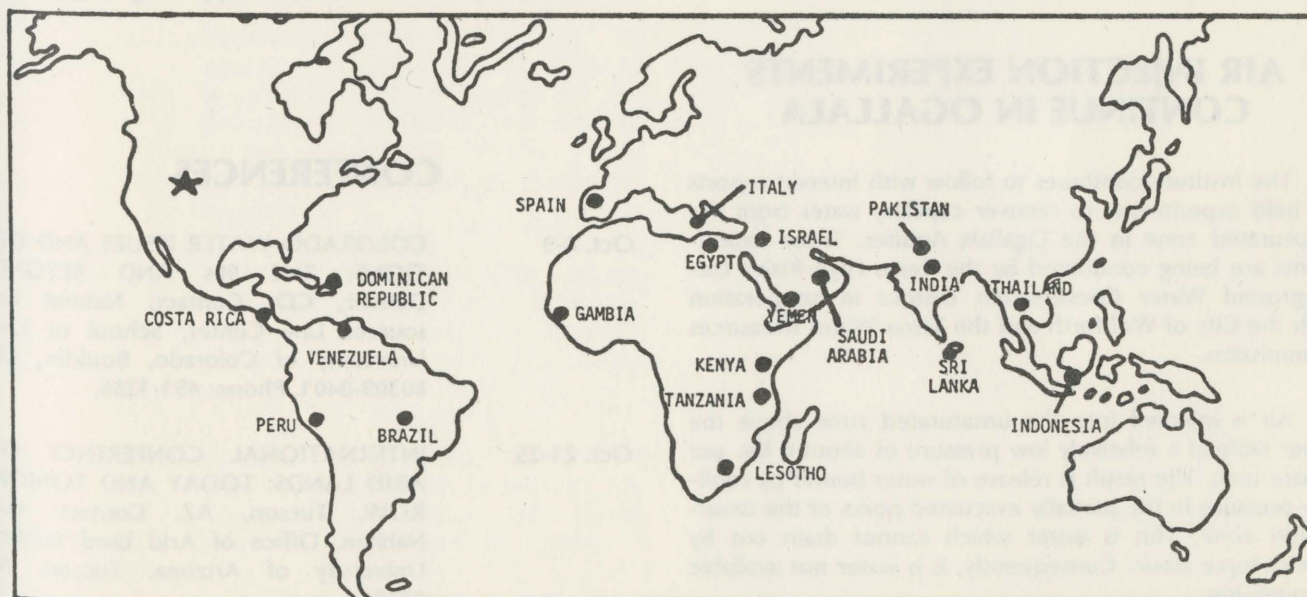
Dr. E.V. Richardson of CSU's Civil Engineering Department is the Campus Project Coordinator for the USAID \$5,425,000 contract and Dr. Susumu Karaki is the project manager in Egypt.

Other current and recent international technical and educational assistance projects are briefly described below to reflect further the worldwide sharing of water expertise among the CSU faculty.

**Pakistan** — CSU provides technical assistance on irrigation methods, water allocation among farmers and user organizations, operating and maintenance procedures, delivery canal reconstruction, land leveling and drainage. Dr. Norman A. Evans, Institute Director, will be in Pakistan during September on a one-month assignment as a member of the technical assistance program team.

**Dominican Republic** — Water engineers from CSU are undertaking studies to determine the optimal operation and safety of the Dominican Republic's Valdesia Reservoir. Dr. Jose Salas, Civil Engineering Department, CSU, is project director.

**Peru** — CSU fishery biologists developed technically





and economically viable trout-farming techniques for Peru's highland region. CSU was also the lead university and managed a two-year project to develop and improve irrigation in the high Sierra.

**Indonesia** — CSU provides technical assistance to West Java in planning and implementing its water conservation program. The project includes the establishment of vegetative and mechanical erosion control practices at a pilot watershed area.

**Sicily** — A videotaped course in water resources planning and management resulted from contact of several CSU water specialists with Italian counterparts at the Institute of Hydraulics, Hydrology and Water Management in Sicily. The 30-lecture course is produced in English and Italian.

An updated CSU faculty directory was released last spring, documenting the international experience of 353 faculty members. It includes a list of cooperative agreements between CSU and 15 countries for 17 technical assistance projects.

Another important contribution to international water resources management is the training of young men and women to enter the water professions. The Asian Institute of Technology in Bangkok, Thailand is one example — CSU was responsible for the initial design and staffing of the Institute in 1959. The school opened with 15 students, and by 1969 the enrollment had expanded to 184. Latest figures show an enrollment of 500 students with 70 faculty.

The injection of air introduces pressure to counter the capillary pressure and thereby free some of the water remaining in the soil pores. This water flows downward by the force of gravity to join the saturated zone at the water table and becomes available for pumping.

In the experiments the result of air injection was a rise in the elevation of the water table. Investigators estimated over 8,000 acre-feet added to the available water supply from one air injection test. The area over which the rise in water table occurred was more than 100 square miles.

Estimates of the cost of producing water by air injection range from \$17 per acre-foot to \$50 per acre-foot, depending on local geology and other factors. The effectiveness of air injection seems to be established, but the process will require more development to get the technology to the point where design criteria can be formulated.

Ogallala Aquifer water users should be encouraged by the estimate that around 1.46 billion acre-feet of capillary water would remain in the aquifer after all the gravity water is exhausted and that up to 30 percent (438 million acre-feet) of that capillary water in storage can be extracted by air injection. Investigators believe that this process is now economically feasible for municipal or industrial water supplies, but not feasible for agricultural purposes.

The Colorado Water Resources Research Institute will watch closely further developments in this technology and will be ready to furnish research assistance in adapting the technology to Colorado when and if it proves to be usable (subject to availability of supporting funds).

## AIR INJECTION EXPERIMENTS CONTINUE IN OGALLALA

The Institute continues to follow with interest reports on field experiments to recover capillary water from the unsaturated zone in the Ogallala Aquifer. These experiments are being conducted by the Texas High Plains Underground Water Conservation District in cooperation with the City of Wolfforth and the Texas Water Resources Commission.

Air is injected into the unsaturated zone above the water table at a relatively low pressure of about 8 lbs. per square inch. The result is release of water bound by capillary pressure in the partially evacuated pores of the unsaturated zone. This is water which cannot drain out by gravity force alone. Consequently, it is water not available by pumping.

## CONFERENCES

Oct. 8-9

COLORADO WATER ISSUES AND OPTIONS: THE 90s AND BEYOND, Denver, CO. Contact: Natural Resources Law Center, School of Law, University of Colorado, Boulder, CO 80309-0401. Phone: 491-1286.

Oct. 21-25

INTERNATIONAL CONFERENCE ON ARID LANDS: TODAY AND TOMORROW, Tucson, AZ. Contact: G.P. Nabhan, Office of Arid Land Studies, University of Arizona, Tucson, AZ 85721.



- Nov. 13-15 PETROLEUM HYDROCARBONS AND ORGANIC CHEMICALS IN GROUND-WATER — PREVENTION, DETECTION AND RESTORATION, Houston, TX. Contact: Barbara J. Graves, Conference Coordinator, National Water Well Assoc., 500 W. Wilson Bridge Rd., Worthington, OH 43085.
- Nov. 13-15 WATER LAW SHORT COURSE, IFG 300, Colorado State University, Fort Collins, CO. Sponsored by Instream Flow Group, USFWS. Contact: Helen Bundy/Caroline Frye, WELUT Courses, Office of Conference Services, Colorado State University, Fort Collins, CO 80523. Phone: 491-6222.
- Nov. 14-15 EDUCATION AND PROFESSIONAL DEVELOPMENT IN HYDROLOGY AND HYDROGEOLOGY: NEEDS AND OPPORTUNITIES, Las Vegas, NV. Contact: Program Coordinator, American Institute of Hydrology, P.O. Box 14251, St. Paul, MN 44114. Phone: (612) 379-1030.
- Nov. 16 EXPERT WITNESS COURSE, IFG 305, Topic: UNDERSTANDING THE ROLE OF EXPERT WITNESSES AND ATTORNEYS, Colorado State University, Fort Collins, CO. Sponsored by Instream Flow Group, USFWS. Contact: Helen Bundy/Caroline Frye (see address above).
- Nov. 17-21 3RD INTERNATIONAL DRIP/TRICKLE IRRIGATION CONGRESS, Fresno, CA. Sponsored by ASAE and The Irrigation Association. Held in conjunction with International Irrigation Exposition and Conference. Contact: Loretta Dibble, ASAE, 2950 Niles Road., St. Joseph, MI 49085-9659.
- Nov. 19-21 CHARACTERIZATION AND MONITORING OF THE VADOSE (UNSATURATED) ZONE, Denver, CO. Contact: Barbara J. Graves, NWWA (see address above).
- Dec. 9-13 AMERICAN GEOPHYSICAL UNION FALL MEETING, San Francisco, CA. Contact: AGU Meetings, 2000 Florida Ave., N.W., Washington, D.C. 20009.
- Dec. 16-17 NATIONAL CONFERENCE ON ADVANCES IN EVAPOTRANSPIRATION, Chicago, IL. Sponsored by ASAE. Contact: Loretta Dibble, ASAE (see address above).
- Jan. 26-31 ASTM INTERNATIONAL SYMPOSIUM ON GEOTECHNICAL APPLICATIONS OF REMOTE SENSING AND REMOTE DATA TRANSMISSION, Cocoa Beach, FL. Contact: Symposium Chairman A. Ivan Johnson, Woodward-Clyde Consultants, Harlequin Plaza-No., 7600 E. Orchard Rd., Englewood, CO 80111. Phone: 425-5610.
- Jan. 27-31 APPLICATION OF TECHNICAL INFORMATION IN DECISION MAKING, IFG 310, Topic: NEGOTIATION AND CONFLICT RESOLUTION OF NATURAL RESOURCES ISSUES, Colorado State University, Fort Collins, CO. Sponsored by Instream Flow Group, USFWS. Contact: Helen Bundy/Caroline Frye (see address above).
- Mar. 24-27 FEDERAL INTERAGENCY SEDIMENTATION CONFERENCE, Las Vegas, NV. Contact: G. Douglas Glysson, Chairman, U.S. Geological Survey, WRD, 415 National Center, Reston, VA 22092. Phone: (703) 860-6834.
- Mar. 31-Apr. 4 3RD INTERNATIONAL SYMPOSIUM ON RIVER SEDIMENTATION: ESTUARINE AND COASTAL SEDIMENTATION, Jackson, MS. Contact: S.Y. Wang, School of Engineering, University of Mississippi, University, MS 38677. Phone: (601) 232-7219.

## OFF THE PRESS

The following publications are available upon request at prices listed plus postage:

Up to 99¢ .....	\$ .75
\$1.00-\$4.99 .....	\$1.00
\$5.00-\$9.99 .....	\$1.50
\$10.00 and over .....	\$2.00

Send order and check payable to Colorado State University to:



Bulletin Room  
Aylesworth Hall  
Colorado State University  
Fort Collins, CO 80523

- IS55 PROCEEDINGS OF WORKSHOP ON WATER QUALITY MONITORING IN COLORADO, Edited by Robert C. Ward and William L. Raley. \$5.00

The proceedings record presentations made during a one-day workshop on Water Quality Monitoring in Colorado held at Colorado State University on May 16, 1985. Discusses the evolving role of monitoring in water quality management by review of existing monitoring efforts and current research on monitoring system design. The workshop consisted of three sessions: (1) a review of current monitoring efforts by EPA, the Colorado Department of Health, and the Larimer-Weld Council of Governments; (2) a review of current research efforts underway at CSU on the design of water quality monitoring systems; and (3) a panel discussion focused on summarizing the current ability to get water quality information.

## OTHER PUBLICATIONS

ANNUAL REPORT, 1984, Western States Water Council, 220 So. 2nd E., Suite 200, Chancellor Bldg., Salt Lake City, UT 84111 (801)521-2800.

ANNUAL REPORT, Hydrologic Engineering Center, U.S. Army Corps of Engineers, 609 Second St., Davis, CA 95616 (916)551-1748.

1985 SOIL AND WATER CONSERVATION — RESEARCH AND EDUCATION — PROGRESS AND NEEDS, Soil Conservation Service, USDA, P.O. Box 2890, Washington, D.C. 20013.

ARTIFICIAL RECHARGE OF GROUNDWATER, by Takashi Asano (California State Water Resources Control Board and Civil Engineering Dept., University of California), Butterworth Publishers, 80 Montvale Ave., Stoneham, MA 02180. ISBN250-40549-0.

REGIONAL AND STATE WATER RESOURCES PLANNING AND MANAGEMENT, Proceedings, American Water Resources Association, 5410 Grosvenor Lane, Suite

220, Bethesda, MD 20814.

COPING WITH DROUGHTS, by Vujica Yevjevich, Luis da Cunha, and Evan Vlachos. Water Resources Publications, Distribution Division, P.O. Box 2841, Littleton, CO 80161 (303)790-1836.

SAFETY OF DAMS: FLOOD AND EARTHQUAKE CRITERIA, NAS/NRC, Commission on Engr. and Tech. Systems, Water Science and Technology Board, Comm. on Safety Criteria for Dams. Order from: National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

TRANSACTIONS, 12TH CONGRESS ON IRRIGATION AND DRAINAGE. USCID, P.O. Box 15326, Denver, CO 80215.

WATER RESOURCES FOR AGRICULTURAL PRODUCTION IN THE US. American Society of Agricultural Engineers, 2950 Niles Rd., St. Joseph, MI 49085 (616)429-0300.

## COLORADO WATER

Published by the

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

Norman A. Evans	Director
William L. Raley	Extension Water Resources Specialist
Shirley Miller	Editorial Assistant
Cydney Conway	Secretary

Editorial comments and opinions expressed in COLORADO WATER do not necessarily reflect the views of Colorado State University, the U.S. Department of the Interior, or the Institute.



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

NONPROFIT  
ORGANIZATION  
U.S. POSTAGE  
**PAID**  
Fort Collins, Colorado 80523  
Permit Number 19