COLORADO WATER

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

January - February 1984

WATER IN AMERICA 1983

The U.S. Dept. of Interior's new booklet, "Water in America 1983," highlights water policy issues facing the nation. Improving river management is mentioned first in the following words:

> "We are only beginning to realize the full potential of effective river management, but currently available high technology as a tool to facilitate decision-making should be used to help reduce conflicts over limited water resources in heavily developed river basins."

Outstanding examples of successful high technology applications are cited in California and on the Tennessee and Potomac Rivers. In the Potomac case an Interstate Commission developed a management plan with the aid of sophisticated computer-based river modeling techniques. The yield in basin water supply systems was increased by nearly 50 percent. They solved the supply problem for many years ahead.

Proposed solutions to the water supply problems had included as many as 16 new reservoirs. Yet, by cooperative, improved operations identified with computer-based techniques, the system's yield was increased with only one reservoir and eight operating agreements among *cooperating* water users.

Colorado

This is why the institute has put priority on development of high technology for computer-based river basin modeling. The South Platte River simulation model (SAMSON) is now being constructed using one product of that 10-year research program. By June 1985 it will be ready for state or private use to improve basin water supply management through voluntary, integrated basin-wide action.

While high-technology models are not going to solve all the problems, they are essential tools which will lead to the solutions. They will simulate *physical* solutions and test them for acceptability. For example, changes in water rights as to place or type of use, plans of augmentation, and water right exchanges are constantly proposed within the basin. In the past the effects of such changes could not be determined reliably in advance. Therefore, a judicial process relying on adversarial claims has been depended on for solution. While this has been the only practical approach, increased competition and value of water argues for a technical solution. Fortunately, the technical tools are now available. Water right owners can use them to reduce the burden of constant vigilance in protecting their property rights. (Or an objective state agency can do so in the public interest.) Presently owners are forced to view every proposed change as a potential threat and suffer the cost of legal and technical actions to defend their water rights.

Copies of Water in America 1983 may be obtained from the Director, Office of Policy Analysis, Department of Interior, Washington, D.C. 20240.

HEALTHY FISH IN GUNNISON RIVER

Fish in the Gunnison River were recently sampled to determine the amount of metals accumulated in their flesh and internal organs. Metal levels in the fish were compared with levels known to be safe for human consumption. Personnel of the National Park Service Water Resources Laboratory at Fort Collins conducted the study because the river flows through Curecanti National Recreation Area. The study established baseline data for future reference — if, for example, metal-mining activity increases in the basin.

Rainbow trout, brown trout, kokanee salmon, and white sucker taken from the river between the town of Gunnison and Blue Mesa Reservoir were analyzed for aluminum, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, strontium and zinc. The investigation showed that metals tend to accumulate more in internal organs, especially liver and kidneys, than in the flesh. Metal accumulation levels in these fish were generally lower, however, than in fish from other areas and well below the concentrations considered questionable for human consumption. White suckers do appear to accumulate more mercury in the flesh than other species, but not enough to cause concern for human health.

The amount of metals in one pound of Gunnison River fish flesh, compared to the typical daily human intake of metals, eliminates these fish as a source of health concern. In fact, the levels of most metals in these fish should be beneficial in human nutrition.

METAL CONCENTRATIONS IN FISH AT CURECANTI NATIONAL RECREATION AREA, GUNNISON, COLORADO, WRFSL PROJECT REPORT NO. 83-3-P, available from: Water Resource Field Laboratory, National Park Service, Colorado State University, Fort Collins, Colorado 80523.

SATELLITE STREAM MONITORING

Colorado will have a state-of-the-art stream monitoring system using satellite technology demonstrated on the Arkansas River during the last two years.

Sutron Corporation of Virginia will supply equipment for this new system under a contract to be negotiated by the Colorado Water Resources and Power Development Authority. The contract price will be about $1.28 million. The equipment includes a master computer and control center in the State Engineer's office in Denver and terminals in each of the seven division engineers' offices around the state.

Monitoring stations installed on rivers throughout the state will send instantaneous data on river flow conditions through a satellite to the control center, where it will be processed. The data will be available to river commissioners via terminals in district offices, for use in administering water rights, and to others, such as industry, municipalities or conservancy districts, for aid in managing water supplies.

Rapid flood warning information is a secondary but important capability in this monitoring system.

ARKANSAS WATER TO THE SOUTH PLATTE?

Arkansas River water users were alarmed when tentative plans to purchase Arkansas River water for the Denver metro area were announced last spring. The Arkansas basin's water supply is not adequate to meet current demands, and the prospect of water export from the basin is a legitimate cause for concern.

One key element in the export plan may have been preempted by the Pueblo City Water Board's mid-December offer to purchase 5,000 acre-feet of CF&I storage space in Pueblo Reservoir.

This reservoir storage is a key element in the export plan, because water rights from the lower basin could be transferred into Pueblo Reservoir and stored for replacement of water to be diverted higher in the basin to the South Platte.

While the Pueblo action may forestall one particular export plan, water rights remain available for sale in the Arkansas basin that potentially could be purchased and exported to the South Platte basin. Some water users have suggested that the Southeastern Colorado Water Conservancy District purchase any water put up for sale as a strategy to keep the water in the basin. The district board, however, has questioned whether that would be consistent with the district's purpose and if it might put the district in competition for water with basin water users.

If the district decides to pursue a water-purchase policy, legislative action to increase the statutory mill levy limit or, alternatively, a general district election to raise the limit will be necessary.

MODSIM OR SAMSON?

Two major advances have been made in computer-based high technology for analyzing and evaluating basinwide effects of local water management changes or water storage projects. Each has a different purpose, with one complementing the other. The two models are called MODSIM and SAMSON. Another article in this issue summarizes progress of construction of the SAMSON model for the South Platte basin. Applications of MODSIM have been reported in other issues.

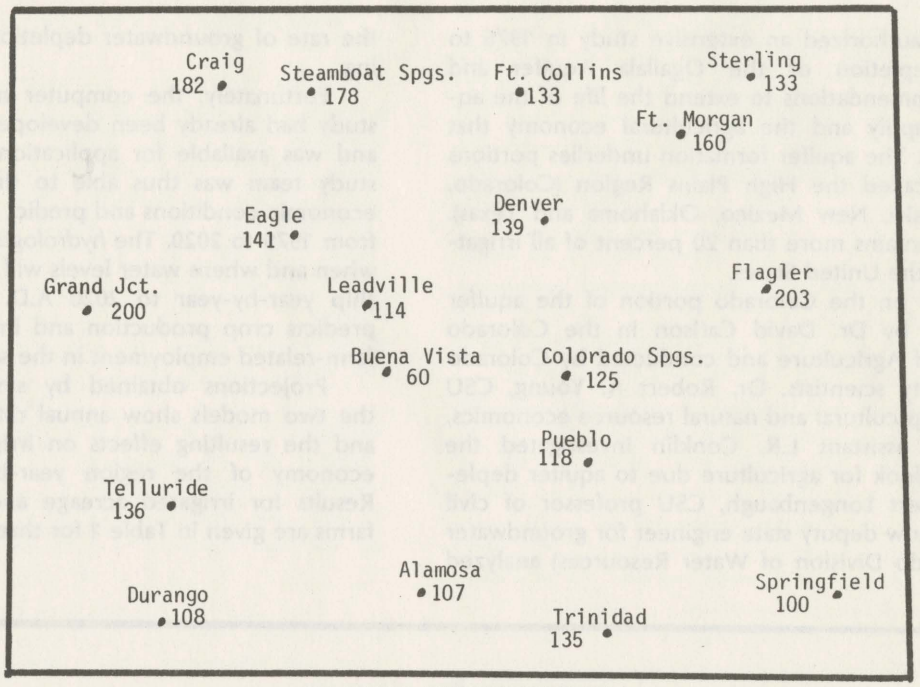
MODSIM is a high-technology model with reasonable accuracy for planning and screening purposes. The methods used in the model are relatively simple and low-cost. It includes a method based on the principle of economic optimization to select the best from several possible actions. Such factors as water right priorities are accounted for.

This model is ideal for evaluating possible storage reservoir locations and size to find the best combination. Rules can be developed for storage and releases that will get maximum benefit from the water while meeting priority demands for hydropower, irrigation, domestic water supply, flood control, instream habitat, etc.

SAMSON is capable of computing day-by-day the effects on every part of the basin water system due to a local action anywhere in the basin. Effects on downstream water rights of changing points of diversion, groundwater pumping, upstream storage projects, etc. can be calculated in day-by-day detail. Options for potential management improvements that look good in preliminary screening with MODSIM can be fully tested with SAMSON.

The model simulates each part of the physical system in a river basin. River flow, groundwater flow, precipitation, aquifer recharge, evapotranspiration from vegetation, etc. are individually computed at thousands of locations throughout the basin. In the South Platte model, for example, computations will be made at over 2,000 points. Advances in technology permit many computations to be made at relatively small computer cost. Thus, the model is practical for basinwide application.

Together MODSIM and SAMSON provide a full range of high technology for project planning and basinwide water management improvements from preliminary planning and screening to detailed operational simulation. Both models have their appropriate application and each complements the other.



COLORADO PRECIPITATION

FOR OCTOBER 1983 - JANUARY 1984

(PERCENT OF NORMAL)

WATER FORUM LUNCHEON MEETINGS TO CONTINUE

The Colorado Water Forum meetings sponsored by the institute on the third Tuesday of each month will continue in 1984. Authoritative speakers on subjects of current interest to water managers, professionals and citizens will present noon programs at Wyatt's Cafeteria, Alameda and Wadsworth, Denver.

Recent speakers have included Charles Jordan (Metropolitan Roundtable progress), Tess McNulty (state water planning), Harold Miskel (Homestake I and II), Rollie Fischer (west slope concerns), Lew Grant (cloud seeding), Jim Gibson (acid rain in Colorado), and David Brown (Huston decision).

Interest in the informational meetings has been high, said Bill Raley, the institute's extension water resources specialist. Participants included representatives from USBR, USGS, EPA, SCS, Colorado Water Conservation Board, Division of Water Resources, Division of Water Quality Control, private law firms, engineering consultants and interested citizens.

Upcoming meetings include:

Mar. 20 — Felix Sparks (Upper Colorado River Commission) — VALUE OF COLORADO RIVER BASIN FUND FOR THE STATE OF COLORADO

Apr. 17 — Tom Looby (Colorado Department of Health) — PROPOSED GROUNDWATER QUALITY REGULATIONS FOR COLORADO

RESEARCH MADE OGALLALA PREDICTIONS POSSIBLE

Congress authorized an extensive study in 1976 to investigate depletion of the Ogallala Aquifer and develop recommendations to extend the life of the aquifer water supply and the agricultural economy that depends on it. The aquifer formation underlies portions of six states called the High Plains Region (Colorado, Kansas, Nebraska, New Mexico, Oklahoma and Texas). This region contains more than 20 percent of all irrigated acreage in the United States.

The study on the Colorado portion of the aquifer was managed by Dr. David Carlson in the Colorado Department of Agriculture and conducted by Colorado State University scientists. Dr. Robert A. Young, CSU professor of agricultural and natural resource economics, and research assistant L.R. Conklin investigated the long-term outlook for agriculture due to aquifer depletion. Dr. Robert Longenbaugh, CSU professor of civil engineering (now deputy state engineer for groundwater in the Colorado Division of Water Resources) analyzed the rate of groundwater depletion as a result of pumping.

Fortunately, the computer model needed for this study had already been developed in previous research and was available for application to the problem. The study team was thus able to simulate hydrologic and economic conditions and predict changes that will occur from 1979 to 2020. The *hydrologic* model simulates how, when and where water levels will decline for each township year-by-year to 2020 A.D. The *economic* model predicts crop production and income, energy use and farm-related employment in the same time frame.

Projections obtained by simultaneously operating the two models show annual rate of aquifer depletion and the resulting effects on irrigated acreage and the economy of the region year-by-year through 2020. Results for irrigated acreage and number of irrigated farms are given in Table 1 for three possible scenarios:

Table 1. Irrigated Agriculture Projections for Colorado High Plains

BASELINE OPTIMISTIC projections assume no pumping restrictions, moderate energy cost increases and a continued trend of increases in crop yield, prices and foreign exports.

VOLUNTARY WATER CONSERVATION uses the same assumptions as BASELINE OPTIMISTIC. Financial assistance and low interest rates are provided as incentives for farmers to adopt water-saving practices and equipment.

BASELINE PESSIMISTIC projections assume no pumping restrictions but higher energy costs, lower foreign exports, uncertain prices, smaller increases in crop yields and fewer improvements in crop-production technology.

Scenario	Year	No. of Farms	Irrigated Acres	Acreage Decrease Percent
CURRENT	1979	1332	600,000	—
BASELINE (OPTIMISTIC)	1990	1164	529,000	11.85
	2020	737	364,000	39.33
VOLUNTARY WATER CONSERVATION	1990	1262	567,000	5.50
	2020	983	472,000	21.33
BASELINE (PESSIMISTIC)	1990	318	235,000	60.83
	2020	-0-	-0-	100.00

Young's projections show a 40 percent decline in irrigated agriculture acreage by 2020 under optimistic assumptions. With pessimistic assumptions the irrigated acreage would drop to zero.

Improving pumping and irrigation efficiency on eastern Colorado farms by 15 to 20 percent can significantly extend the life of the Ogallala Aquifer, says Young, but research, extension and individual farmer initiatives are needed to slow the aquifer's water depletion. A Technical Assistance Coordinating Committee has been formed, composed of federal and state agencies offering appropriate services to farmers in the region.

COLORADO HIGH PLAINS STUDY SUMMARY REPORT, November 1983, available from: Resource Analysis Section, Colorado Department of Agriculture, 1525 Sherman Street, Room 406, Denver, Colorado 80203. $3.00

Other study reports available are listed under OFF THE PRESS.

LAND TREATMENT AND DISPOSAL OF MUNICIPAL WASTEWATER

Nothing is more important to life than water, but for two centuries America's streams have been used to dilute and flush away its wastes. The waste products of human life flow from millions of homes — a torrent of wastewater rich in nitrogen, phosphorus and other materials that can be reclaimed and re-used. Still more wastes — and resources — come from industry containing valuable metals and chemicals. Every day 20 billion gallons of treated sewage discharges from treatment plants into streams. Land treatment offers an alternative that will recycle water, conserve energy and utilize nutrients for crop production.

"Municipal Wastewaters: America's Forgotten Resource," is a new film produced by the institute under a contract with the Environmental Protection Agency. The 35-minute color film illustrates the capability of using land as a treatment and disposal medium for municipal sewage effluent. Dr. Norman A. Evans, institute director, was technical leader for the film.

Today more than 3,000 land treatment sites operate in the United States, some used successfully for more than 50 years. The film shows many sites across the nation and uses the experiences of their managers as the basic text. Good examples of land treatment applications are shown, including Steamboat Springs, Colorado, but the film also points out the technology's limitations.

The film was produced by Carlos Seegmiller of CSU's Office of Instructional Services, and the script narrative was written by Fred Shook of the CSU Department of Technical Journalism. One copy of the film for each state has been distributed to EPA regional offices and is available for community and educational use.

PROGRESS ON SOUTH PLATTE SIMULATION MODEL

Following the institute's successful development and use of a computer hydrologic simulation model (SAMSON) for the lower half of the South Platte basin, the 1983 General Assembly appropriated funds to complete construction of the model for the balance of the basin (Balzac through Denver). The simulation model's completion will make it possible to test the impact of proposed water storage projects or water management changes in the basin, said Dr. Norman Evans, institute director.

An advisory panel of experienced water managers and potential users of the computer simulation model is advising Dr. Hubert Morel-Seytoux, developer of the technology, in planning the model extension. The panel will advise on data selection that is most representative of basin conditions and where data are not available will recommend the most realistic assumptions, said Morel-Seytoux.

The simulation model will be completed in June 1985 and made available to state agencies or water-user organizations. Its use will greatly increase the scope of technical information available on the basin's surface-groundwater interaction and provide a comprehensive basis for future water management decisions, both public and private.

Evans said the institute has received inquiries from other states considering construction of the hydrologic simulation model. He said the new technology developed by Morel-Seytoux is the most advanced of its kind in the world and is used in several countries.

Members of the advisory panel include Larry Simpson, Northern Colorado Water Conservancy District; Bill Farr, Colorado Water and Power Development Authority; David Walker, Colorado Water Conservation Board; Harold Simpson, Colorado Division of Water Resources; Jack Odor, Groundwater Appropriators of the South Platte, Inc.; Gary Friehauf, Lower South Platte Water Conservancy District; Tom Cech, Central Colorado Water Conservancy District; Marvin Thurber, City of Broomfield; Larry Mugler, Denver Regional Council of Governments; Alan Burns, U.S. Geological Survey; and Jerry Trotter, St. Vrain Water Conservancy District.

NATIONAL WATER SUMMARY AVAILABLE

The 243-page *National Water Summary 1983: Hydrologic Events and Issues* prepared by the U.S. Geological Survey and released in early February discusses changes and trends in the availability, quantity, quality and use of water resources.

"Hydrologic conditions change abruptly in space and in time, and this variability tends to complicate the development and management of water resources and the response to hydrologic problems," the summary states.

Many of the extreme events of 1982 and 1983, the summary explains, were manifestations of a "single, unified global-scale atmospheric phenomenon," known as an El Nino-Southern Oscillation (ENSO) event. This shift in the atmospheric and oceanic flows in the Pacific caused increased storm activity and flooding throughout the U.S.

The book outlines four categories of water issues: water availability, water quality, hydrologic hazards and land use, and institutional and management issues. The summary contains a state-by-state discussion of each category and color-coded maps detailing water problems in each state.

Water Availability Issues

Most states have sufficient supplies of water. In only a few areas of the U.S. is the "raw" supply of water limited — the Colorado River Basin, the Rio Grande Basin, the Great Basin, parts of the High Plains, and parts of California.

Competition for water is increasing. Both surface and groundwater withdrawals are up. During the period from 1950-1980, the withdrawal from streams, reservoirs, lakes and aquifers increased two-and-one-half times, while population increased by only one-and-one-half times.

In order to supply the increasing demand water users, especially those engaged in agriculture in the West, have turned to groundwater for a reliable water supply. Groundwater withdrawals have increased from nearly 35 billion gallons per day to over 98 billion gallons per day in the period from 1955 to 1980. Most is used for irrigation, although nearly half the nation's population uses groundwater for domestic purposes. Very large volumes of water continue to be withdrawn from the High Plains region.

Water Quality Issues

The nation's water quality "indicates improvements in some aspects . . . and deterioration in others," according to data collected from streams in the period from 1974-1981.

"Considerable progress" has been made in the control of point-source pollution of surface water, especially industrial point sources. But "further improvements in surface-water quality will require increasing attention to the difficult task of controlling nonpoint sources of pollution," USGS asserts.

Salinity of surface waters is "an issue of concern for many rivers, particularly those where there is extensive irrigation or where naturally occurring saltwater sources exist." In addition, states' summaries show a wide range of water quality problems relating to eutrophication, bottom sediment contamination, salt water intrusion, hazardous wastes, radioactive wastes, and acid precipitation. The summary indicates that "neither the full extent nor the full impact of groundwater pollution by hazardous wastes has been fully determined."

Institutional and Management Issues

The summary is an indication of a state management approach through a clear emphasis on "state" over "federal" water issues.

The nation "is only just beginning to realize the full potential of effective river basin management," the report states. A new set of principles for such management is based upon the physical interconnectedness of heavily engineered river systems, competition that will create new incentives to solve problems through cooperative and innovative management, and computer technologies.

Copies of *National Water Summary 1983: Hydrologic Events and Issues* (USGS Supply Paper 2250) are available for $9 from the Branch of Distribution, Text Products Section, USGS, 604 South Picket Street, Alexandria, VA 22304.

Condensed from Water Information News Service, Washington, D.C., Vol. VIII, No. XVIII, January 24, 1984.

CONFERENCES

February 20, 1984	COLORADO WATER AND POWER DEVELOPMENT AUTHORITY, regular meeting, Denver (location not announced), call 830-1550.
February 21, 1984	COLORADO WATER ISSUES PUBLIC FORUM — "Federal Reserved Water Rights: Is There a Threat?" No-host luncheon at Wyatt's Cafeteria, Villa Italia Shopping Center, Wadsworth and Alameda, Denver, 11:45 a.m. to 1:30 p.m. (The Forum is sponsored by the institute and meets the third Tuesday of each month.)
February 23-24, 1984	COLORADO WATER CONGRESS 26TH ANNUAL CONVENTION, Denver, Colorado. Contact: Colorado Water Congress, 1390 Logan St. #312, Denver, Colorado 80203. Phone (303) 837-0812.
March 8, 1984	COLORADO WATER CONSERVATION BOARD, regular meeting, Centennial Building, 1313 Sherman St., Denver, 8:30 a.m.
March 19-21, 1984	DESIGN, INSTALLATION AND SAMPLING OF GROUND WATER MONITORING WELLS, Boulder, Colorado, sponsored by National Water Well Association. Contact: National Water Well Association, Education Foundation, 500 W. Wilson Bridge Rd., Worthington, Ohio 43085.
March 20, 1984	COLORADO WATER ISSUES PUBLIC FORUM — "Value of the Colorado River Basin Fund for Colorado," no-host luncheon at Wyatt's Cafeteria, Villa Italia Shopping Center, Wadsworth and Alameda, Denver, 11:45 a.m. to 1:30 p.m.

March 27-29, 1984 — SECOND INTERNATIONAL CONFERENCE ON GROUNDWATER QUALITY RESEARCH, Tulsa, Oklahoma. Contact: Norman N. Durham, University Center for Water Research, Oklahoma State University, 203 Whitehurst, Stillwater, Oklahoma 74078. Phone: (405) 624-6995.

May 1-4, 1984 — GROUNDWATER MODELING WITHOUT MATHEMATICS, Denver, Colorado, sponsored by National Water Well Association. Contact: National Water Well Association, 500 W. Wilson Bridge Rd., Worthington, Ohio 43085.

PUBLICATIONS

DRINKING WATER AND HEALTH, VOL. V, National Academy Press, 2101 Constitution Ave., N.W., Washington, D.C. 20418.

THE NONPOINT SOURCE REPORT TO CONGRESS, Contact Jim Meek, Chief, Implementation Branch, Office of Water, U.S. EPA, Washington, D.C. (202) 382-7085.

WATER-RELATED TECHNOLOGIES FOR SUSTAINABLE U.S. ARID/SEMIARID AGRICULTURE, U.S. Government Printing Office (GPO), Superintendent of Documents, Washington, D.C. 20402. Stock No. 052-003-00930-7; Price $8.50.

THE MAGNITUDE AND SEVERITY OF GROUNDWATER PROBLEMS, Contact the Office of Drinking Water, U.S. EPA, Washington, D.C. 20460, or call EPA Public Affairs (202) 382-4374.

OFF THE PRESS

The following publications are available upon request at prices listed. Send order with check payable to Colorado State University to: Bulletin Room, Aylesworth Hall, Colorado State University, Fort Collins, Colorado 80523.

CR125 — A RIVER BASIN NETWORK MODEL FOR CONJUNCTIVE USE OF SURFACE AND GROUNDWATER: PROGRAM CONSIM, by John W. Labadie, Sanguan Phamwon, and Rogelio C. Lazaro. $7.00
Presents the computer model CONSIM, designed for preliminary planning and screening of storage and water distribution projects with capability for optimization. Handles surface systems as well as conjunctive surface-groundwater systems.

CR126 — INCREASING THE ECONOMIC EFFICIENCY AND AFFORDABILITY OF STORM DRAINAGE PROJECTS, by Harold C. Cochrane and Paul C. Huszar. $3.00
Includes improved evaluation methods to increase the economic efficiency and affordability of storm drainage projects. The methods are explained and illustrated using examples from the City of Fort Collins, Colorado. Master plans for two specific drainages in Fort Collins are used to illustrate problems with standard evaluation techniques and improvements that can be made.

IS49 — PROCEEDINGS: FIFTH WORKSHOP ON HOME SEWAGE DISPOSAL IN COLORADO: OPERATION AND MAINTENANCE OF ON-SITE WASTEWATER TREATMENT SYSTEMS, by Robert C. Ward. $4.00
Presents papers given at the fifth annual workshop held at Colorado State University in 1983.

IS50 — POSSIBLE CAPTURE OF THE MISSISSIPPI BY THE ATCHAFALAYA RIVER, by John D. Higby, Jr., P.E. $4.00
Summarizes the ongoing controversy regarding the possible capture of the Mississippi River by the Atchafalaya and man's effort to prevent it. The Atchafalaya is a main distributary for the Mississippi River. Many members of the scientific and technical community believe it is only a matter of time before the Atchafalaya captures the Mississippi.

TR29 PROJECTED POPULATION, EMPLOYMENT, AND ECONOMIC OUTPUT IN COLORADO'S EASTERN HIGH PLAINS, 1979-2020, by John R. McKean. $7.00
Provides a description and analysis of the economy for eleven counties in eastern Colorado's High Plains region. Develops a detailed description of the economy and an analytical framework capable of assessing the direct and indirect consequences of alternative scenarios for resource exploitation proposed by the public and private sectors of the economy; includes an analysis of the value of water in the economy.

TR30 ENERGY PRODUCTION AND USE IN COLORADO'S HIGH PLAINS REGION, by Emm McBroom. $7.00
Includes historical baseline data and projections of (1) energy production and its associated impacts, and (2) irrigation energy demand for the irrigated area supplied by pumping from the Ogallala aquifer. Projections were made for five specific years: 1980; 1985; 1990; 2000; and 2020.

TR31 COMMUNITY AND SOCIO-ECONOMIC ANALYSIS OF COLORADO'S HIGH PLAINS REGION, by Robert Burns. $7.00
Describes the resource base of Colorado's High Plains region and analyzes its geographic structure, its economic development, its population and settlement patterns, and its communities. This provides a basis for analyzing the local economy and services available to the region's residents to determine their adequacy and their susceptibility to changes in the economic base.

TR33 AN ECONOMIC INPUT-OUTPUT STUDY OF THE HIGH PLAINS REGION OF EASTERN COLORADO, by John R. McKean, Ray K. Ericson and Joseph C. Weber. $7.00
The High Plains-Ogallala regional investigation produced forecasts of economic and hydrologic conditions for 40 years under each of several policy scenarios.

TR34 THE IRRIGATED AGRICULTURAL ECONOMY OF THE COLORADO HIGH PLAINS: DIRECT ECONOMIC-HYDROLOGIC IMPACT FORECASTS (1979-2020), by Robert A. Young, Lawrence R. Conklin, Robert A. Longenbaugh, with Rich Gardner. $7.00
Final report on the Colorado portion of the seven-state Ogallala groundwater study making forecasts to 2020 A.D. of groundwater depletion and associated impacts on the irrigated agricultural economy in the Colorado Ogallala-High Plains region.

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