COLORADO WATER

Newsletter of the Water Center at Colorado State University

OCTOBER 2003

Charles W. Howe, Professor of Economics at the University of Colorado-Boulder, received the 2003 Warren A. Hall Medal from the Universities Council on Water Resources at the Council's annual meeting in August. The award recognizes unusual accomplishments and distinction in the water resources field.

See page 24

From left: Jon Bartholic, President of UCOWR and Institute Director at Michigan; Brig. Gen. Gerald Galloway (ret.), U.S. Army Corps of Engineers and former Superintendent, U.S. Military Academy; Brian Hurd, Assistant Professor of Economics at New Mexico State University (former Howe student); Chuck Howe, Professor Emeritus of Economics, University of Colorado-Boulder; Lynn Lewis, member of UCOWR Board of Directors and Associate Professor of Economics, Bates College (former Howe student); Duane Baumann, Retired Executive Director of UCOWR; and Robert Ward, CWRRI Director.

THIS ISSUE INCLUDES THE FOLLOWING ARTICLES ON GROUNDWATER IN COLORADO:

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WATER ITEMS AND ISSUES . . .

WORLD WATER MONITORING DAY
October 18, 2003
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EDITORIAL

EVALUATING CWRRI

by Robert Ward, Director

The Colorado Water Resources Research Institute (CWRRI) is a federally authorized and funded, as well as state authorized, water research institute located on the campus of Colorado State University (CSU). The federal legislation (administrated by the U.S. Geological Survey) and the state legislation (administered by CSU) both require periodic reviews of CWRRI's operations, accomplishments, and efficiency. CWRRI was last evaluated by CSU (through its 'program review' process) in 1997 and by the U.S. Geological Survey in 1999. Both these reviews are to be conducted again in 2004.

The two evaluations, occurring simultaneously, provide the director of CWRRI, the 'water' faculty of higher education, and Colorado's water managers and users, an opportunity to critically examine the relevance and value of higher education's water expertise to Colorado's need for new water knowledge and its need for a new generation of water managers. In the words of New York's former mayor, Ed Koch, CWRRI asks the question, "How'm I doin'?"

The purpose, therefore, of this editorial is to request readers to share with CWRRI their thoughts, opinions, and suggestions regarding past, current, and future operations of CWRRI. What have been CWRRI's strengths? What are its weaknesses? How can CWRRI better connect higher education's water expertise with the water research and education needs of Colorado water managers and users – CWRRI's key mission?

To further stimulate your reflection upon CWRRI, let me share with you some of the requirements associated with the two evaluations currently underway at CWRRI and reflect upon past CWRRI reviews and collaborations.

The Federal Water Resources Research Act, under which the Colorado Water Resources Research Institute (CWRRI) operates, states in 42 USC Section 10303(e):

> *The Secretary (of Interior) shall conduct a careful and detailed evaluation of each institute at least once every 5 years to determine that the quality and relevance of its water resources research and its effectiveness as an institution for planning, conducting, and arranging for research warrants its continued support under this section. If, as a result of any such evaluation, the Secretary determines that an institute does not qualify for further support under this section, then no further grants to the institute may be made until the institute's qualifications are reestablished to the satisfaction of the Secretary.*

The U.S. Geological Survey organizes the review, in a peer-review panel format. Four well-respected members of the water research community request data and information from all 54 water institutes operating under the federal legislation. The panel members review the submitted information, identifying those institutes that are viewed as not effective in producing relevant, quality science. In the 1999 review administered by the U.S. Geological Survey, the panel identified ten institutes as not satisfying the quality and relevance objectives of the federal legislation.

USGS's 1999 review also identified four institutes that were viewed as 'exceptional programs'. CWRRI, with the following comment, was designated as an exceptional program:

> *The Colorado Institute is not large in terms of over-all financial support. Its program is truly a model of how a smaller institute without access to discretionary or extramural funds ought to function. The Institute's program is clearly defined and well focuses on the development of synthesized information and the dissemination of that information to water users and managers throughout Colorado. The research and information development programs are tightly integrated with the information transfer program. Both programs are excellent given that the programmatic emphasis is on the synthesis and transfer of known information rather than on the generation of new knowledge per se. The Institute's website is exemplary and allows the Institute to serve as a clearinghouse for a number of water related activities in Colorado. The Institute has done a good gob of involving other institutions of higher education, including the University of Colorado and the Colorado School of Mines, in its programs and activities.*

CWRRI, unlike a number of institutes in neighboring states, does not receive funding from its legislature. Thus, the limited size of the institute is acknowledged above in evaluating CWRRI's operations for 1994-1999.

CWRRI is currently assembling the data and information it will submit to the review panel. The CWRRI webpage (http://cwrri.colostate.edu/) contains a large amount of the information we will compile and submit (such as research projects completed over the past five years and reports/newsletters employed to convey the research findings to Colorado water managers and users).

Under CSU's 'Unit Review' guidelines, CWRRI must conduct a review which, among other things, identifies areas of strength and areas of needed improvements. The CSU review also includes plans to improve quality and efficiency. CWRRI currently is also assembling the data and information to submit for the CSU review process.

Both reviews will, in particular, highlight the support CWRRI receives from Colorado's 'water' faculty at institutions of higher education all around Colorado. Without such excellent cooperation, CWRRI could not begin to accomplish its mission. The reviews will also highlight CWRRI's close relationship with Cooperative Extension, the Agricultural Experiment Station (AES), and the Colorado State Forest Service (CSFS), in developing and communicating water knowledge. CWRRI and the AES work closely in planning water research efforts to avoid duplication and ensure the highest water research priorities are covered. CWRRI works closely with the Cooperative Extension's network of water specialists in transferring water information to water managers and users. Reagan Waskom, Cooperative Extension's State Water Resources Specialist, is co-located with CWRRI to insure efficient transfer of water knowledge. CWRRI and the CSFS collaborate at the interface of forest and water management practices – a topic of considerable interest to Colorado in recent years.

The reviews will also highlight CWRRI's work with the Water Archive in the CSU's Morgan Library. Considerable basic water data and information are now being protected and made available using the latest in archival standards and practice.

If you regularly read this newsletter, I am sure you have thoughts about CWRRI's strengths and weaknesses, as well as ways it could better serve your particular water research and education needs. Please share these thoughts with me as I proceed to carefully and thoroughly examine CWRRI's operations, accomplishments, and efficiency. I can assure you your comments will be considered and incorporated into the two reviews currently underway.

My e-mail address is Robert.Ward@Colostate.edu and my phone number is (970) 491-6308. Thanks for considering my request.

36 States Anticipate Water Shortages

Thirty-six U.S. states anticipate suffering water shortages under normal water conditions within the next 10 years, state water managers indicated in a survey released by the U.S. General Accounting Office (GAO) on 9 July. The report to Congress, entitled, "Freshwater Supply: States' view of How Federal Agencies Could Help them Meet the Challenges of Expected Shortages," is the first comprehensive national assessment of water availability and use since a 1978 report by the U.S. Water Resources Council. The GAO report states that current trends – including declining groundwater levels and increasing population – indicate that "the freshwater supply is reaching its limits in some locations, while freshwater demand is increasing." It states that eight water shortages from drought or heat waves over the past 20 years resulted in $1 billion or more in monetary losses for each episode, according to the National Oceanic and Atmospheric Administration.

To help meet these anticipated shortages, 26 states are likely to add water storage capacity, while 18 are likely to add water distribution capacity, according to the Water Managers. They noted that federal assistance is most needed in planning and constructing water storage and distribution systems; in collecting and sharing water data from stream gage and other sites; and in terms of allowing more flexibility in administering some federal environmental protection laws.

The report cautions about the difficulty of forecasting future water availability, which depends on a number of factors, including technological advances, conservation efforts, and the potential impact of climate change.

To read the report (GAO-03-514), visit the Web site: http://www.gao.gov and run a search.

Source: EOS newsletter / August 5, 2003

NSF AND UCAR GRANTS PROMOTE EXPANSION OF COLORADO STATE'S CoCo RaHS PROGRAM

Colorado State University's popular Community Collaborative Rain and Hail Study, or CoCo RaHS, has received grants from the National Science Foundation and the University Corporation for Atmospheric Research to expand the volunteer-based weather watcher program across the Central Great Plains. The grants are further providing opportunities for CoCo RaHS to collaborate with Colorado State's CHILL Radar facility, one of the world's most advanced weather research radars, to improve weather tracking, forecasting and analysis for the National Weather Service and other organizations.

CoCo RaHS is currently recruiting hundreds of volunteers to help expand the program's region of coverage into far eastern Colorado, and soon will be looking for volunteers in southeastern Wyoming, western Nebraska and western Kansas, where water resources are often scarce but play a critical role in the livelihood of the local population. The region's diverse and extreme weather is a challenge to climatologists and has a direct affect on urban water supplies, fire danger, surface water, groundwater, industry, soil, crops, livestock and wildlife. Through a network of more than 500 active volunteers, CoCo RaHS is helping answer many questions about the region's storm characteristics, providing valuable data to Colorado State researchers, the National Weather Service, water managers and many others, and educating the public first hand about weather research.

Each time a rain, hail or snow storm occurs, volunteers take measurements of precipitation using backyard gauges provided by the Colorado Climate Center. Precipitation reports and observer notes are transmitted via telephone or the Internet to the Climate Center each day. Daily updated maps of rain, snow and hail are automatically generated. Scientists and resource managers study these maps to learn how storms develop and move, and to make water-use decisions. CoCo RaHS information is updated daily and available for free public access on the Web at www.cocorahs.org.

New data collected by the expanding CoCo RaHS volunteer network will additionally be used to validate radar-derived precipitation estimation and hail detection techniques from the CHILL Radar facility. The CSU-CHILL radar utilizes state-of-the-art technology to detect hail and quantify rainfall amounts over northeastern Colorado. The collaboration is expected to create improved methods for more accurately tracking storms and flood events using advanced weather radar technology. It also will provide researchers with new insight into storm area, duration, intensity and frequency. Researchers expect to learn more about storm tracks as well as local wetter and drier regions and about how the risk of hail damage varies from place to place across the Central Great Plains. This work is particularly relevant because the National Weather Service will be upgrading all of its current NEXRAD radars in the United States to technology similar to the CHILL radar in the near future.

CoCo RaHS data have been included in formal research, have provided a more accurate picture of local precipitation patterns and variability, and are currently being used routinely by several government, research and private organizations for making informed decisions. A few are highlighted below.

- The National Weather Service monitors CoCo RaHS rain and hail data daily to help track severe weather, issue severe storm warnings and verify forecasts.

- The U.S. Department of Agriculture uses CoCo RaHS information to evaluate drought, hail and crop conditions and to improve estimates of future crop yields.

- The U.S. Bureau of Reclamation and the Northern Colorado Conservancy District both use CoCo RaHS data to look at how precipitation affects water inputs into specific river basins and how it impacts irrigation demands in those areas.

- The Colorado Water Conservation Board and the State Engineer's Office are interested in CoCo RaHS data for mapping rainfall patterns that can lead to both drought and flood events.

- The Urban Drainage and Flood Control District closely monitors weather conditions and flood potential in the Denver metro area, and CoCo RaHS provides a low cost supplement to their network of automated rain gauges.

- CoCo RaHS data over agricultural areas helps farmers determine how much irrigation water may be needed to keep their crops healthy, and in urban areas, the data also show how much water may be needed for lawns, gardens, parks and landscapes.

- Teachers from throughout Colorado use CoCo RaHS information to help teach math and science to students. Lesson plans are being developed for the Web for teachers to use to utilize CoCo RaHS information in their classrooms.

Abstracted from a news release by Brad Bohlander, CSU Public Relations, 7/31/03.

RESEARCH PUBLICATIONS

NEW CWRRI REPORTS

The reports described below will be available on the CWRRI Website at **http://cwrri.colostate edu** *or for a free CDRom, contact CWRRI at CWRRI@colostate.edu.*

Completion Report No. 195
APPLICABILITY OF TROPHIC STATUS INDICATORS TO COLORADO PLAINS RESERVOIRS

by
John D. Stednick and Emile B. Hall
Department of Earth Resources
Colorado State University
Completion Report No. 195

Anecdotal evidence indicates that off-channel storage reservoirs on the eastern Colorado plains downstream of Denver, Colorado are experiencing symptoms of eutrophication. Measures of eutrophication include nutrient concentrations, chlorophyll-a measurements and water transparency. Algal growth promoted by high nutrient inputs may create costly maintenance problems in reservoirs and water distribution systems, ecological changes, low dissolved oxygen and fish kills.

To mitigate the potential impacts of high nutrient inputs and resulting algae growth, Trophic Status Indices (TSI) and linear models are often used in classification and management. Although currently in use, the applicability of the models and other efforts to determine a trophic status of reservoirs in Colorado has not been examined. The recent proposed change in Cherry Creek Reservoir TMDL brought to light several issues about using a trophic status index (TSI) for water quality in Colorado reservoirs. Concerns range from applicability to interpretation.

Off channel storage reservoirs along the South Platte River downstream of Denver, Colorado are often filled with river water that may contain high concentrations of nitrogen and phosphorous. This study measured reservoir nutrient concentrations from April through October 2001 in Jackson, Prewitt and North Sterling Reservoirs. Median total nitrogen (TN) concentrations were as follows: Jackson (2,550 µg/L), Prewitt (3,100 µg/L) and North Sterling (3,550 µg/L). Median total phosphorous (TP) concentrations were as follows: Jackson (208 µg/L), Prewitt (267 µg/L) and North Sterling (183 µg/L).

An analysis of the applicability of common Trophic Status Index (TSI) models suggested that all reservoirs are eutrophic - hypereutrophic based upon chlorophyll-*a*, TP and Secchi depth measurements. Models using chlorophyll-*a* generally resulted in a lower trophic designation than those based upon TP. Model precision analysis (correlation coefficients, 95% confidence intervals, and average and percentage error) was used to evaluate 24 common models that predict chlorophyll-*a* from nutrient concentrations. Using precision analysis, models based upon TP were the best at Prewitt Reservoir, while models using TN and TP were best at Jackson and Sterling Reservoirs. This study suggested that one model does not fit all reservoirs. Based on precision analysis and model selection methods, nitrogen and phosphorous concentrations should be used when assessing off channel storage reservoir trophic status.

Completion Report No. 196
FORESTS AND WATER: A STATE-OF-THE-ART REVIEW FOR COLORADO

by
Lee H. MacDonald and John D. Stednick
Department of Rangeland Ecosystem Science
Colorado State University

Forests occupy 22.6 million acres in Colorado, or 32 percent of the land area, and nearly three-quarters of the forest lands in Colorado are in public ownership. About 55 percent of the forested area is considered suitable for forest harvest. National forests comprise nearly half of the forested area and approximately 60 percent of the area is considered suitable for forest harvest. There are no significant, privately-owned, industrial forest lands in Colorado.

Historic photographs, forest stand

records, and other data indicate that forest density in Colorado is generally greater than in the mid to late 1800s. This increase in forest density, attributed to suppression of forest fires, reduced grazing, and lower rates of forest harvest for timber, fuel, and other products, are generally believed to have decreased annual water yields. Annual water yields from the 1.34 million acres of national forest lands in the North Platte River basin are estimated to have decreased by approximately 8 to 14 percent or 135,000 to 185,000 acre-feet per year, depending on the assumed stand history for the spruce-fir forests. Hydrologic models indicate that average annual water yields could be increased in the North Platte River basin by about 55,000 acre-feet per year if all 502,000 acres designated as suitable for timber harvest were regularly harvested on a sustained yield basis. Similar data are not available for other river basins in Colorado, although the overall trends are probably similar.

This research looked at how reducing forest canopy affects the rate of spring snowmelt and water yield, how it affects evapotranspiration, what happens when the forest regrows, whether reducing forest density affects water yields if annual precipitation is a factor, the effects on water quality, and the necessity for water storage facilities to store the increased runoff. The report does not attempt to address the myriad of other issues that must be considered when evaluating various management alternatives for forested lands. Some of these issues include the numerous laws and regulations that affect land management, economic considerations, the downstream uses of water and water storage capacities, and the effects of forest management on recreation, local communities, aesthetics, and other plant and animal species.

Planning for Uncertainty
Proceedings of the 14th Annual South Platte Forum
October 22-23, 2003
(Speaker Abstracts)
Jennifer Brown, Editor
October, 2003
Information Series No. 97

"The grass is always greener…," has never been truer than in 2003… Cities lost revenue for their water systems by the forced conservation. Small towns lost businesses because the farmers didn't have money to spend. The landscaping industry took a huge hit. Governments are suing each other. And, unfortunately, the average water user still doesn't know how the water system in Colorado really works. But what a great time to be in the water business. Things are ripe for change. Bold new ideas can take hold and good things will come. Everyone will be forced to work together. The public will have to become educated and informed. Hopefully the result will be something future generations point to as genius…" *Jennifer Brown, Editor*

The South Platte Forum was initiated in 1989 to provide an avenue for a timely, multi-disciplinary exchange of information and ideas important to resource management in the South Platte River Basin. Its stated mandates are to enhance the effective management of natural resources in the South Platte River Basin by promoting coordination between state, federal and local resource managers and private enterprise, and to promote the interchange of ideas among disciplines to increase awareness and understanding of South Platte River Basin issues and public values.

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U.S. Geological Survey

Colorado State University Agricultural Experiment Station

USER CENTER DECISION SUPPORT TOOLS FOR COMPUTING AUGMENTATION REQUIREMENTS IN THE SOUTH PLATTE RIVER

by Leslie Patterson and Luis Garcia

History of the SPMAP Tools

Water managers in the South Platte basin are facing competing demands for water including sustaining irrigated food production, providing high quality water to growing populations, and establishing flow conditions to protect habitats for threatened and endangered species. In order to meet water supply challenges, local water management organizations in the Lower South Platte have turned to the development of computer-based tools tailored to the modeling needs of this unique area. Water managers are looking to cutting-edge technology that will help them to manage both the conjunctive use of ground and surface water resources and to determine augmentation requirements in the South Platte basin.

In the mid 1990's, CWRRI funded a project to evaluate the informational needs of water managers for the South Platte basin and to develop databases and models based on these needs. This CWRRI project represented a unique experiment in which water managers were an integral part of the design, development and implementation of tools developed to meet their needs. This effort, the South Platte Mapping and Analysis Program (SPMAP), has been a successfully implemented "user-centered" decision support system.

Jon Altenhofen, Supervisory Water Resources Engineer of the Northern Colorado Water Conservancy District and Coordinator for the South Platte Lower River Group, claims, *SPMAP is here to stay as the computer software for*

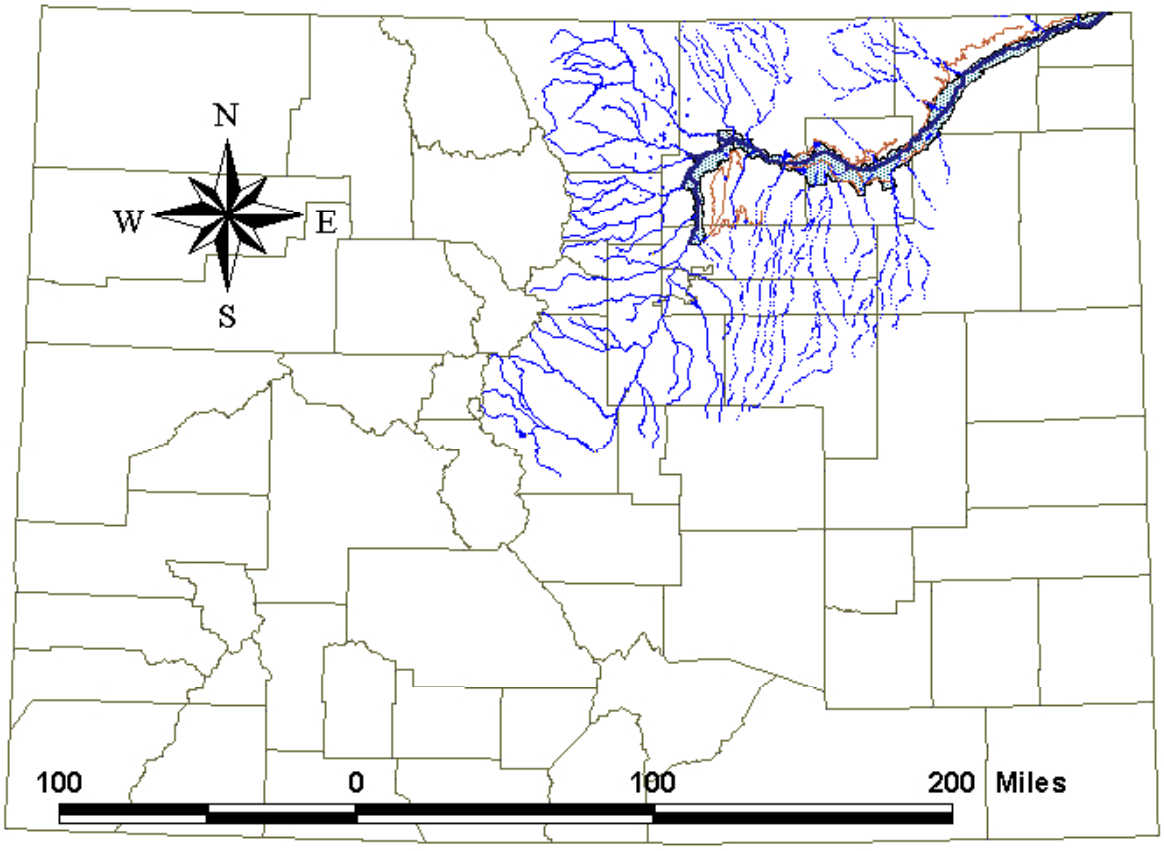

Figure 1. Lower South Platte Project Boundary in Colorado with County Boundaries.

management of augmentation supplies in the South Platte River Basin.

One reason why we feel that the SPMAP tools are so popular is that the software has been developed cooperatively by users (water managers) and researchers, says Dr. Luis Garcia, Associate Professor of Civil Engineering at Colorado State University and Director of the Integrated Decision Support (IDS) Group. Since 1995, Garcia and the IDS Group have been working with a number of local and regional water management organizations along the South Platte River to create the SPMAP tools. The user-directed effort has resulted in the development of three modular tools: the South Platte Geographic Information System (SPGIS), the Integrated Decision Support Consumptive Use Model (IDSCU Model), and the Stream Depletion Factor model (SDF View).

Description of the SPMAP Tools

SPGIS is a geographic information system containing regularly updated data for the South Platte Basin. SPGIS runs in ArcView using extensions that have been programmed to meet the needs of South Platte water managers. Themes include well locations, stream depletion factor lines and boundaries, streams, canals, reservoirs, weather stations, roads, county boundaries, cities and numerous other GIS layers. Also, included with the tool are satellite images in black and white, color, and as digital quads (DRG's). Based on the needs of water managers, one of the tools that has been developed is an extension called Well Tools. Well Tools allows users to locate a well and generate a UTM set of coordinates from a legal description or a footing call and to calculate a footing call or a legal description from a well location in UTM coordinates. The tool also provides users with the capability to calculate stream depletion factors (SDF) for a well theme. The user can delineate the location of a farm or modeling area and this data (area, closest weather stations, and crop types) can be imported into the IDSCU Model, the second component of SPMAP.

Recently, Colorado water managers expressed the desire for a stand-alone tool that performed the same functions as the Well Tools included in SPGIS. In response to this request, the Integrated Decision Support Group (IDS) has developed a program called the IDS Public Land Survey System Locator. This stand-alone tool allows users to view

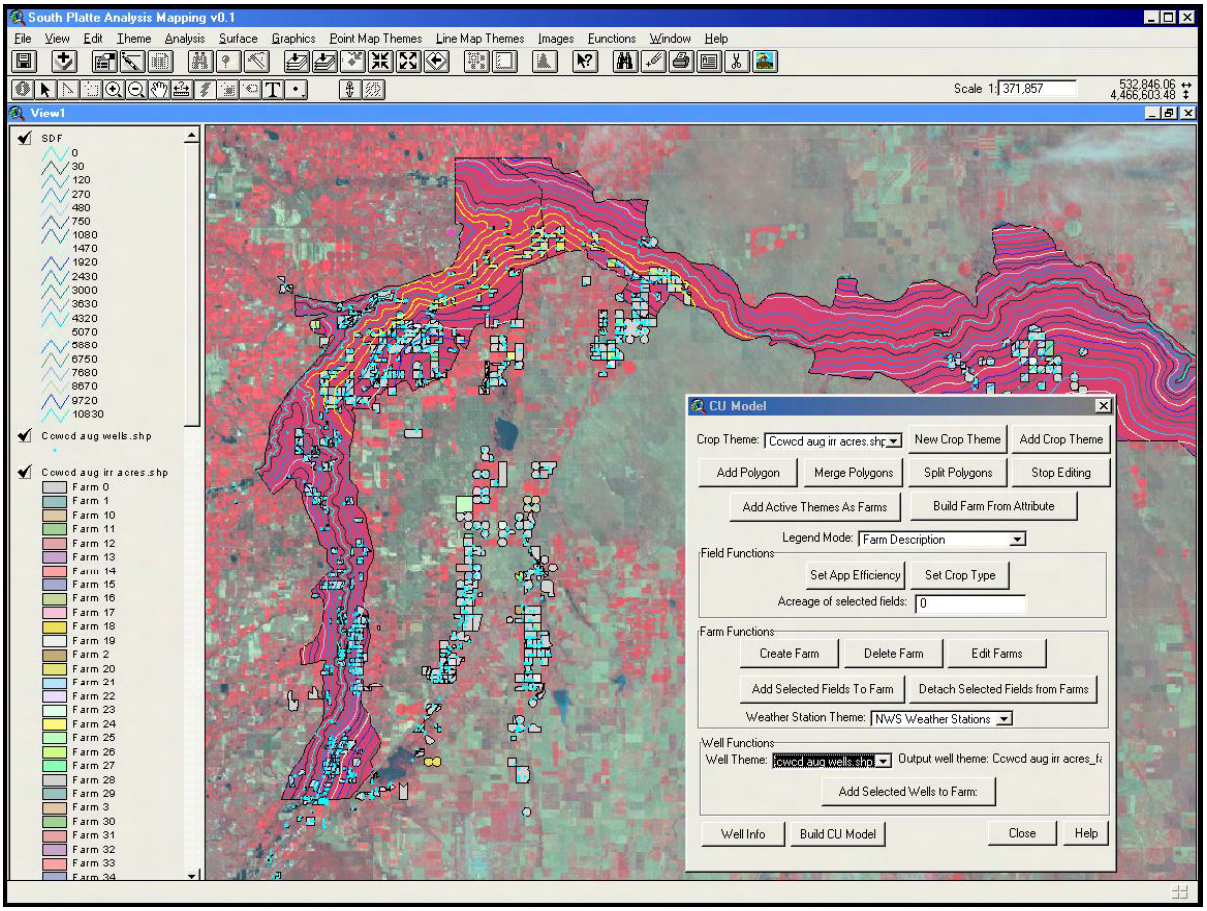

Figure 2. The South Platte Mapping and Analysis GIS Spatial Database.

GIS layers and generate UTM coordinates for wells based on PLSS locations or footing calls, as well as generated footing calls or PLSS locations for wells based on UTM coordinates. Additionally, IDS has developed a web-based map viewing tool that allows users to view all the GIS layers developed for this project, including the 5 meter black and white images and the 7.5 minute quads.

The second component of SPMAP, the Consumptive Use Model, has been significantly upgraded in 2003. Indeed, upgrades were so significant that the SPMAP Advisory Committee and the staff at IDS opted to change the program's name to IDSCU to reflect the fact that the program is data

Input for IDSCU can be entered directly into the model's interface or can be imported from SPGIS or another existing database. Recently, demand for the model has driven a significant number of enhancements which allow different water-user groups to import their individual databases to generate datasets for the model. Users also like the fact that the program allows weather station and surface water supply information to be imported from the Colorado State Engineer's office database, HydroBase. Weather station information can also be imported from the Northern Colorado Water Conservancy District weather stations or from the Colorado Agricultural Meteorological Network (Coagmet). The IDSCU Model has been enhanced to

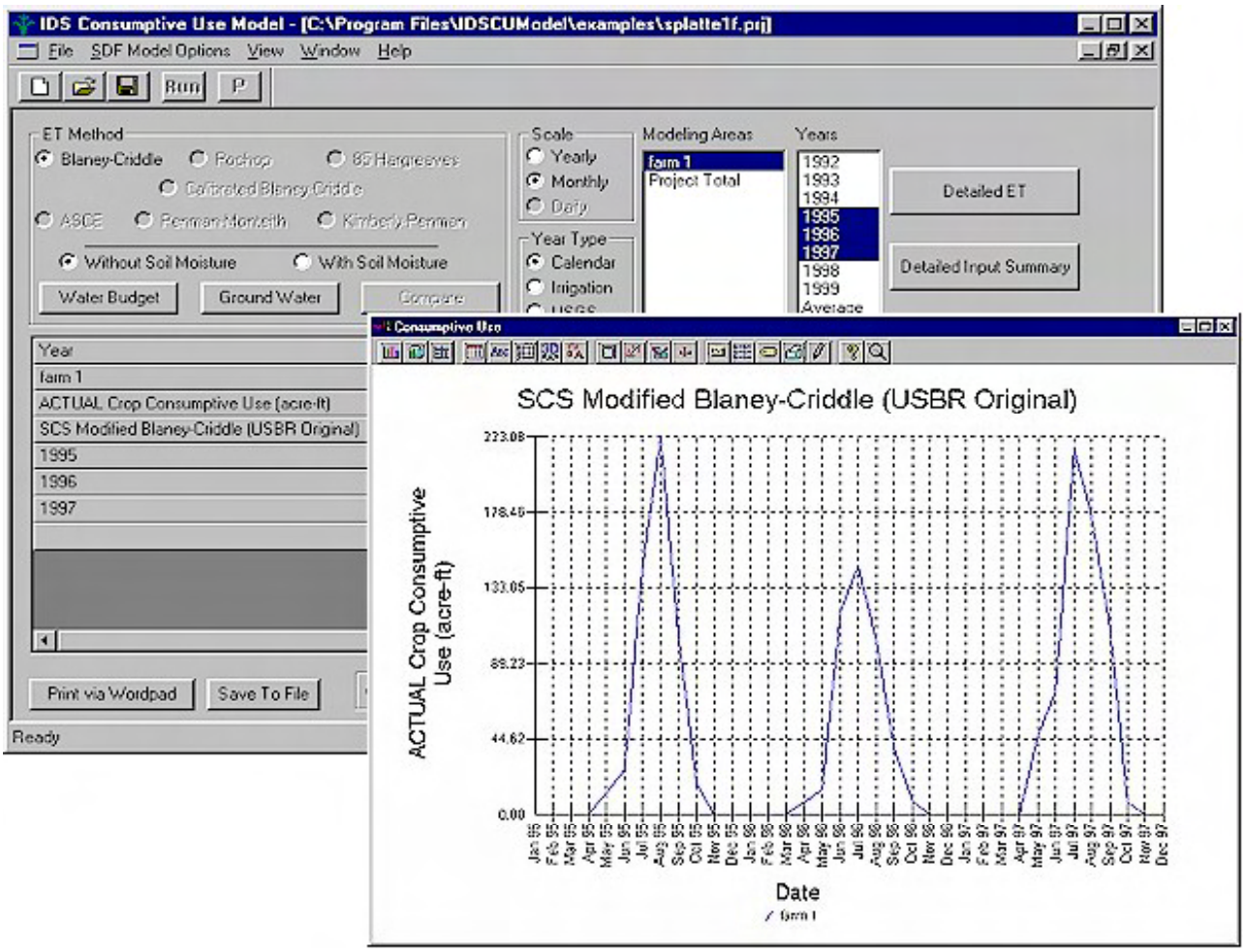

Figure 3. Sample IDSCU Output.

driven and is applicable throughout the state. The model is being used by a number of consultants as well as the State Engineer's offices throughout the state.

The IDSCU Model enables water managers to estimate the consumptive use (CU) of ground water based upon surface water supplies and crop consumptive use estimates.

compute monthly CU using the SCS Blaney Criddle, Hargreaves, and Pochop methods. Users may also create a calibrated Blaney Criddle method with IDSCU. Daily CU can be computed by the model using the Penman-Monteith, Kimberly-Penman, and new ASCE standardized reference evapotranspiration equation. The IDSCU Model applies crop coefficients to determine the water use of various crops

during the growing season. Water budgets can be calculated that take into account soil moisture. When pumping records are available, the application efficiencies of wells can be estimated. Recharge from ditch conveyance loss and well loss can be calculated. Scenarios for forecasting CU can be created by repeating or averaging any sequence of historical years.

has resulted in the program IDS Alluvial Water Accounting System (IDS AWAS). IDS AWAS was developed in response to requests by the SPMAP advisory committee for a program that would meet their needs for more detailed augmentation accounting. Most specifically, water managers stated that areas closer to the river needed daily time-step accounting. IDS AWAS allows daily and

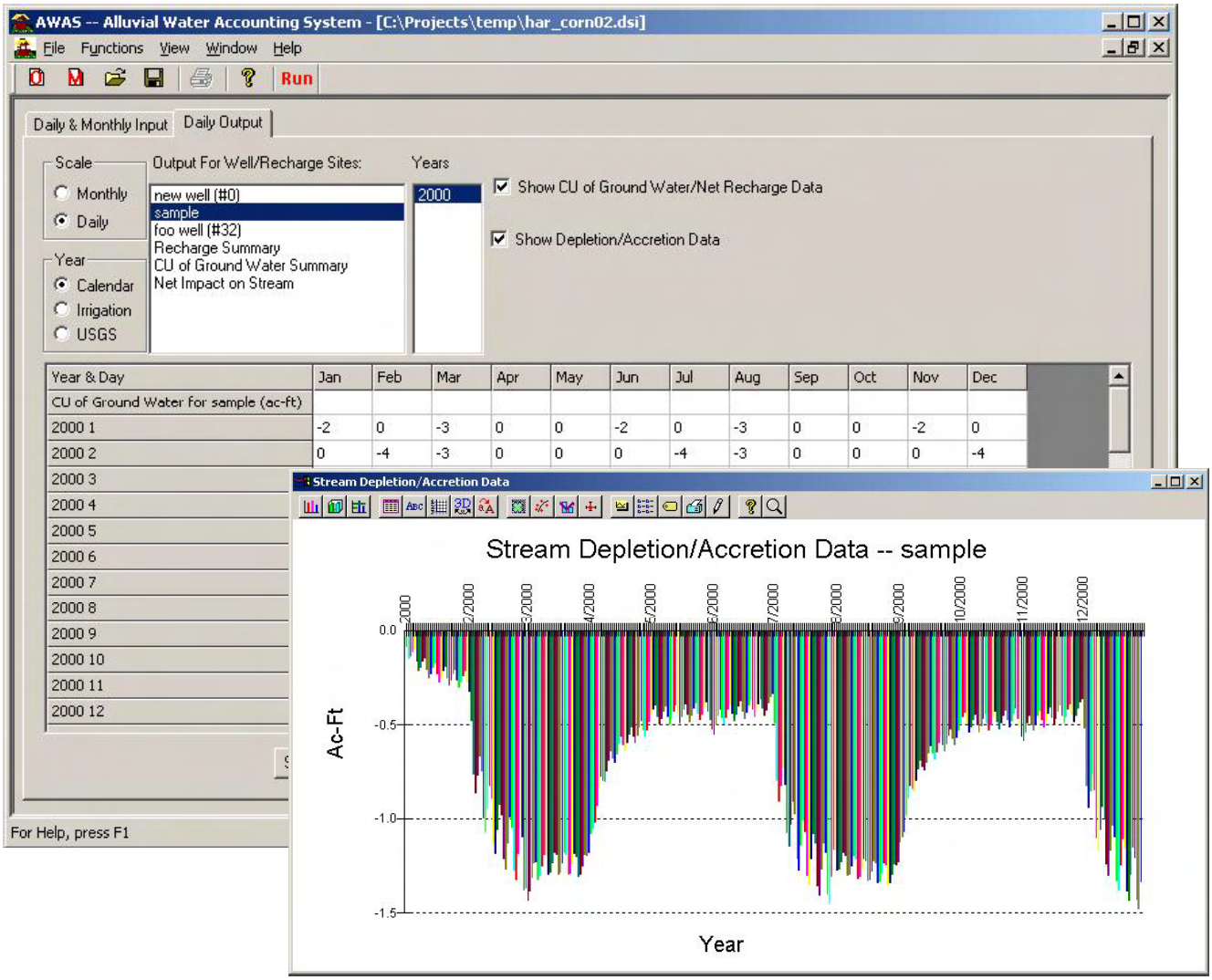

Figure 4. AWAS Stream Depletion/Accretion Output Sample.

Water managers use stream depletion factors (SDF) to determine the lag time from when a well is pumped or water is recharged to a recharge site and when a depletion or accretion happens in the river. SDF View, the original program for calculating SDF included in the SPMAP tools, calculates monthly SDF, has tools for forecasting impacts on the South Platte River, and can model irrigation wells and recharge sites. However, in the past year, it was decided to reconfigure the SDF module of SPMAP based on the *Analytical Stream Depletion Model (Schroeder 1987)* from the Office of the State Engineer. This reconfiguration monthly time-steps and uses equations based on Glover which allow for alluvial aquifers, boundaries, imaginary wells and SDF.

The Future of SPMAP

Reflecting on last year's severe drought Altenhofen says, *A drought causes water suppliers to consider numerous new options for meeting demands. SPMAP's flexibility and ease of use allowed rapid evaluation and accounting of numerous water supplies.*

Tom Cech, Executive Director of the Central Colorado Water Conservancy District, says *Central utilized SPMAP this past year in development of our 2003 Substitute Water Supply Plan, and it was a critical component of our work. Past efforts have been invaluable as we prepare to augment over 1500 wells in 2004.*

John Eckhardt, General Manager of the Lower South Platte Water Conservancy District, also appreciates SPMAP and foresees the continued value of the tools. *As Lower moves to define its mission in the next decade,* Eckhardt says, *the development, operation and accounting of plans for augmentation will be a key aspect of that mission. The use of user-friendly tools to complete these tasks is a necessity in these times of limited budgets and staffs. The SDF View and CU (IDSCU) models, both key components of the SPMAP, are tools we plan to use on a regular basis.*

Users continue to define SPMAP's development. Eckhardt states, *Lower believes the SPMAP should be moved from a prototype implementation to end-user implementation where limited staff, with in some cases limited skills, can use, understand and explain the data input, computations and results.* He adds, *Since results from the SPMAP will be used in water rights court proceedings, good documentation and clean, structured computer coding are a necessity.*

Tom Cech agrees. *Real time accounting is of great importance to Central (Central Colorado Water Conservancy District),* says Cech. *We are currently preparing for a court hearing in May 2005, and it is anticipated that real-time accounting will play a large role in negotiations with objectors.*

The focus of the SPMAP project is to develop modeling tools and data for conjunctive management of ground and surface water. The past eight years have shown that the idea of a "user-centered" approach, where managers and researchers work in close cooperation to design, develop and implement tools that meet new challenges, works.

COLORADO STATE STUDY SAYS SPRAWL EXPENSIVE FOR TAXPAYERS

A recent study by Colorado State University indicates that sprawling low-density residential areas require more funds than are covered by the taxes they generate. While high-intensity areas tend to generate greater employment and tax revenues than low-intensity areas, high-intensity areas also tend to demand more services. Farm and forest land uses, on average, require 35 cents of every dollar of tax revenue generated for services. However, disperse rural residential development, such as urban sprawl with one residence per 35 acres, costs tax payers $1.15 for every dollar generated. Transforming a low-intensity area into a high-intensity area creates a number of changes, many unintentional.

According to a study by Andy Seidl and Roger Coupal, residential areas have a great demand for community services such as police and emergency services, schools and transportation infrastructure - services cows and corn do not require. Seidl is an Associate Professor of agriculture and resource economics at Colorado State University and Cooperative Extension public policy specialist. Coupal is a University of Wyoming associate professor in the Department of Agriculture and Applied Economics and a Cooperative Extension community development specialist.

Policy makers face great decisions when it comes to rural land. This land can be converted from low-intensity uses, such as farming, to high-intensity uses, like residential areas. However, once the land is converted to a high-intensity use, it is almost impossible to convert it back into a low-intensity area. "Our results suggest that small acreage residential areas do not pay for themselves," said Seidl." Although agriculture and forest lands do not generate as much revenue, they tend to pay for themselves because they don't require as many costly services."

According to Seidl and Coupal's study, there are no counties in Colorado that will financially benefit from transforming agricultural acres into low-density residential areas. The study revealed transformations in Sedgwick County would be the least expensive, costing current residents about $1.10 for every dollar of tax revenue generated. Meanwhile, Larimer County has one of the highest estimated costs, leaving its citizens to pay almost $2.22 for every dollar generated to change farm lands into residential areas.

A copy of this study is available at http://dare.agsci.colostate.edu/extension/apr03-02.pdf.

Source: News release by Dell Rae Moellenberg, CSU University Relations

Colorado State University Cooperative Extension

OGALLALA AQUIFER SYMPOSIUM SET FOR 2004 IN WRAY

by Joel Schneekloth
CSU Cooperative Extension

The next Ogallala Aquifer Symposium is scheduled for February 23, 2004 at the high school in Wray, Colorado. This symposium, sponsored by Colorado State University Cooperative Extension will be the fifth one held and has been an ongoing event since 1996 when the first symposium was held at Northeastern Junior College in Sterling, Colorado. The theme of this symposium is *Saving Water Today for Tomorrow.*

Highlighting this year's program will be a session regarding the Republican River Compact Litigation. The lawsuit by the State of Kansas has recently been settled. Representatives from Colorado, Nebraska and Kansas will discuss impacts of the settlement upon each of their States and strategies on how they will manage their compact obligation.

Another topic of the program is a discussion of the overall water supply in the Ogallala Aquifer. Topics will include discussion by Virginia McGuire of the United States Geological Service on water table declines in Eastern Colorado, Southwest Nebraska and Northwest Kansas as well as the entire Ogallala Aquifer. This will give people an idea of the extent of declines within the region as compared to other regions that depend upon the Ogallala Aquifer as their water source. Nolan Doesken, Colorado State University, will discuss the current drought that the region is facing and a historical discussion of weather within the region. Also, Kevin Dennehy will discuss current research being conducted by the USGS within the Ogallala Aquifer on water quality and quantity in the region.

Other sessions will discuss conservation programs and management for water conservation. These sessions will include current research and educational programs aimed at reducing water usage and prolonging the life of the Ogallala Aquifer.

Another session will include a farmer panel with a discussion on what they are doing to improve water management and reduce their water usage.

Who should attend? Ag producers, elected officials, city council/mangers, electric association boards, SCD boards, ground water management boards, people associated with water use issues and citizens.

This symposium will enlighten you about the "Big Picture" of the Ogallala Aquifer and bring you up-to-date with the current water use and management practices as well as give you food for thought on the issues at hand concerning the future and protection of this most valuable resource.

The one-day event is scheduled to begin with registration at 8:00 a.m. and conclude at 4:20 p.m. The cost to attend the symposium is $15 (single) and $25 (couple), which includes a roast beef lunch. For more information, please contact:

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Commercial booths and exhibits - $150
For more information call 970/345-2287

Ogallala Aquifer Symposium
Monday, February 23, 2004
Wray High School - Wray, CO
Water Conservation:
Saving Water Today For Tomorrow

8:00 – 8:50 Registration

Opening Remarks

Overall Water Supply
- **Declines in the Central Great Plains**
- **Weather History of the Central Plains**
- **Water Quality and Quantity**

Republican River Litigation – Management of the New Compact
- **Colorado**
- **Nebraska**
- **Kansas**

Water Legislation

Water Conservation Programs and Management
- **EQIP Programs**
- **ET/Web Based Irrigation Scheduling**
- **Drip Irrigation – Pro's and Con's**

Farmer Management Panel
- **Innovative Producers Talk About Their Management**

THE OGALLALA AQUIFER

For more information contact:

Joel Schneekloth	Gisele Jefferson	Ron Meyer
970-345-0508.....	970-345-2287	719-346-5571

Name _____

Address _____

City/State/Zip _____

Home Phone _____

Business Phone _____

Fax Number _____

Registration Fee: Lunch, Breaks & Handouts

Before February 2th – $15/person or $25/couple

Late Registration Fee - $25/person or $35/couple

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FEATURES

PROGRESS REPORT: HIGH PLAINS REGIONAL GROUND-WATER-QUALITY STUDY (1998-PRESENT)

by Kevin F. Dennehy
U.S. Geological Survey

In 1998, the U.S. Geological Survey (USGS) began evaluating ground-water quality in the High Plains aquifer (Figure 1). The High Plains aquifer underlies 174,000 square miles within the Great Plains in parts of eight western States. The High Plains aquifer (also known as the Ogallala) is the most abundant source of ground water in any agricultural region of the United States and is being threatened by deteriorating water quality. Water extracted from the High Plains aquifer has transformed the area into one of the major agricultural regions of the world. However, detections of elevated concentrations of nitrate and atrazine in ground water indicate agriculture is affecting ground-water quality.

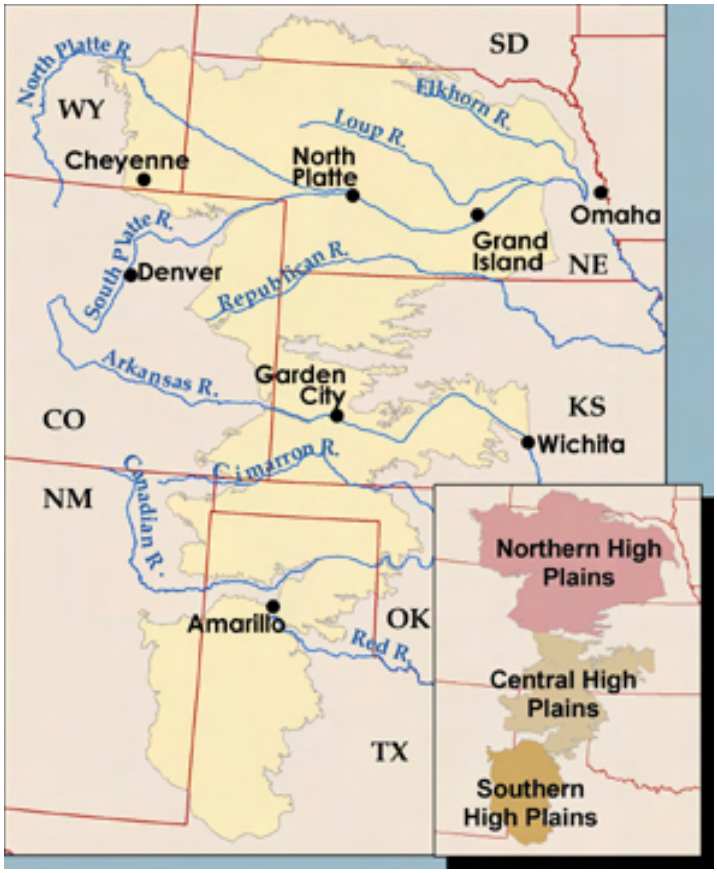


Figure 1. Location of the High Plains Regional Ground-Water Quality Study Area.

Understanding the geologic, hydrologic, and chemical characteristics of this area is essential to identifying the factors that affect this ground-water resource. During 1995, water use from the High Plains aquifer was estimated to be 19.9 billion gallons per day. Of this amount, 81% was pumped from the aquifer, while 19% was withdrawn from rivers and streams. About 96% of water pumped from the aquifer was used to irrigate cropland on an area equal to nearly 27% of the total irrigated land within the United States. Additionally, irrigation withdrawals from the aquifer account for about 30% of the total groundwater pumped nationally. The aquifer also provides drinking water to about 82 % of the 2.4 million people who live over the aquifer. The High Plains aquifer has been significantly affected by human activities. Ground-water withdrawals from the aquifer exceed recharge in many areas, resulting in substantial declines in ground-water levels. Residents once believed that the aquifer was an unlimited resource of high-quality water, but they now face the prospect of an uncertain future.

The goals of the High Plains National Water Quality Assessment (NAWQA) study are to describe the status and trends in the water quality of the High Plains aquifer and to provide a sound understanding of the natural and human factors that affect the quality of the resource. A comprehensive study design is essential to successfully achieving the stated goals of the investigation. The High Plains NAWQA design is based on the belief that multiple-scale nested studies are integral to the High Plains water-quality assessment. By nesting studies, both aerially and vertically, it is possible to explain observed variability and develop an understanding of the physical & chemical processes that govern water quality. This multiple-scale design consists of 4 scales of ground-water investigations, which are integrated components of this comprehensive assessment. The four components are: Major Aquifer Study, Land-Use Study, Regional Transect Study, and Unsaturated-Zone Study.

Major Aquifer and Land-Use Studies are designed to determine the occurrence and distribution of chemical

constituents in the aquifer and Regional Transect and Unsaturated-Zone Studies are designed to develop an understanding of the processes that control water quality. More specifically, the objective of the Major Aquifer Study is to characterize, in a nationally consistent manner, the broad-scale geographic distribution of water-quality conditions in relation to major contaminant sources and background conditions. To accomplish this goal, studies of the primary hydrogeologic units that compose the aquifer (ex., the Ogallala Formation) are planned. Hydrogeologic unit studies characterize water quality without targeting specific land uses. Domestic wells are randomly selected for sampling in each major hydrogeologic unit in the study area.

The second ground-water study component, Land-Use Study, characterizes the quality of recently recharged groundwater associated with a particular land-use setting. In a land-use study, 30 water-table wells are installed at randomly selected sites within a prescribed land-use setting for a given hydrogeologic unit. A land-use study in a large irrigated agricultural setting is planned for each region of the High Plains aquifer. Results from these studies can be compared with results from major-aquifer studies to determine the effects of land use on regional ground-water quality. As an example of study integration, a broad-scale assessment of the northern High Plains aquifer is currently underway (2002-2004) in Colorado and Nebraska. This study component is being coordinated with an assessment of recently recharged ground water associated with irrigated agriculture in eastern Nebraska.

In addition, process-oriented studies are underway to explain the variability in water quality observed in the occurrence and distribution studies. Two examples of process-oriented studies include regional transects and unsaturated-zone studies. The objectives of the transect study are threefold:

(1) measure vertical gradients in ground-water chemistry and age in the Ogallala Formation;
(2) develop an understanding of ground water residence times and recharge rates in the Ogallala Formation; and
(3) provide a better understanding of contaminant sources and sinks in the Ogallala Formation.

The objectives of the unsaturated zone studies are twofold:

(1) determine the rate of movement of water and chemicals from land surface to the water table beneath irrigated fields; and
(2) estimate recharge rates for comparison to other settings across the Ogallala Formation.

Occurrence and distribution studies and process-oriented studies provide a holistic assessment of water quality in the High Plains aquifer. The combination and integration of all scales of ground-water studies listed above are needed to assess water quality of the High Plains aquifer. Figure 2 illustrates the holistic approach applied to the High Plains aquifer. The information acquired from this study will be

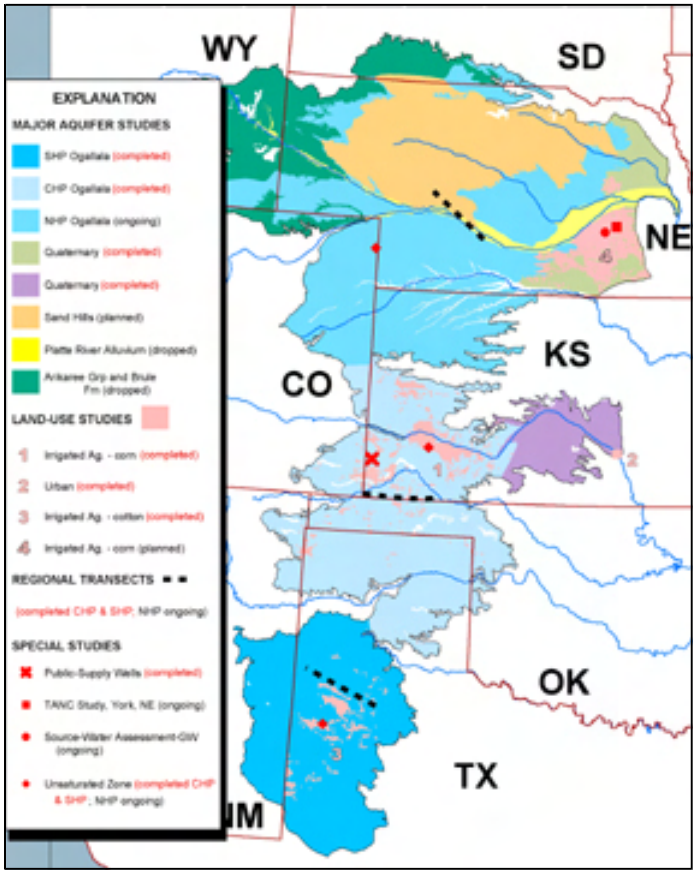


Figure 2. Location of completed and proposed ground-water study activities within the High Plains Regional Ground-Water-Quality Study Area.

valuable in assessing the long-term sustainability of the aquifer from a water-quality perspective.

The High Plains Regional Ground-Water-Quality Study was designed to have a 10-year life that contains 6 years of high-intensity water-quality monitoring because of the complexity of the various groundwater activities and the large geographic extent of the study area. High-intensity monitoring began in 1999 and will continue through 2004, with about 2 years being spent in the central, southern, and northern High Plains regions. Initial high-intensity monitoring during 1999–2000 focused on the central High Plains. In 2001, the investigation shifted to the southern High Plains for 2 years and will end after more than 2 years

of intensive effort in the northern High Plains. The final 2 years of the study will culminate with a series of technical and non-technical reports describing the results of the high-intensity data-collection activities across the High Plains aquifer.

Analysis and interpretation of water-quality information from the data-collection activities is ongoing. Some preliminary findings are available, but the summary of the water-quality assessment for the High Plains aquifer is still about 2 years away. It is possible to provide some general statements about the water-quality from data and analysis obtained from the central and southern High Plains study activities, however complete results from the northern High Plains aquifer will not be available until 2005.

In general, the quality of water obtained from domestic wells as part of the broad-scale assessment is good; however, the aquifer is vulnerable to human activities. Dissolved solids concentrations exceeded the USEPA secondary maximum contaminant level (500 mg/L) in about 60 percent of the ground-water samples in the southern High Plains but to a lesser extent (25 %) in the central High Plains. Nitrate concentrations were elevated above background in a majority of samples with some concentrations exceeding the drinking-water standard of 10 mg/L-N. Pesticides were detected in about a quarter of the samples but did not exceed any drinking-water standard. Atrazine was the most frequently detected pesticide. Radon exceedances above the drinking-water standard were observed and appear to be related to the geology of the bedrock.

The regional transect studies to date have indicated there are vertical gradients in ground-water age and chemistry within the High Plains aquifer. Gradients resulted from chemical inputs to the aquifer from underlying sediments, from streamflow, and from agricultural activities. In areas where those chemical inputs occurred, water quality in the aquifer was impaired and may not be suitable for some uses. About 70 percent of the ground-water samples collected as part of the agricultural land use studies had nitrate concentration larger than the established background values and also contained detectable concentrations of pesticides in recently recharged ground water (<50 years old) beneath irrigated fields.

The unsaturated-zone studies demonstrated that irrigated fields can be an important source of recharge and chemicals to the aquifer. Recharge rates beneath irrigated fields are larger than beneath rangeland. Increasing irrigation efficiency will reduce water and chemical loadings to the aquifer. The unsaturated zone beneath irrigated fields contains a reservoir of agricultural chemicals that will affect ground water for decades to come.

As stated earlier, these findings are preliminary and will be compiled and analyzed for the entire High Plains aquifer in the near future. At that time implications of these findings will also be presented to provide science-based insights for current and emerging water issues and priorities. Furthermore, these results can contribute to informed decisions that result in practical and effective water-resources management and strategies that protect and restore the long-term sustainability of the High Plains aquifer.

Additional information about the High Plains Regional Ground-Water-Quality Study can be obtained from the project's Web site at **http://co.water.usgs.gov/nawqa/hpgw/HPGW_home.html**. Specific questions about the High Plains Regional Ground-Water-Quality Study should be directed to Kevin Dennehy, Project Manager, Denver, Colorado, at kdennehy@usgs.gov or at (303) 236–4882, x 312.

AN UPDATE ON THE STATUS OF WATER LEVELS IN THE HIGH PLAINS AQUIFER

COLORADO

Northern High Plains Designated Ground Water Basin

During the winter of 2002-2003, water levels were obtained for approximately 650 wells in the Northern High Plains Designated Ground Water Basin. For most of the basin, all wells were measured by February 1, 2003. Throughout the Northern High Plains, the water levels continue to show the regional decline that is to be expected when water is being "mined." The past year, along with the last several years, was very dry in the High Plains and declines accelerated rapidly. The 2001-2002 decline was 1.12 ft., while the 2002-2003 decline was 2.47 ft. Based on previous work, the overall decline of 2.47 feet indicates that approximately 2,223,000 acre-ft. have been removed from storage. A decline of one ft. is equal to a depletion from storage of approximately 900,000 acre-ft. Over the past five years (1998 to 2003), the basin-wide water level has declined approximately 5.93 ft., representing a depletion of approximately 5,373,000 acre-ft. or over five percent of the estimated 1965 storage in the aquifer. The depletion for the past 10 years (1993 to 2003) indicates that over 8,460,000 acre-ft. have been removed from storage (decline of 9.4 ft.). This equates to a rate depletion of a little over ½ percent per year.

Southern High Plains Designated Ground Water Basin

The 2003 measurements for the Ogallala Aquifer area of Colorado included a total of 21 wells completely or in part within the aquifer monitoring network. In 2002-2003 the average decline of Ogallala wells was 3.42 ft. as compared to the average Ogallala well decline of 3.83 ft. in 2001-2002. Six wells experienced declines of 0.40 to 8.40 ft. Three wells showed rises in water levels, with an average rise of 5.97 ft. as compared to 1.08 feet of rise in 2002 and 0.33 rise in 2001. The average of all changes was 1.58 ft. of decline, as compared to a decline of 0.75 ft. of average change in 2001-2002.

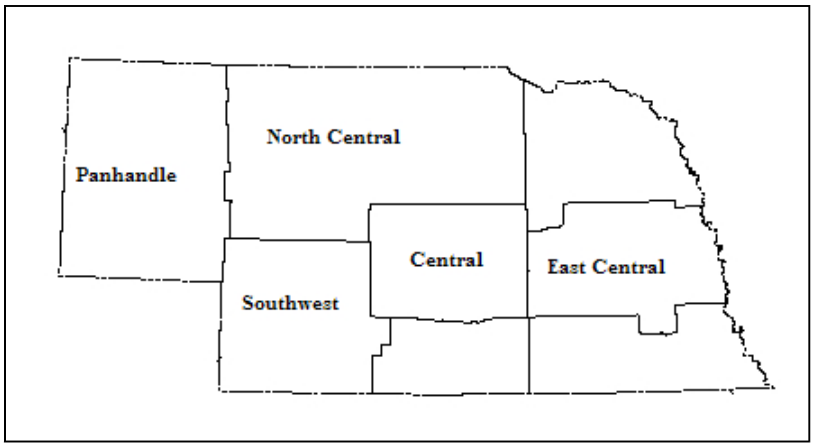
The High Plains States: Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming.

KANSAS

Groundwater levels measured in wells in central and western Kansas declined an average of slightly less than two ft. from January 2002 to January 2003, according to preliminary analyses by scientists at the Kansas Geological Survey, based at the University of Kansas. The decline compared with an average drop of about one ft. during the previous year. Those numbers are based on 1070 wells in central and western Kansas that have been measured every year from 1996 to 2003 by the Survey and the Division of Water Resources, Kansas Department of Agriculture. Most of the measured wells are used for irrigation, and this year's larger decline is likely related to extended dry weather. Water level changes varied across the state. On average, wells measured in west-central Kansas dropped about 1.2 ft. last year, compared to 0.7 ft. of decline the previous year. In northwestern Kansas, the decline averaged about 1.5 ft. in 2002-2003, compared to 0.2 ft. the previous year. In southwestern Kansas, the decline was the greatest, averaging three ft. in 2002-2003, compared to 1.6 ft. in 2001-2002. In south-central Kansas, water levels declined a little less than the statewide average: about 1.3 ft. compared to a decline of about 0.6 ft. in 2001-2002. In the district north of Wichita, the decline was about 0.4 ft. compared to 1.1 in 2001-2001.

NEBRASKA

Water-level changes during water year 2002 were determined from a statewide network of observation wells measured by 28 Federal, State, and local agencies. The network consists of approximately 3,000 wells measured annually, semiannually, or monthly and approximately 60 wells equipped with continuous recorders. Because of the importance of ground water as a source for irrigation and municipal supplies, most observation wells in Nebraska are located in those areas where large quantities of ground water are withdrawn. Water-level fluctuations in selected observation wells for water years 2001 and 2002 are described below. Water-level fluctuations for an observation well are generally representative of water-level fluctuations in wells in each division of the state.



Nebraska's Water Divisions

Panhandle: The observation well shows the influences of recharge from surface-water irrigation canals. Typically, ground-water levels reach their highest levels in early to late spring (March through June) prior to ground-water withdrawals for irrigation. Exceptions to this can occur when leakage from surface-water irrigation canals, typically operating from May-June through September, recharge shallow aquifers. At the end of surface-water irrigation, infiltration of surface water slows or stops, and by late spring, ground-water levels return to pre-irrigation conditions. Because water levels in this well are affected by surface-water irrigation, annual comparisons are made from June to June (typically the lowest water levels during the year) rather than at the end of the water year. The lowest water level in June 2002 was lower (0.13 foot) than the lowest water level in June 2001.

North Central: Precipitation in the division was normal for the first quarter, but only 63 percent of normal for the remainder of the water year. The observation well showed water levels rose 1.65 ft from the end of September 2001 to the end of April, but

insufficient rainfall prevented further recharge of the aquifer. The lack of normal precipitation likely created a greater demand for ground-water withdrawals for irrigation. Subsequently, by the end of September, the water level in this well was 4.72 ft lower than at the end of the 2001 water year.

Central: Monthly total precipitation was above normal only in November and August. For the year, precipitation was only 64 percent of normal. The observation well showed that precipitation was not substantial enough to sufficiently recharge the aquifer. From the end of September 2001 through the end of April, the water level in this well rose only 0.75 ft. The overall lack of precipitation in June and July coupled with ground-water withdrawals for irrigation resulted in a steady decline in the water table of the aquifer so that, by the end of water year 2002, the water level was 3.47 ft lower than the previous water year.

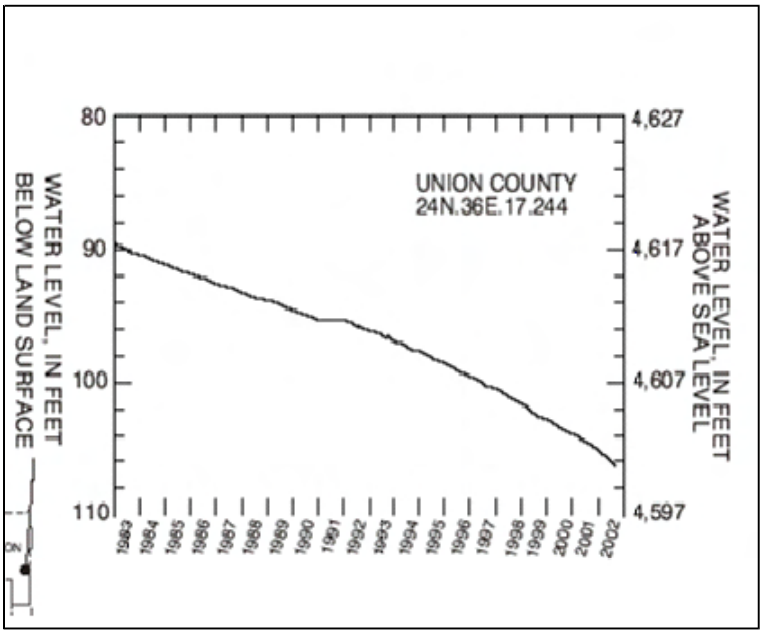
East Central: During water years 2001 and 2002, precipitation was 80 percent of normal, with only June, July, and September being significantly below normal. The observation well showed recharge caused a water-level rise of 1.11 ft. Following the start-up of ground-water withdrawals for irrigation in June, ground-water levels began to decline so that by mid-August, when water levels were at their lowest, water levels were 8.78 ft lower than they had been at the end of May, when they were at their highest levels.

Southwest During water years 2001 and 2002, precipitation was below normal for all months except October and November. For January through September, precipitation was only 54 percent of normal. By the end of August, when water levels were their lowest, they were 5.88 ft lower than at the end of April (their highest level) and 2.67 ft lower than the end of August 2001, which were the lowest recorded levels for that water year.

NEW MEXICO

Ground-water levels are measured periodically in a network of about 6,000 observation wells in order to record changes in ground-water storage. Water levels in about 1,200 wells are measured annually and the remaining 4,800 wells are scheduled for measurement at 5-year intervals, so that wells in different areas are measured each year.

The areas of water-level measurements are in eight of the nine major surface-water drainage basins; most are in areas where ground water is used in large quantities for irrigation, municipal, or industrial purposes. The hydrograph of water levels in Union County in the Northern High Plains illustrates the water level trends for the last 20 years. Water levels continue to show a decline since pre-development. The largest rate of decline (2-5 ft. per year) is in heavily irrigated areas along the New Mexico-Texas border in Curry and Roosevelt counties.



Groundwater trends for the last 20 years, Union County, New Mexico

OKLAHOMA

The Oklahoma Water Resources Board (OWRB) has been monitoring water level change in the High Plains Aquifer since the early 1960s. The aquifer underlies parts of eight counties in Oklahoma. On an annual basis (between January and March of each year), staff of the OWRB collect water-level measurements from selected observation wells. Currently, there are 270 observation wells in the High Plains Aquifer. The average decline in water level from 2002-2003 was approximately 0.90 ft./well. One-hundred eighty-five wells are situated in the Panhandle area of Oklahoma. Most of the negative change in water level can be attributed to Cimarron and Texas Counties in the Panhandle. Since the early 1980s, the downstate (other 6 counties) areas have seen water levels recovering (moderately) or remaining static.

SOUTH DAKOTA

Generally speaking, there is little development of the High Plains Aquifer in South Dakota. What development there is goes mostly for irrigation in Todd and Bennett Counties, plus some municipal and rural water system usage that is not significant. Generally speaking, the ground water levels are higher now than in the '50s. This is the result of the wet years (recharge) of the mid '90s and general dry years of the '50s. This rise shows in nearly all the hydrographs, even those that show the effects

of localized pumping. Generally, the observation well hydrographs do mirror the local climatic conditions for the area, and the existing development has not significantly impacted water levels.

TEXAS

The High Plains Underground Water Conservation District No. 1 makes annual depth-to water level measurements in an observation network of more than 1,200 privately-owned water wells. Annual depth-to-water level measurements made by the district during the early part of 2003 indicate an average decline of 1.06 feet in the ground water levels of the Ogallala Aquifer during 2002 within the water district's 6.8 million-acre service area. The average decline increased by 0.28 of a foot as compared to the previous year. This number indicates an increase of ground water pumpage during the 2002 water production period as compared to 2001. Historically, depth-to-water level measurements show district average declines as follows: 1.46 ft. in 1993; 2.15 ft. in 1994; 1.91 ft. in 1995; 1.49 ft. in 1996; 0.34 ft. in 1997; 2.15 ft. in 1998; 0.68 ft. in 1999; 1.14 ft. in 200; and 0.78 ft. in 2001. There are eight other ground water districts that overlie the Ogallala Aquifer in the High Plains of Texas, and most conduct annual depth-to-water level measurements.

WYOMING

Wyoming continued to experience prolonged drought during water year 2002. Water-levels measured in Wyoming in water year 2002 continued to decline. On average, water-levels in the statewide observation-well network decreased by 0.89 ft between water years 2000 and 2001 and by 1.18 ft between water years 2001 and 2002. Record low water levels were recorded at 46 percent of the wells in the statewide network in water year 2002. Wells completed in the High Plains aquifer coincide with areas of ground-water withdrawal in southeastern Wyoming and comprise 60 percent of the observation-well network. Ground water is withdrawn from the High Plains Aquifer for irrigation in Niobrara County, Platte County, Goshen County, and the eastern part of Laramie County. In addition, large quantities of ground water are withdrawn from the High Plains Aquifer for municipal and domestic use in central Laramie County. Record low water levels were recorded during water year 2002 at 63 percent of the network observation wells completed in the High Plains Aquifer.

Changes in water levels for the statewide observation-well network and for wells completed only in the High Plains Aquifer are summarized in table 1. Many of the observation wells in these networks are located in areas with extensive ground-water withdrawal or in areas of artificial recharge.

Table 1.--Changes in ground-water levels in statewide observation-well network and wells completed in the High Plains Aquifer.

Observation-well Network	Water years[1]	Number of wells in network	Number of wells with water-level increase	Average water-level increase (in feet)	Number of wells with water-level decrease	Average water-level decrease (in feet)	Number of wells with few water-level measurements
Statewide network	2001-2002	67	9	0.34	45	-1.49	13
High Plains aquifer	2001-2002	43	4	0.13	34	-1.12	5

[1]Water year is from October 1 to September 30 of the following year.

Sources: COLORADO: Water Levels in the Southern High Plains Designated Groundwater Basin, June 2003, Colorado Division of Water Resources, Department of Natural Resources, State Engineer's Office. Ground Water Levels, Northern High Plains Designated Ground Water Basin, April, 2003, Colorado Division of Water Resources, Department of Natural Resources, State Engineer's Office. **NEBRASKA: Water Resources Data--Nebraska, Water Year 2002, Water-Data Report NE-02-1. NEW MEXICO: Water Resources Data -New Mexico 2002, Water-Data Report NM-02-1.** OKLAHOMA: Mark Belden, OWRB, State of Oklahoma. SOUTH DAKOTA: Jim Goodman, Department of Environment and Natural Resources, State of South Dakota. TEXAS: The *Cross Section*, published by High Plains Underground Water Conservation District No. 1, April 2003. WYOMING: Water Resources Data for Wyoming, 2002, Vol. 2. Ground Water, Water-Data Report WY-02-2.

NEW JOURNAL COLUMN PROVIDES OUTLOOK FOR WATER PROFESSION

The American Water Works Association (AWWA has announced a new column titled "Market Outlook," that premiered in the August 2003 issue of the *Journal AWWA*. The new bi-monthly "Market Outlook" column will provide detailed outlooks and forecasts on multiple water issues including drought, regulations, wastewater, privatization, and the cost of water. "Market Outlook" is authored by Steve Maxwell, managing director of an environmental consulting group in Boulder, Colorado. Maxwell is also the editor and founder of *The Environmental Benchmarker and Strategist*, a comprehensive source of competitive and financial data for the environmental industry. Complete coverage of the August *Journal AWWA* including feature articles, executive summaries, departments, and expanded coverage can be found online at http://www.awwa.org/communications/journal/

CHANGING PERSPECTIVES - INTERNATIONAL STUDY EXPERIENCES OF A CSU ENGINEERING STUDENT

by John Lewis Edgerly

I had planned on studying abroad from the time I began my education at Colorado State, my home university. When it came time to pick a country and a university, I focused my search on Scandinavia because of my love of the nature found in the northern latitudes and my interest in Nordic cultures. My decision was also influenced by the fact that I study Environmental Engineering and was aware of Scandinavia's reputation for being advanced in environmental policies and technologies pertaining to sustainable development.

I studied at the Technical University of Denmark, (DTU), in Lyngby, Denmark from September 2001 to December 2002, where I took classes as a guest student in their international Environmental Engineering M.S. program. This program has been around for a while, so it is well established and internationally known and respected.

The campus of Technical University of Denmark, (DTU), Lyngby, Denmark.

The Danish style of teaching differs quite a bit from the American style. First, they usually do not grade homework assignments or give exams throughout the semester as they do in the States. A course grade is often determined by a single final examination or final project. This puts added pressure on students for self-discipline and keeping on schedule; otherwise, it is a mad scramble during the last month of the semester.

The next major difference is that the Danes emphasize working in groups and learning by doing. Students often are required to work in groups when writing reports, creating designs, doing presentations, or carrying out laboratory experiments. During my experience in American schools, the focus was more on the theoretical aspects of the material, listening to lectures and then completing assignments independently.

Another difference that I would like to note is that most classes I took at DTU were very well organized. They were tailored and to the point, providing exactly what one needs to know for their area of interest without any excess, irrelevant information. These well-tailored classes are probably the result of the fact that the Environment and Resources department at DTU is one of the largest departments at the university. At CSU, the Environmental Engineering Program is relatively small and is a branch of the Civil Engineering Department, so in the first 2-3 years environmental engineering majors find themselves in civil, mechanical and chemical engineering courses that were not set up solely with them in mind.

The last difference that I will mention is that DTU does not have the core requirements found in the American university system. Students are exposed to the rough equivalent of the CSU core electives in their high schools, leaving their university years for specialization. One could conceivably go through the entire engineering education program without taking any non-engineering subjects. However, the option to branch out is there if it is so desired. DTU is very flexible about allowing students to gain credit for courses taken at other Danish universities. For example, some Danish friends and I took a course offered in the international M.S. program at the Copenhagen Business School called "Economic Globalization, Environment and Development" and this credit was transferable to DTU.

My favorite class in Denmark (and probably in my entire life) was "Environmental Management and Ethics," taught by Professor Poul Harremoes. This class had 30 students from just about every continent, most of who were studying environmental engineering. In addition to some excellent lectures, we had in-class and online debates about technical papers concerning environmental management issues. The diverse backgrounds of my fellow students made these discussions very interesting. The class culminated in a large project, presentation, and discussion. During the last month or so of the semester the class was broken up into six separate groups, each of which was assigned one of what had been identified as the most significant environmental management problems facing the world today. Each group produced a research paper on their topic and then presented what they had found in the context of some of the management tools discussed throughout the semester. Each group also had to highlight a cross-cutting issue that pertained to several of the six topics. This helped

to reemphasize the interconnectedness of it all. Being someone who enjoys looking at "the big picture," I enjoyed this exercise very much.

Professor Harremoes introduced me to policy and technology issues and the emerging field of integrated assessment (IA) to be used for decision support. IA is a broad term, which includes a variety of attempts being made by a number of academics around the world to find better ways to integrate specialists from different disciplines working on multi-media, multi-disciplinary problems by focusing on the areas in which these disciplines or media overlap. The thought of specialization scares me a bit, as I am a person with many interests, so I was very excited to hear that people can actually specialize in the "bigger picture."

Bicycles are lined up outside a DTU classroom building, just as one sees in many U.S. universities and colleges.

I was able to arrange for Professor Harremoes to be my mentor for my senior design project. My project involved applying a new uncertainty analysis technique, proposed by Harremoes and some of his colleagues in Walker et al. 2003, to a case study. My case study was the risk assessment of urban wet-weather chemical pollution, an analysis to identify situations in which the level of uncertainty associated with a deterministic approach is high enough to warrant a different engineering approach, namely the empirical, iterative approach. This is done by producing a conceptual system model that describes the "big picture" of the situation in question. This model is then used to arrange the various understandings of system components and their associated interrelationships based on their physical location within the model. Knowledge gaps and uncertainties are then highlighted and assigned magnitudes. The uncertainties are then put into a three-dimensional matrix, the three dimensions being location, nature, and magnitude. In this way it is proposed that the most significant uncertainties can be identified and the relevance or usefulness of what is known can be assessed.

My design project went well and my case study was then chosen to be the focus of a research project that would result in a technical article. I accepted an invitation from Harremoes to join him, one of his PhD students, and four other DTU professors in writing this article. This offer, combined with an opportunity to travel to the Crimean peninsula on the Black Sea and visit some friends for a few weeks in early September, was enough to persuade me to stay in Denmark for another semester, extending my total stay there to one and a half years.

Being involved in writing the article gave me a taste of academic think tanks. Much to the dismay of the PhD student, Martin, and me, the strategy for writing this article was that the group would meet and brainstorm and then Martin and I would produce a draft of the article based on those discussions which would then be edited by the experts and then discussed. Although it sounds like a good idea to put a group of experts in environmental chemistry and ecotoxicology, water pollution, pollution control engineering, urban drainage and wastewater infrastructure, and environmental management all in the same room for a brainstorming session, it can be pretty chaotic to say the least. Martin and I scribbled frantically as each of these experts veered off on his or her own tangents, and at the end of an hour or two we would retire to his office, feeling overwhelmed, and discuss our plan of action.

We produced a new draft or section of the article and met to discuss it about once every three weeks. Unfortunately, just when we were starting to figure out how to hold a more efficient meeting with a room full of experts, the semester was over and the unfinished article had to be put on hold. It is still intended to be completed long distance via email sometime this year.

My time abroad has changed my life. I made lifelong friendships in Denmark, at DTU, and during my travels with people from around the globe, from as far north as Norway to as far south as Australia. I have gained a new perspective on the world by living outside of the U.S. for a year and a half. I was able to take a step back and see how the rest of the world views the United States. Living in a country as small as Denmark, you pay much more attention to the rest of the world, whereas in a country as enormous as the U.S. it is easy to see the rest of the world as distant and insignificant. Having experienced this, I now feel like more of a global citizen than just an American citizen. This experience has inspired me to pursue an environmental engineering career in the international arena.

Reference: Walker, W.E., P. Harremoes, J. Rotmans, J.P. van der Sluijs, M.B.A. van Asselt, P.H.M. Janssen, M.P. Krayer von Krauss. 2003. "Defining Uncertainty: A conceptual Basis for Uncertainty Management in Model-Based Decision Support." Integrated Assessment (4)1, pp. 5-17.

CWRRI University Water News

University of Colorado

CONTAMINATED WATER FROM ABANDONED MINES THREATENS COLORADO SKI AREAS, CU STUDY SAYS

In a paper that was in the Sept. 23rd issue of Eos, published by the American Geophysical Union, CU-Boulder's Andrew Todd and Diane McKnight of the Institute of Arctic and Alpine Research and Lane Wyatt of the Northwest Council of Governments describe how past Colorado mining is adversely affecting tourism, now a $9 billion industry.

Colorado's severe drought has made artificial snowmaking essential at many ski areas, including Keystone and Arapahoe Basin, the focus of the authors' study. Although periodic droughts are normal in Colorado, affecting at least 5 percent of the state periodically, the potential impact of climate change could negatively affect ski resorts. The main portion of the Snake River, which is contaminated with heavy metals, has been the source of Keystone's artificial snowmaking since 1971. Heavy metals have been detected in headwater drainages within the ski areas, according to a recent study conducted by Hydrosphere, a regional consulting firm. Currently, at the point where river water is diverted for this purpose, concentrations of zinc, cadmium and copper occasionally exceed criteria for aquatic life.

One method of mitigating these effects would be additional snowmaking on a large scale, wrote the authors. Another is moving to a four-season strategy, with spring, summer and fall activities focused on fishing, golfing and rafting. Many of these activities depend on clean water supplies, however, and winter snowmaking, using less abundant and contaminated water, can adversely affect these other sports. The authors observe that, at present, there are no reliable methods of mitigating acid-rock drainage at its source, the abandoned mines that dot today's recreational areas.

Both McKnight and Todd also are affiliated with the environmental engineering program at CU-Boulder. For additional information, contact Andrew Todd, (303) 735-6059, andrew.todd@colorado.edu or Diane McKnight, (303) 492-4687, diane.mcknight@colorado.edu, Harvey Leifert, AGU (202) 777-7507, or Jim Scott, CU) (303) 492-3114.

Diane M. McKnight is a newly elected 2003 American Geophysical Union (AGU) Fellow. She was selected for her outstanding contributions to the undertanding of the biogeochemistry associated with transport of metals and organic substances in streams and lakes.

Making the Most of Science in the American West
by Patricia Nelson Limerick and Claudia Puska
Center of the American West
University of Colorado at Boulder

...as environmental conflicts proliferate in the West, this is no time to give up on the dream of finding guidance in science...We will put history to work...for the good reason that the settlement of the West and the rise of American science are "sibling" histories. They grew up together, and you cannot understand one without the other. For reasons growing from the region's history, the West has a spectacular talent pool of environmental scientists. Judging by the proportion of environmental scientists to the general population, this region has within its borders the human resources to lead in steady, farsighted, and scientifically-informed decision-making. The existence of all those scientists—trained, skilled, certified, champing at the bit for research projects in which to invest their abundant energies—constitutes an enormous regional asset. What we have to do is figure out how to make the most of this treasure of human talent...

This report from the Center of the American West had its genesis in a workshop on the history of science in the American West, co-sponsored by the National Park Servide and the Gilder-Lehrman Institute in May of 2002. This report captures the high points of that gathering. For additional information contact Patricia Nelson Limerick, Faculty Director and Chair of the Board, Center of the American West, 282 UCB, University of Colorado at Boulder, Boulder, CO 80309-0282. Fax: 303/492-1671, e-mail Patricia .Limerick@colorado.edu. The report is available fre on the Web, or in hardcopy from the Center for $5.00. The Website for the Center of the American West is located at **http://www.centerwest.org**.

CHUCK HOWE RECEIVES THE 2003 WARREN A. HALL MEDAL

Chuck Howe, Professor Emeritus of Economics and former Director of the Environment and Behavior Program, Institute of Behavioral Science at the University of Colorado, received the 2003 Warren A. Hall Medal at the annual UCOWR meeting in August, 2003. The medal is presented by the Universities Council on Water Resources to recognize distinguished achievements of an individual in the field of water resources. Dr. Warren A. Hall, known worldwide for his active involvement in water resources research, was a founder in 1962 of the Universities Council on Water Resources. Dr. Hall pioneered the introduction of systems analysis and multi-objective tradeoff analysis in water-resources planning and management. He taught at Colorado State University from 1975 to his retirement in 1985.

Dr. Howe has had a distinguished and unique career in water resources activities at the university, state, federal and international levels. He served as chairman of the Department of Economics at the University of Colorado from 1972 to 1976. In 1986 he became Director of the Environment and Behavior Program, Institute of Behavioral Science at CU. He was Chair of the Governor's Science and Technology Advisory Council, State of Colorado (1983-1987) Dr. Howe's federal appointments include Director of the Water Resources Program, Resources for the Future, Inc., Washington, D.C. (1965-1970); Chair of the Committee on Privatization of Water Services in the United States, Water Science and Technology Board, National Research Council (1999-2002); and Lead Author on Water Resources for the Intergovernmental Panel on Climate Change (IPCC) (1998-2001). He served on other WSTB//NRC panels that evaluated climate impacts, irrigation-induced water quality problems, and international development. He was a member of the National Panel for the Evaluation of the State Water Resources Research Institutes by the U.S. Geological Survey in 1994.

Dr. Howe has been a Visiting Professor at the Universities of York (UK) and Montpellier (France), University of Wageningen (Netherlands), and Gadjah Mada University (Indonesia). He has served as a consultant on water issues for the United Nations, the Agency for International Development, World Bank and the Ford Foundation in Senegal, Botswana, Kenya, Ghana, and Mexico.

Currently, Dr. Howe serves as General Editor of the Edward Elgar Publisher Series on Water Resources.

Chuck Howe received a B.A. in Economics and Business Administration from Rice University in 1952, and an M.A. (1955) and Ph.D in Economics (1959) from Stanford University. He began his career at Stanford as an Instructor in Economics and was Assistant and Associate Professor of Economics at Purdue University from 1958-1964.

After Dr. Howe received the award, he made a few comments. Below is a subset of his comments that present perspectives of water management Dr. Howe has gained, thus far, during his distinguished career.

Comments by Charles W. (Chuck) Howe Upon Receiving the Warren A. Hall Medal
Washington D.C., July 31, 2003

I'm humbly honored to be awarded this medal that honors the great contributions of Warren Hall to teaching, research and service to the water resources community. I had the privilege of meeting Warren early in my tenure at Resources for the Future, Inc. when he was Director of the California Water Resources Research Institute, centered at UCLA. He generously devoted several hours informing me about water issues in the western U.S. and discussing river systems optimization procedures on which we were both working. We later met on various occasions in Washington where he held major policy advisory positions. The honor of this award is further defined by the list of 10 distinguished previous recipients. It is indeed an honor to be included in this group of major contributors to water policy, water engineering, water education and service to the water community.

I would like to mention three topics that merit increased research from water professionals, even though the points have long been on the research agenda. The *first* can be called *the return to the river basin* as the basis for socially responsible water management. The river basin is the natural unit for managing our surface water resources, yet we have chopped up our basins into many jurisdictions (states, special districts, project authorities, international authorities) that fail to consider the system-wide consequences of their actions. The result is the generation of "jurisdictional externalities" that reduce the national benefits from use of the river by imposing losses on other user groups.

To set basin-wide planning and management as a goal is ambitious indeed, and will require political wisdom beyond all of our water-related disciplines. While a few river basin

Chuck Howe discusses three topics that merit increased research from water professionals: return to the river basin, improved management of the water infrastructure, and finding the right balance in the roles of the public and private sectors in providing water services.

commissions have been successful, attempts under the 1965 Water Resources Planning Act were largely stillborn. Yet, the potential payoffs are large enough to permit "win-win" situations for all basin groups. The "Severe Sustained Drought Study" of the Colorado River showed how much could be gained by optimizing over the entire river rather than state-by-state or district-by-district. In this conference, the study of the lower Rio Grande by the Texas A&M Team pictured the maze of local districts that stand in the way of larger scale optimization. Aaron Wolf's paper on conflict resolution/prevention illustrated the same point at an international scale.

A *second topic* warranting our increased attention is improved management of the huge water infrastructure that we already have. This point was strongly made in this conference by Edward Dickey, former Chief of Planning for the Army Corps of Engineers and is not independent of the proceeding point on river basin scale. The point relates also to *ex-post analyses* as a way to learn how we might improve our use of this great infrastructure. The emphasis of such analyses is not primarily how individual projects have turned out relative to expectations at the planning stage, but to learn how rapidly changing and uncertain physical and socio-economic environments are impacting the efficacy of our water management techniques.

A *third topic* relates to the search around the world for the right balance in the roles of the public and private sectors in the provision of water services. Regarding *raw water*, *water markets* of one sort or another are playing an increasing role in the flexible allocation of water. We are aware of the power of markets, properly organized and regulated, to generate information and efficiently reallocate water in a changing economic environment. We are also aware of the severe social/community impacts that large, sudden ag-to-urban transfers can have on the areas-of-origin. The issue is how far U.S. States should go in constraining water markets to protect these local community values. While unconstrained markets may ultimately result in more efficient uses of water, the transition period can be very costly to the area-of-origin. The case of Chile's privatization of raw water also shows that unconstrained markets need not lead to efficient water use if the judicial framework is weak and allows monopolization to occur.

Ari Michelsen congratulates Chuck Howe. Michelsen is Resident Director, Agricultural Research and Extension Center, Texas A&M University-El Paso, and Past President of UCOWR. At lower left: Duane Baumann, retired Executive Director of UCOWR.

In the area of urban water provision, the issue is, under what conditions should operation and/or ownership of water and wastewater systems be turned over to private companies (in very few cases is ownership of utility assets turned over to private companies). These companies have a lot to offer, but the contracting conditions must be carefully designed and monitored. In the U.S., there have been both positive and negative results of private contracts. One of the biggest benefits of the privatization movement has been to spur publicly owned and operated utilities (that are still a vast majority) to improve their operations. This record needs to be better understood.

CENTER OF THE AMERICAN WEST PRESENTS:
Inside Interior
Conversations with Secretaries of the Interior
On Their Roles in Shaping the West
The 2003-04 Wren and Tim Wirth Forum

The Center of the American West announces a series of exciting events that illuminate the role of Secretary of the Interior in managing public lands. The series will take place over the course of the 2003-2004 academic year, and will feature former Secretaries of the Interior, as well as current Secretary Gale Norton. The Secretaries of Interior events are free and open to the public, and reservations are not required. Seating is limited, and will be filled on a first-come, first-served basis. See the Center of the American West Website at: **http://www.centerwest.org**.

FALL SERIES – (Began Sept. 24 , 2003 with Stewart Lee Udall, Secretary of the Interior from 1961-1969)

Oct. 15, 2003 — 7:00 p.m., Humanities IB50 – University of Colorado campus
Walter J. Hickel – Hickel served for two years (1969-1970) under President Nixon. He is known for helping awaken America to the emerging environmental crisis and for his role in establishing the Environmental Protection agency.

Nov. 19, 2003 — 7:00 p.m., Old Main Chapel, University of Colorado campus
John C. Whitaker – Whitaker served on the Nixon White House staff from 1969 to 1972, coordinating environment and natural resources policy, and from 1973 to 1975 as Under Secretary of the Interior, reporting to Secretary Rogers C.B. Morton, who died in 1979. Together, Morton and Whitaker prided themselves on their ability to walk the fine line between Interior's competing natural resources development and preservationist constituencies.

SPRING SERIES

Jan. 2004 — 7:00 p.m., Date and location TBA
James G. Watt – Watt served as Secretary for three years (1981-1983) under President Reagan, during which time the Sagebrush Rebellion was in full swing. Watt implemented a Good Neighbor Policy to quell the rebellion. He also oversaw a complete rewriting of water reclamation law.

Feb., 2004 — 7:00 p.m., Date and location TBA
Manuel Lujan, Jr. – Lujan served as Secretary for four years (1989-1993) under President George W. Bush. He helped implement the President's "no net loss" of wetlands.

Mar. 2004 — **Bruce Babbitt** – Babbitt served as Secretary for eight years (1993-2000) under President Clinton. Among his accomplishments were promulgation of new grazing policies and regulations for public lands, a new consultative use of the Antiquities Act, resulting in Presidential monument decress of some 4 million acres, reorganization of the U.S. Geological Survey, and development of multi-species Habitat Conservation Planning.

Apr. 2004 — 7:00 p.m., Date and location TBA
Gale A. Norton -- Sworn in as the 48th Secretary of the Interior under President George Bush in 2001, Norton is the first woman to head the 154-year old department. Norton will reflect on her predecessors' experiences and observa-

Program on Environment and Behavior -- Institute of Behavioral Science
Fall "Brown Bag" Presentation Series

The series presentations are given from 12:30-1:30 in IBS 3 "Pop Program" Conference Room.

Nov. 3	Spillover Effects of "Brownfields" and Opportunities for Creative Financing of their Clean-up	Laura Taylor, Visiting Scholar and Associate Professor, Georgia State University
Nov. 25	Water Utility Pricing and Local Collective Action	Edna Loehman, Visiting Scholar, Dept. of Agricultural Economics, Purdue University
Dec. 1	Colorado Resort Communities: Drought Impacts and Lessons Learned	Environmental and Societal Impacts Group, NCAR

CU-DENVER

WESTERN WATER RIGHTS AND WATER ENGINEERING

This three week, 16-hour course is designed for people interested in water resources, and will emphasize Colorado water rights, but examples from other western states will be included. Students will acquire valuable information in each of the following areas:

- The development of the water rights doctrine
- Water Institutions in Colorado
- Water rights changes, transfers, administration, and plans for augmentation
- The implications of the above factors for water resource management.

The course will be taught from a professional engineering point of view, not a legal perspective. This course is designed for engineers, hydrologists, managers, and planners who need an understanding of the effects of water rights on water resources. The instructor, **Cheryl Signs, P.E.,** operates Cheryl Signs Engineering, a consulting firm specializing in water resources engineering. She received her Bachelor of Science in Engineering Science from Colorado State University in 1972. Her previous water engineering experience includes working for the City of Westminster and Leonard Rice Consulting Water Engineers. Ms. Signs is a past president of both the Colorado Engineering Council and the Colorado Section of the American Society of Civil Engineers. She has taught this *Western Water Rights* short course for the University of Colorado at Denver several times over the past 16 years.

The course is scheduled Tuesday and Thursday evenings, **October 21 through November 6, 2003**, from 5:30 p.m. to 8:10 p.m. on the Auraria campus in downtown Denver. The course fee is $495. Students who successfully complete the course will earn 1.6 Continuing Education Units. Call Continuing Engineering Education at 303-556-4907 or toll free 1-877-859-7304 for more information. Visit **www.cudenver.edu/engineer/cont** for course details and on-line registration forms.

MESA STATE COLLEGE

Gigi Richard has again organized a Water Seminar -- **Western Water: A limited resource--Are we facing insurmountable problems or creative solutions?** at Mesa State College this fall. The seminars will be held Wednesday afternoons at 4pm in the Saccomanno Lecture Hall (SL 110) at Mesa State. The seminar is a 1-credit class (GEOL 396 sec 002), but will be open to the public.

GEOL 396 - TOPICS: Water Resources
Westerm Water: A Limited Resource
Are We Facing Insurmountable Problems or Creative Solutions?

Oct. 29	What are Instream Flows?	Jay Skinner Colorado Division of Wildlife
Nov. 5	Case Study: Black Canyon of the Gunnison	TBA-National Park Service
Nov. 12	Collaboration in Action: The Pathfinder Project	U.S. Forest Service

For information contact: Gigi A. Richard, Ph.D. Asst. Prof. of Geology, Department of Physical and Environmental Sciences, Mesa State College, 1100 North Ave., Grand Junction, CO 81501. E-mail: grichard@mesastate.edu, office: +1-970-248-1689.

NEBRASKA'S NRD MAY HALT WELL DRILLING

The Central Platte Natural Resources District may suspend well drilling as it studies the interaction of groundwater and surface water. State officials also are looking at ways to better manage water taken from streams and rivers, which are regulated at the state level, and water taken from wells, regulated by natural resources districts. Central Platte's board has voted to propose a suspension of well drilling, and a final decision will be made on Nov. 20. Meanwhile, the board will hold public hearings in early November on the proposal. Suspending new well drilling would give the board time to determine whether the district's surface and groundwater supplies are over-appropriated and to develop an integrated water management plan if one is needed, said Ron Bishop, district manager. The area included in the proposed suspension runs the length of the district from Gothenburg to Columbus and six to eight miles either side of the Platte River. The suspension, with some exceptions, would last three years and could be extended for two more years if necessary, Bishop said. If the study determines the district is using too much water, new well drilling could be banned, Bishop said. The state Department of Natural Resources has indicated the district's water basin is over-appropriated in some areas, Bishop said.

http://www.journalstar.com/Nebraska.php?story_id=84961

RESEARCH AWARDS

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

COLORADO STATE UNIVERSITY, FORT COLLINS, COLORADO
Awards for July 26, 2003 to Sept. 25, 2003

Primary PI	Department	Sponsor	Title
Gray, Mary Mcphail	Coop. Ext.	CDPHE	Nonpoint Source Information & Education Coordination
Kreidenweis-Dandy, Sonia M.	CIRA	NOAA	Role of Stratocumulus Clouds in Modifying Pollution Plumes Transported to North American Continent
Randall, David A.	**CIRA**	**NOAA**	**Climate Process Team on Low-Latitude Cloud Feebacks on Climate Sensitivity**
Deo, Shripad D.	CIRA	NOAA	Applied Research in Support of Implementation of National Weather Service
Kummerow, Christian	CIRA	NOAA	Variability & Trends in Global Precipitation
Grasso, Lewis O.	**CIRA**	**NOAA**	**Severe Weather & Tropical Cyclone Product Development for the National Polar-orbiting...**
Vonderhaar, Thomas	**CIRA**	**NOAA**	**Research & Development for GOES-R Risk Reduction**
Venkatachalam, Chandrasekaran	**CIRA**	**NOAA**	**Polarimetric Radar Observations of Precipitations: Measurements**
Walker, Lloyd R.	Civil Engr.	USDA	Coordinated Agricultural Water Quality Programming for EPA Region VIII
Hoag, Dana	**DARE**	**USDA-CSREES**	**Drought Management Risk Simulation for Research & Education**
Bergersen, Eric P.	CFWLU	Montana State Univ.	Testing Impacts of Channel Modifications to Reduce T. tubifex Habitat
Rocchio, Joseph F.	**FWB**	**USFWS**	**Alamosa National Wildlife Refuge Survey & Assessment of Wetlands on Adjacent Private Lands**
Loftis, Jim C.	**Civil Engr.**	**NPS**	**Design, Develop, Implement & Manage Integrated Biological Research Projects**
Rocchio, Joseph F.	FWB	BLM	Wetland Classification of Blanca Wetlands
Hobbs, N. Thompson	NREL	USGS	Willow Persistence in Yellowstone National Park: Interactive Effects of Climate
Binkley, Daniel E.	FRWS	USGS	Influence of Stand Structure on Growth & Resource Use in Rocky Mountain Forests
Clements, William H.	FWB	NPS	An Integrated Assessment of the Effects of Polycyclic Aromatic Hydrocarbons on Aquatic Communities...

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

STATE/LOCAL SPONSORS: CDA-Colorado Department of Agriculture, CDNR-Colorado Dept. of Natural Resources, CDPHE-Colorado Dept. of Public Health and the Environment, CDWL-Colorado Division of Wildlife, NCWCD-Northern Colorado Water Conservancy District. OTHER SPONSORS: AWWA-American Water Works Assn., CID-Consortium for International Development.

UNIVERSITY DEPARTMENTS, INSTITUTES AND CENTERS: Colorado State: BSPM-Bioagricultural Sciences & Pest Management, CBE-Chemical & Bioresource Engr., CFWLU-Cooperative Fish & Wildlife Unit, CSMTE-Center For Science, Mathematics & Technical Education, CIRA-Cooperative Inst. for Research in the Atmosphere, DARE-Dept. of Agric. & Resource Economics, ECE-Electrical & Computer Engineering, ERHS-Environment & Rad. Health Sciences, FWB-Fishery & Wildlife Biology, HLA-Horticulture & Landscape Architecture, NREL-Natural Resource Ecology Lab, NRRT-Nat. Resources Recreation & Tourism, RES-Rangeland Ecosystem Science, SCS-Soil & Crop Sciences. University of Colorado: ACAR-Aero-Colorado Center for Astrodynamic Research, AOS-Atmospheric & Oceanic Sciences, CADSWES-Center for Advanced Decision Support for Water and Environmental Systems, CEAE-Civil, Environmental, and Architectural Engineering, CIRES-Cooperative Institute for Research in Environmental Sciences, CRCMAST-Cooperative Research Center for Membrane Applied Science & Technology, EEB-Ecology & Environmental Biology, EPOB-Environmental, Population & Organismic Biology, IAAR-Institute for Arctic & Alpine Research, IBS-Institute of Behavioral Science, ITP-Interdisciplinary Telecommunication Program, LASP-Lab. For Atmos. And Space Physics, PAOS-Program in Atmospheric and Oceanic Sciences.

Primary PI	Dept.	Sponsor	Title
Binkley, Daniel E.	FRWS	USGS	Structure & Function of Northern Ecosystems & Their Response to Global Change…
Cooper, David J.	**FRWS**	**NPS**	**Relative Importance of Beaver & High Flows in Maintaining Wetland Hydrology in the Kawuneeche Valley...**
Redente, Edward F.	**FRWS**	**NPS**	**Vegetative Restoration of Four Disturbed Areas & the Revision of the Vegetative Restoration Management Plan...**
Cooper, David J.	FRWS	USBR	Riparian Vegetation Studies on the Colorado River & its Tributaries
Loftis, Jim C.	Civil Engr.	NPS	Synthesis, Digitization, & Analysis of Clean Water Act Impairments & Use - Designations for National Park System Water …
Loftis, Jim C.	Civil Engr.	NPS	Establishing the Status & Trends of Impaired, Threatened, & Outstanding National/State Resource Waters...
Rutledge, Steven A.	**Atmos. Science**	**NASA**	**Physically-based Observational Studies for Tropical Rainfall Measuring -- Mission & Concept Development...**
Berg, Wesley K.	**Atmos. Science**	**NASA**	**A New Approach to Quantifying Both Random Errors & Systematic Climate Regime Biases in Tropical Rainfall Measuring …**
Austin, Richard T.	**Atmos. Science**	**NASA**	**Combined Active/Passive Retrieval of Snowfall**
Fausch, Kurt D.	**FWB**	**USDA-NRCS**	**Effects of Grazing on Input of Terrestrial Invertebrates That Feed Stream Fish**
Peterson, Gary A.	**Soil &Crop Sciences**	**USDA-ARS**	**Develop Sustainable & Flexible Dryland Cropping Systems & Management - Decision Support Technology...**
Paustian, Keith H.	NREL	USDA-NRCS	Quantifying the Change in Greenhouse Gas Emissions Due to Natural Resource Conservation Practice Application
Sale, Thomas C.	Civil Engr.	DOD	Sequential Electrolytic Degradation of Energetic Compounds in Groundwater
Cooper, David J.	**FRWS**	**NPS**	**Effects of Grand Ditch Breakage on the Colorado River Valley Near LuLu City**
Culver, Denise R.	**FWB**	**BLM**	**Survey of Bureau of Land Management's Critical Wetlands in South Park**
Hannah, Judith L.	Geosciences	NPS	Inventory & Monitoring Natural Resource Status & Trends in the National Park Systems
Stednick, John D.	**FRWS**	**NPS**	**Evaluation of Existing Water Quality Information in the Sierra Nevada Network for Vital Signs - Water Quality Monitoring…**
Romme, William H.	**FRWS**	**NPS**	**Environmental Analysis & Fire Management Plan for Black Canyon of the Gunnison National Park & Curecanti National Forest…**
Parton, William J.	NREL	USGS	Responses of Hydrologic & Aquatic Ecosystem Processes to Potential Climate Change
Stevens, Joseph E.	FWB	NPS	Develop Information and Database for Threatened/Endangered Species
Cooper, David J.	Geosciences	USGS	Status of Fremont Cottonwood Forests in the Upper Colorado River Basin
Bergersen, Eric P.	CFWLRU	USGS	Fish Losses Associated With Irrigation Diversions On the Wind River Indian Reservation
Cooper, David J.	Geosciences	USGS	Beaver Effects on Riparian Landscape Structure & Function: Hydrology
Wilkins-Wells, John	Sociology	USBR	Management Practice Study II - County Land Use Impacts on Irrigation Districts
Loomis, John B.	**DARE**	**NSF**	**Modeling Complex Interactions of Overlapping River & Road Networks in a Changing Landscape**
Garcia, Luis	Civil Engr.	DOE	Framework for Decision Support System for Rocky Flats
Hanan, Niall P.	**NREL**	**Univ. of Nebraska**	**Carbon & Water Management in Conservation Reserve Program Lands of the Shortgrass Prairie**
Ojima, Dennis	NREL	NPS	Modeling the Timeline for Acidification from Excess Nitrogen Deposition in Rocky Mountain National Park
Kalkhan, Mohammed	NREL	USGS	Determining Present & Future Impacts of Coal Bed Methane Development in Powder River Basin, Wyoming & Montana
Labadie, John W.	Civil Engr.	USBR	MODSIM Enhancement and Maintenance
Loftis, Jim C.	Civil Engr.	NPS	Inventorying & Monitoring National Resources Status & Trends in National Park Service
Barbarick, Kenneth A.	Soil & Crop Sci.	City of Littleton	Land Application of Sewage Biosolids
Qian, Yaling	**HLA**	**Noer Fdn.**	**Mowing Effects on Turfgrass Salinity Tolerance & Associated Mechanisms**
Bledsoe, Brian	**Civil Engr.**	**Eagle River Watershed Council**	**Eagle River Watershed Inventory & Assessment**

Primary PI	Department	Sponsor	Title
Khosla, Rajiv	**Soil & Crop Sci.**	**EPA**	**Innovative Precision Management Strategies to Reduce Pesticides & Nitrogen Loading...**
Davis, Richard A.	Statistics	EPA	Applying Spatial & Temporal Modeling of Statistical Surveys to Aquatic Resources
Bledsoe, Brian	Civil Engr.	Three Forks Ranch Corp.	Monitoring of the Little Snake River & Tributaries
Wohl, Ellen E.	Geosciences	DOD	Characterization Channel Disturbance Regimes in Hydroclimatically Extreme Regions
Macdonald, Lee H.	**FRWS**	**USFS**	**Monitoring, Assessing, & Predicting Sediment Production, Sediment Deliver, & Cumulative Watershed Efforts...**
Donnelly, Maureen P.	NRRT	USFS-Pacific SW	Recreationist's Acceptability Norms Toward Fire Management-Phase II
Macdonald, Lee H.	**FRWS**	**USDA**	**Effects of Post-Fire Treatments on Erosion Rates After the Hayman Fire**
Macdonald, Lee H.	**FRWS**	**USFS-RMRS**	**Postfire Erosion & the Effectiveness of Emergency Rehabilitation Treatments Over Time**
Loomis, John B.	**DARE**	**USFS-RFRS**	**Application of Aquarius to River Basin Planning**
Wohl, Ellen E.	**Geosciences**	**USFS-RMRS**	**Aquatic, Riparian, & Wetland Ecosystem Assessment of the San Juan-GMUG Unit of the Forest Service**

UNIVERSITY OF COLORADO, BOULDER, COLORADO
Awards for June, 2003

Primary PI	Dept.	Sponsor	Title
Williams, Mark	**IAAR**	**CO Mountain College**	**Isotope Tracing Analysis for Leadville Mine Drainage Tunnel, California Gulch Superfund Site and Affected Areas**
Emery, William	**ACAR**	**Jet Propulsion Lab**	**A Prototype System for Improving Satellite-Derived Sea Surface Temperature Through Enhanced In-Situ Validation Measurements**
Evans, K. Franklin	PAOS	Jet Propulsion Lab	Analysis of Airborne Data for Validation of CLOUDSAT Ice Cloud Measurements
Jennings, Anne	**IAAR**	**NSF**	**Holocene Marine Climate Evolution and Variability from Multi-Proxy Analyses of High Resolution Shelf Cores in the Northern North Atlantic…**
Lubinski, David	IAAR	NSF	Reconstructing the Past 20,000 Years of Glacial and Sea-Level History for Severnaya Zemla, Russia…
Lynch, Amanda	**CIRES**	**NSF**	**An Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region**
Moore, Andrew	CIRES	NSF	Modular Ocean Data Assimilation
Hernandez, Mark	**CEAE**	**NSF**	**Reactive Saturation Behavior and Ozone Induced Coagulation of Microorganisms Used to Model Disinfection Processes**
Curry, Judith	ACAR	NSF	Applications of Aerosondes to Long-Term Measurements of the Atmosphere and Sea Ice Surface in the Beaufort/Chukchi Sector of the Arctic Ocean
Blanken, Peter	**Geography**	**NPS**	**Snow Drift Control by Vegetation in Rocky Mountain National Park**
Pak, Ronald	CEAE	Dept. of Education	Interdisciplinary Fellowship Program in Civil, Environmental and Architectural Engineering
Zagona, Edith	**CADSWES**	**DOA**	**Modeling COE-SW Division Flood Control Features and Algorithms**
Pitlick, John	**Geography**	**USFS**	**Sediment Transport Technology**

Across the Board is a newsletter devoted to keeping the water monitoring community apprised of the activities of the Methods and Data Comparability Board, a partnership of water quality experts from federal agencies, states, tribes, municipalities, industry, and private organizations. The Board, and its parent organization, the National Water Quality Monitoring Council (NWQMC) are subcommittees of the Advisory Committee on Water Information (ACWI). ACWI was chartered in 1997 under the Federal Advisory Committee Act (FACA). The National Council and the Methods Board are multi-agency committees charged with developing a voluntary, integrated, and nationwide water quality monitoring strategy. The current issue of *Across the Board* highlights specific workgroup activities in the areas of terrorism response, laboratory accreditation, the National Environmental Methods Index (NEMI), Water Quality Data Elements, laboratory comparability, and more. For information about *Across the Board*, contact Editor Dennis J. McChesney, Hydrologist, Monitoring and Assessment Branch, U.S. EPA Region 2, 2890 Woodbridge Ave., Edison, NJ 08837-3602; Voice (732) 321-6729, Fax (732) 321-6616. For information about how you can get involved with the Board, contact mdcbinfo@tetratech-ffx.com.

FACULTY PROFILE

CSU WELCOMES COLORADO NATIVE TO WATER FACULTY

In August 2003, Colorado State University welcomed Dr. Jeffrey D. Niemann as Assistant Professor and Faoro Professor of Water Resources to the Department of Civil Engineering. Born and raised in Colorado, Dr. Niemann received his Bachelor of Science degree in Civil Engineering from the University of Colorado, Boulder in 1993. He earned both his Masters of Science degree and his Ph.D. in Civil and Environmental Engineering from the Massachusetts Institute of Technology in Cambridge, Massachusetts in 1997 and 2001, respectively. Dr. Niemann is excited to be back in Colorado where, in his words, "Water is such a key issue and something that people are really interested in. It's a fun place to teach too, for that reason." Niemann is a Professional Engineer in Pennsylvania, where he worked from 2000 to 2003 as Assistant Professor at Pennsylvania State University, University Park.

Niemann's research interests focus on the interface between hydrology and geomorphology. His specialty is how topography influences the movement of water in the environment and how water influences the evolution of topography through time. Dr. Niemann illustrated, "Water shapes topography over a long period of time by the erosion of rivers, rain droplets impacting the ground surface, and numerous other processes that ultimately sculpt the landscape." Niemann said he is also interested in how the topography of the landscape today affects run-off, stream flow rates, and other practical water issues.

This fall, Niemann is teaching an undergraduate course in hydrology and is actively supervising graduate students' projects funded by a PECASE (Presidential Early Career Award for Scientists Engineers) grant awarded through the United States Army Research Office. One of his grad students is working to improve the description of the hydrologic processes in models that simulate the evolution of landscapes through time. Niemann said, "Our goal is to develop a better model of the hydrology that includes ground water flows, soil moisture levels, precipitation rates, and how they change, as well as their influence on erosion rates." Another one of Niemann's grad students is looking at the influence of topography on the moisture in the soil to discover where the Army can train on their land without degrading it and how they can efficiently route their vehicles on the topography during combat. Niemann stressed the value of this work by stating, "Topography impacts hydrology and hydrology influences many Army activities."

Jeffrey D. Niemann
Assistant Professor
and
Faoro Professor of
Water Resources

Department of
Civil Engineerng

Dr. Niemann, himself, is working on research that involves using digital data and modeling to simulate hydrologic processes in detail locally at a point and instantaneously in time. He then uses ideas from probability to integrate that description up to the whole region, which is the entire Illinois River Basin. He is also studying the geometric and "fractal" properties of river basins that have been generated in a laboratory and comparing those properties with observations of real river basins.

Being a Colorado native, Niemann said he has always enjoyed hiking and has been climbing "fourteeners" since his youth. Niemann also enjoys traveling and has been to an estimated 30 countries, many in Europe. Between his undergraduate and graduate degrees Dr. Niemann lived in Vienna, Austria for about fourteen months, where he met his wife while he worked at IIASA, The International Institute for Applied Systems Analysis. It was there, he said, that he started doing research and got the first taste of his career. During his time at IIASA, Dr. Niemann visited Cairo, Egypt and Nairobi, Kenya studying the Nile River and looking at climate change impacts. He has acted as a consultant in Nepal and Bangladesh, again looking at climate change impacts. Last summer, Dr. Niemann worked on a service project in Guatemala helping to develop water and wastewater systems for a rural orphanage campus.

FACULTY PROFILE

LYN KATHLENE NAMED DIRECTOR OF CSU'S PUBLIC POLICY INSTITUTE

Dr. Lyn Kathlene's vision for the CSU Public Policy Institute is to apply Colorado State's interdisciplinary strengths at the intersection of agriculture, the urban sector, and the environment. Lyn Kathlene brings strong credentials to her new position as Director of the Public Policy Institute: her educational background at the University of Colorado includes a B.A., magna cum laude, in Political Science and Environmental Conservation in 1985; a M.A. in Political Science and Public Policy Analysis in 1988; and a Ph.D. in 1991 in Political Science with a major field of Public Policy and Minor Fields in American Government and Empirical Methods.

"The role for the Public Policy Institute is to bring together expertise of the CSU faculty and research centers to address issues from a comprehensive policy perspective and make the results accessible to policymakers, stakeholders, and interested Colorado communities," says Kathlene. Activities of the Institute include:

- **White Papers** – From an interdisciplinary approach, developing white papers on pressing policy issues facing the State of Colorado.
- **Competitive Grant Projects** – Developing federal, state and foundation grants calling for interdisciplinary, policy-relevant applied research and outreach. This will involve bringing together faculty and groups across the CSU campus, partnering with other campuses, and collaborating with community-based groups and state agencies.
- **Community Capacity Building** – Providing services to communities to help them address their needs, including help with visioning and planning their future, developing leadership capacity, making informed decisions about economic development opportunities, and identifying their strengths and weaknesses.
- **Public Discourse on Important Policy Issues** – Serving as a facilitator to design campus and community forums focused on pressing policy issues at the local, state or national levels. "In essence," says Kathlene, "the Public Policy Institute work in this area provides support for a healthy, functioning democracy."

The Public Policy Institute's current activities include:

- Partners with Jefferson County Health and Human Services on a recently awarded HHS-Children's Bureau $2.5 million grant to create a county-wide Systems of Care. The Institute provided help with grant writing and will serve as a subcontractor to provide resource identification and evaluation services.
- Bringing together an interdisciplinary team of CSU faculty to create a white paper on plant pharmacology to address this contentious policy issue through the best of technical, social, and philosophical understandings.
- Working on a Community Mapping Project with the Tri-County Workforce Center to identify unknown community support systems and create collaborative social service partnerships.
- Applying for a Henry Luce Foundation grant to create a Water Resources Planning and Management option for graduate students at CSU. Robert Ward, Director of the CSU Water Center, partnered with the Institute in this effort. The grant would provide any graduate student studying in a water-oriented major coursework exposure to the political and policy process in which water policy and management occurs.
- Partnering with CSU centers and community agencies to apply for a National Institute of Mental Health $2 million dollar grant to create a Western Mountains Suicide Intervention Research Center. The Center will identify factors that contribute to risk of suicide and attempted suicide and those that contribute to resilience against suicide and attempted suicide in communities and among individuals.

Before coming to CSU, Kathlene served as Visiting Professor, Department of Political Science, at the University of Colo-

rado in 1991; as an Adjunct Professor of the Women's Studies Program from 1990-1998 and Assistant Professor, Department of Political Science 1990-1996 at Purdue University; Visiting Associate Professor/Researcher, Hubert H. Humphrey Institute of Public Affairs 1996-1998 at the University of Minnesota; Associate Professor, Department of Political Science 1996-1998 at Purdue University; Affiliated Faculty, Public Policy Center 1998-2003 at the University of Nebraska; and Associate Professor, Department of Political Science and Director of Public Policy Certificate Program 1998-2003 at the University of Nebraska.

Kathlene's numerous externally-funded research projects included serving as Co-chair, Community Services Implementation Plan Transportation Coalition funded by the Woods Charitable Fund, Inc.; serving as a member of the Research Team for Communities in Transition, commissioned and funded by the Nebraska State Legislature and the University of Nebraska; and as Principal investigator and Production Director, Nebraska Education Television Council for Higher Education Grant to create and produce a documentary film and multi-media interactive website entitled, "Community by Design,." The documentary was aired on Nebraska Educational TV in the summer of 2002 and subsequently distributed nationwide to PBS stations.

WATER SUPPLY

No major changes in conditions have occurred over the past months, with the entire state remaining in a below normal water supply situation. The SWSI values show the South Platte basin perhaps a bit better off than the other basins, although both stream flow and reservoir storage are below average in that basin, as they are in the rest of the state. No major changes in conditions have occurred over the past months, with the entire state remaining in a below normal water supply situation. The SWSI values show the South Platte basin perhaps a bit better off than the other basins, although both stream flow and reservoir storage are below average in that basin, as they are in the rest of the state. During August, rains did benefit some of the southern and western areas of the state, including the Rio Grande, San Juan/ Dolores, Gunnison, and Colorado basins. The Arkansas, South Platte, and Yampa/White basins were hot and dry. Reservoir levels dropped as stored water continued to be utilized across the state, helping those who had rights to that water.

The Surface Water Supply Index (SWSI) developed by the State Engineer's Office and the USDA Natural Resources Conservation Service is used as an indicator of mountain-based water supply conditions in the major river basins of the state. It is based on streamflow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, streamflow is the primary component in all basins except the South Platte basin, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for September 1, 2003, and reflect the conditions during the month of June.

Basin	9/1/03 SWSI Value	Change From Previous Month	Change From Previous Year
South Platte	+0.4	+0.7	+3.6
Arkansas	-2.2	-0.4	-0.3
Rio Grande	-3.2	+0.3	+0.4
Gunnison	-3.1	-0.4	+0.7
Colorado	-1.4	+0.8	+2.4
Yampa/White	-3.0	-1.0	+0.8
San Juan/Dolores	-2.2	+1.4	+1.9

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

WATER NEWS DIGEST

by Marian Flanagan

CONSERVATION

Water conflicts predicted

It is highly likely that Colorado's Front Range will see people in conflict over water by the year 2025. This is the conclusion of a U.S. Bureau of Reclamation report titled "Water 2025: Preventing Crises and Conflict in the West." Factors causing this situation, include explosive population growth, aging water storage and delivery systems and the allocation of more water than what exists. USBR recently concluded nine conferences that discussed the growing water crisis in the western states. The recent severe drought in Colorado is only a precursor to how bad things could get if nothing is done, the report says. There are a number of measures western states can take now to begin the process of bypassing bitter water conflicts in the future. Current thinking, to deal with such an event as it occurs, is known as crisis management and is not effective, the report concludes. A report detailing USBR conclusions from the conferences will be available soon.

Douglas County News Press / September 04, 2003

DROUGHT

Denver restrictions lifted Oct. 1; responsibility urged

The Denver Water Board has lifted lawn-watering restrictions effective Oct. 1, but it hopes homeowners won't let their sprinklers run wild. "We're saying water only as you need to," said board President Denise Maes. Cities up and down the Front Range were able to lift restrictions earlier than they expected this year, but Aurora will maintain some mandatory restrictions this fall and winter because its reservoirs remain just 58 percent full, according to spokeswoman Melissa Elliott. "We're not declaring this drought over," said Denver Water Manager Chips Barry. "It won't be over until our reservoirs are back to normal." Although reservoir levels are about 82 percent of capacity, board members said they would continue to monitor snow and rainfall in the coming months and would impose restrictions again if winter snows fail to materialize. The board also agreed to give people planting new grass seed three weeks to water them, effective today. For information, call Denver Water community liaison Joe Sloan at 303-628-6320, or e-mail him at: joseph.sloan@denverwater.org

Rocky Mountain News / September 4, 2003

ENDANGERED SPECIES

DOW's shocking way to count fish

Early in September a Colorado Division of Wildlife crew used electrical current to net fish for fish population estimates on the Roaring Fork between Carbondale and Glenwood Springs, according to Alan Czenkusch, an aquatic biologist for DOW. The fish were caught, measured, weighed, counted and got a hole punched in their tails before being released. The next day, the fish were caught again, measured, recorded and released again. "By recording the number of fish caught the second day that already had a hole punched in their tail, researchers can figure about how many fish are in the river," said Czenkusch. CDOW also gets an idea of how many browns, rainbows, and whitefish are in the river, and researchers also get to look at a large number of fish, which helps them get an idea of the average condition of each species. The Roaring Fork is a state-designated Gold Medal River. "For a river to gain and maintain gold medal status, it must have 60 pounds of trout per surface acre and at least a dozen fish per mile that top 14 inches in length," Czenkusch said.

Glenwood Springs Post Independent / September 4, 2003

Cedaredge company snares funds for endangered fish

Work will begin this month on a passageway that will open more territory to the endangered fish of the Colorado River. The U.S. Bureau of Reclamation HAS awarded a $4.5 million contract to build a concrete-lined passageway to benefit the Colorado pikeminnow, razorback sucker and bonytail chub. Construction should be completed by July. Work on another passageway for the fish is scheduled to begin on the Price-Stubb Dam in the winter 2004. Once both passages are open, long runs of the Colorado River all the way to Rifle will be reopened for the first time in nearly a century. The 17-foot-high Grand Valley dam, where water is pulled out of the river for the Highline Canal, has long been identified by the Upper Colorado River Endangered Fish Recovery Program as a major impediment to the natural range of the fish, in particular the pikeminnow and razorback. The passageway will contain a holding area similar to an existing passageway on the Gunnison River in which biologists will identify and study each fish, said Justyn Hock of the Bureau. A cover also will be built over the canal intake to prevent endangered fish from entering the Highline Canal, she said.

Grand Junction Daily Sentinel / September13, 2003

Feds release too much water flow from Ruedi Reservoir

Ruedi is one of four reservoirs in a coordinated program that ensures four endangered fish species in a 15-mile reach from Palisade to Grand Junction have adequate water year-round. The Bureau of Reclamation operates the reservoir. Water is released into the gold-medal, trout-laden Fryingpan to help improve river habitat and create breeding areas. On September 3, USBR had planned to gradually increase releases by 50 cubic feet per second to a maximum of 300 cfs. The extra water was needed due to a lack of rainfall and low river levels, said Eastern

Area Office Deputy Manager Dawn Wiedmeier. However, anglers on the Fryingpan River received an unpleasant surprise when the flow more than doubled, stranding some on the far bank and forcing others to swim across. "We were conducting maintenance work at the dam and had to switch the releases between the main outlet works and the auxiliary outlet works a couple of times," Wiedmeier said. "That caused an inadvertent release of 720 cfs over a couple hours." The accidental release had reportedly forced some fishermen in the Fryingpan River outside Basalt to scramble to shore. Wiedmeier said steps will be taken to prevent future accidental releases.

The Grand Junction Daily Sentinel / September 5, 2003

WATER QUALITY

Arkansas River pollution to be studied from plane

A cutting-edge, airborne data collection program will help the Colorado Geological Survey determine the extent of acidic minerals contaminating surface water in the upper Arkansas River basin. The goal is to gauge the extent of metals and minerals polluting the stream beds. The Arkansas River has both natural and mine-related contamination. Hyper-spectral remote sensing equipment will obtain fine detail that will allow experts to examine the minerals coating the stream beds, which will be seen as red and orange stains depending on the acid impact. The program is funded by the National Aeronautics and Space Administration as part of a program to advance the use of remote sensing technology by government agencies. The project team will include members of the Colorado Geological Survey, Spectral International Inc. of Arvada, Peters Geosciences of Golden and HENDCO Services of Nathrop. Assisting the project will be students from Leadville's Colorado Mountain College, who will take water samples to compare with the airborne data readings.

Pueblo Chieftain / September 5, 2003

Fish dying from fires

Last summer's Missionary Ridge Fire, last fall's rain and mudslides, and the prolonged drought have claimed thousands of salmon in Vallecito Reservoir. "This is the first time we've had a fish kill of this magnitude in Vallecito Reservoir," Division of Wildlife biologist Mike Japhet said. The sediment and debris that washed into the reservoir last fall and winter from fire-stripped hillsides contained a lot of organic matter. The bacteria resulting from its eventual decomposition resulted in a depletion of oxygen. Then, as the water level dropped, the temperature of the remaining water rose. "The shortage of oxygen and warm water did in the kokanee," Japhet said. "There was no oxygen if they went down to seek cooler water and if they moved closer to the surface where there was more oxygen, the water was too warm for them." According to Japhet, other fish in the reservoir – rainbow and brown trout, northern and walleyed pike, smallmouth bass and suckers – were virtually unaffected, since they live closer to the surface than the kokanee. Vallecito Reservoir is a kokanee breeding ground, producing fish to stock 25 lakes and reservoirs in other parts of the state. "The Durango hatchery will probably turn to Blue Mesa Reservoir, near Gunnison, for young kokanee," Japhet said. "Recent heavy rain in La Plata County probably did more good by bringing in an inflow of oxygenated water. Cooler weather will help, also. All that's needed now", Japhet said, "is heavy snow to replenish the reservoir next year."

Durango Herald / September 14, 2003

WATER RIGHTS

Lawsuit filed over Black Canyon river flows

Environmentalists have filed a federal lawsuit claiming an agreement to cut river flows through the Black Canyon of the Gunnison National Park violates the law. In April, Colorado officials penned an agreement with the federal government that gave up a senior water right for Gunnison River flows through the Black Canyon, a 2,000-foot-deep gorge in southwestern Colorado. Under the agreement, the canyon would get only peak springtime flows if all other demands on the Gunnison River were met first, including water claims from farmers, towns and hydroelectricity producers. Several environmental groups, including Western Resource Advocates and Trout Unlimited, allege in the lawsuit that the agreement violates provisions of the National Park Service Act, the 1999 Black Canyon Act, the Administrative Procedures Act and the National Environmental Policy Act. Department of Natural Resources Director Greg Walcher has described the Black Canyon water agreement as a realistic deal that found the best middle ground between ensuring water for users in the Gunnison Basin and protecting the canyon. A state water court judge in Montrose agreed to delay a decision on whether the state-federal agreement was acceptable under Colorado water law. The judge said he may put the matter off until the new disputes lodged in federal court are worked out, said Bart Miller, an attorney with Western Resource Advocates. "Hopefully, the federal case will help define the issue for the state court," Miller said.

Rocky Mountain News / September 6, 2003

Rancher feuds with feds over water, shoots at helicopter

Phoenix Rancher Fred Conway had been feuding with the U.S. Forest Service over water it had taken from his property to fight wildfires last year when he heard a helicopter near his stock pond again. So he grabbed his shotgun, drove an all-terrain vehicle across his pasture near Punkin Center and tried to wave the pilot away. But the pilot dropped the 240-gallon rubber bucket anyway and Conway fired at it. He now faces up to a year in jail and $7,000 in restitution if convicted of one count of interfering with the performance of a federal contractor. "It has a lot to do with water rights," Conway said. The USFS and the U.S. Attorney's Office declined to comment on the case, but Don Van Driel, group leader for fire and engineering for Tonto National Forest, said that Forest Service district rangers usually try to assess availability of private water before the fire season begins. It's unclear whether Conway has an inviolable right to the water in his stock pond. USFS didn't pay for water used last year, and Conway said he told officials not to come back until he was paid. He said he tried for months to get the Forest Service to compensate him for the water it drew from his spring-fed pond in 2002, but in frustration he finally called the Tonto National Forest headquarters and told a clerk the agency wasn't allowed to take any more water. But during the mop-up operations on the Picture fire, which

started June 17 and burned 12,500 acres northeast of Conway's ranch, a helicopter pilot saw a flare-up and headed toward Conway's pond. The pilot, Matt Conant, said he didn't notice Conway on the ground until the second volley of shotgun fire. "Personally, I kind of feel for the old guy," Conant said. "I'm not the guy trying to throw him in jail. But he still shouldn't be shooting at aircraft."

U.S. Water News Online / September 2003

WATER SUPPLY AND DEVELOPMENT

Sugarloaf line woes jeopardize city plans for water-driven power

A turbine station being built to carry up to 90 percent of Boulder's drinking water from the mountains has been nearly completed on the Lakewood Pipeline. But flaws in buried sections of the 8-mile pipeline could force the city to forgo harnessing the water to generate enough electricity for thousands of households. Last fall, the city announced that welds in sections of the newly installed pipeline under Sugarloaf Road didn't meet the city's specifications. Tests will determine whether the flawed sections can handle the water pressure necessary to generate hydroelectric power. If the sections can't safely withstand the pressure, the city faces a choice — replace or reinforce the buried section of piping, or leave the flawed sections in place but reduce the water pressure of the pipeline. Water dropping 1,800 feet from Lakewood Reservoir north of Nederland to the city's Betasso water treatment plant in the foothills west of Boulder arrives with so much speed and pressure that the city needs to slow it down so it doesn't damage treatment plant equipment. Reducing the water pressure could eliminate the potential to harness electrical power that Boulder plans to sell to Xcel Energy for up to $950,000 a year, money anticipated to help pay for the pipeline's construction.

Boulder Daily Camera / September 5, 2003

U.S. coming apart at the bridges and highways, schools and power grids, report says

America's infrastructure is coming apart at the seams, according to an analysis released by civil engineers, who warned about congested roadways, crumbling bridges and schools, and 2121 outdated drinking water systems. The American Society of Civil Engineers reported that the condition of 12 key categories of infrastructure showed little or no improvement — and in many cases worsened — in the past two years. In addition to population growth, the report cited a weak economy, limited federal programs, and the threat of terrorism — which diverted money to security — as contributing to the nation's deteriorating infrastructure. Overall, the engineers recommended an investment of $1.6 trillion over five years.

Boulder Daily Camera / Associated Press / September 5, 2003

$5 million to go to A-LP for security

As a result of the Sept. 11 terrorist attacks two years ago, the federal Bureau of Reclamation has added $5 million to the total cost of building the Animas-La Plata Project to pay for security measures. The cost of the 120,000-af. Ridges Basin Reservoir, pipelines and a pumping station has escalated to about $500 million, up about $162 million, or 48 percent, from original estimates. Some of that money is for security during construction; some is for security measures after it is built. State Sen. Jim Isgar, D-Hesperus, a member of the Animas-La Plata Water Conservancy District which may be responsible for operating the reservoir once it's completed, said he wonders how much extra operational money would be required of any agency that manages the project to properly maintain $5 million sunk into security measures.

Durango Herald Denver Bureau / September 12, 2003

California/Qualification Settlement Agreement

Four California water agencies have reached tentative agreement on a new Quantification Settlement Agreement (QSA) defining their rights to the waters of the Colorado River. Legislation required to implement papers of the agreement must still be passed,. A two-page summary outlines the major features and benefits for California, the Metropolitan Water District of Southern California (MWD), Coachella Valley Water District (CVWD), Imperial Irrigation District (IID), and San Diego County Water Authority (SDCWA). The QSA will buy California time to make necessary changes to reduce its Colorado River water use from as much as 5.2 million acre-feet (Maf) to its 4.4Maf apportionment.

California River Basin States agreed to a transitional period of 15 years given implementation of California's 4.4 Plan, to reduce its over-use of the river. The QSA is the basis for this plan. According to the outline, "The QSA assures California up to 75 years of stability in its Colorado River water supplies, and provides for a lasting peace among Colorado River users, not only in California, but also among the seven states that share the Colorado River." Further, "The QSA commits the state to a restoration path for the environmentally sensitive Salton Sea, as well as provides full mitigation for these water supply programs… The QSA allows renewed access to surplus water, when available, under the federal Interim Surplus Guideline. For 2004, urban Southern California would be entitled to receive 200,000 acre-feet of surplus water." Of note, restoration of the surplus guidelines will also benefit southern Nevada.

The new QSA major features include a 45-year term, renewable for another 30 years by mutual consent, and quantification of IID's and CVWD's respective water rights at 3.1Maf and 330,000af/year. Under the 75-year agreement, more than 30 Maf of water would move from "primarily agricultural use to primarily urban use."

Source: *Western State Water newsletter / September 5, 2003*

COLORADO STATE UNIVERSITY SEMINARS

Department	Web Site
Atmospheric Science	**http://www.atmos.colostate.edu/dept/seminar/**
Bioag. Sciences & Pest Mgmt.	**http://www.colostate.edu/depts/bspm/**
Biology	**http://www.biology.colostate.edu/seminars.htm**
Chemical Engr.	**http://www.engr.colostate.edu/cheme/seminars/**
Civil Engineering	**http://www.engr.colostate.edu/ce/outreach/index.shtml**
Environmental Health	**http://www.cvmbs.colostate.edu/cvmbs/thiswk.html**
Fishery & Wildlife Biology	**http://www.cnr.colostate.edu/FWB**
Forest, Rangeland, & Watershed Stewardship	**http://www.cnr.colostate.edu/frws/seminar/fall2003/schedule.html**
History	**http://www.colostate.edu/depts/hist/events.html**
Horticulture & Landscape Arch.	**http://hla.colostate.edu/grad/seminars.htm**
Natural Resources Ecology Lab	**http://www.nrel.colostate.edu/events/seminar.html**
Soil & Crop Sciences	**http://www.colostate.edu/Depts/SoilCrop/deptinfo.html (pending)**

For examples of water seminars being conducted on the Colorado State University campus, see below.

Department of Agricultural and Resource Economics & Department of Economics
U.S. Forest Service Rocky Mountain Research Station
FALL 2003 WEDNESDAY LUNCH SEMINAR SERIES
Meets 12:10-1:00 p.m. in 110 Animal Science Bldg., CSU. Pizza and soda served.

Oct. 22	Slow Manifold Dynamics of Optimal Reservoir Sedimentation Management	Ray Huffaker, Washington State University
Oct. 29	Economics and the National Environmental Policy Act (EISs) at EPA	Brad Crowder, USEPA
Nov. 5	Water and the Economics of Growth	Ed Barbier, Univ. of Wyoming
Nov. 12	Integrating Ecological, Social & Managerial Indicators of Quality into Carrying Capacity Decision Making	Peter Newman, NRRT, Colorado State University
Nov. 19	Remaining Challenges in Integrating Economics, Ecology and Psychology	George Peterson, US Forest Service

Department of Atmospheric Science
Fall Semester 2003 Colloquium Schedule
Department gathering from 3:00 to 5:00 p.m. in Atmospheric Science Classroom 101.

Oct. 23	Recent Developments in Data Assimilation at NCAR	Syed R. Rizvi, NCAR/MMM Division
Oct. 30	3D Clouds from Satellite Observations	Tomi Vukicevic, CIRA Colorado State University
Nov. 13	Radar, Rainfall, and Lightning Characteristics of Tropical Rainfall Systems According to TRMM	Steve Nesbitt, Dept. of Atmospheric Science, Colorado State University

ISSUES IN AGRICULTURE
A 300, Fall, 2003
The seminars are held from 10:00 a.m. to 10:50 a.m.in Room 201 Glover Bldg.

Oct. 21	A View From the High Plains/Mid-term	Mark Frasier
Nov. 11	Issues in Rural Colorado	Kent Holsinger
Nov. 13	The Role of Extension	Tom McBride
Dec. 4	Ag Land Preservation	C.J. Mucklow

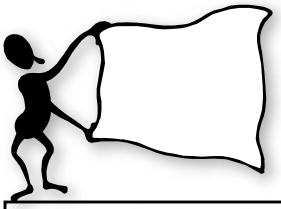
Department of Forest, Rangeland, and Watershed Stewardship (FRWS)
Open Departmental Seminar for Fall 2003

Oct. 23	Landscapes of the New West: Land-use Trends and a West That Works	Bill Travis, Dept. of Geography, University of Colorado
Oct. 30	Rising From the Ashes: The Future of Wilderness in the New West	Gret Aplet, Wilderness Society
Nov. 6	Ethics for a New West	Holmes Rolston, Dept. of Philosophy, Colorado State University
Nov. 13	Beauty and the West: The Region's Last Natural Resource	Rick Knight, Dept. of FRWS, Colorado State University
Nov. 20	If You Think the New West is Groovy, Wait Till You See the Next West	Evan Vlachos, Dept. of Sociology Colorado State University

GS592: FALL 2003 WATER RESOURCES SEMINAR

The seminar is held 4:10pm Tuesday afternoons in Room C-142, Clark Bldg. All interested faculty, students and off-campus water professionals are encouraged to attend and participate.

Date	Topic/Speaker
Oct. 21	"The Agricultural Water Conservation Morass: What Water Managers Should Know" - **Ray Huffaker**, Department of Agricultural and Resource Economics, Washington State University, Pullman, Washington (Dr. Huffaker's presentation is sponsored by the American Institute of Economics)
Oct. 28	"The Colorado Legislature and Future Water Managers" – **Rep. Bob McCluskey**, Representing District 52 of Larimer County in the Colorado Legislature.
Nov. 4	"Technical and Scientific Contributions in the Legal Environment of Water Courts." – **Veronica Sperling**, Water Attorney, Boulder
Nov. 11	"Water Leadership: Delph Carpenter and the Colorado River Compact" – **Dan Tyler**, Emeritus Professor, Department of History, Colorado State University and author of the new biography of Delph Carpenter, 'Father of the Colorado River Compact' (Dr. Tyler's presentation is sponsored by the American Institute of Economics)
Nov. 18	"The International Arena and New Water Managers" – **Michel Scoullos**, Senior Visiting Scholar, Onassis Foundation's University Seminars Program, Athens, Greece



CALLS FOR PAPERS

NATIONAL WATER QUALITY MONITORING COUNCIL -- WORKING TOGETHER FOR CLEAN WATER, May 17-20, 2004, Chattanooga, Tennessee. **Deadline: October 31, 2003.** Visit the Website at **http://www.nwqmc.org** for more information.

WATER RIGHTS AND RELATED WATER SUPPLY ISSUES -- A USCID Water Management Conference, October 13-16, 2004, Salt Lake City, Utah. **Deadline: November 1, 2003.** For information contact: U.S. Committee on Irrigation and Drainage, Phone 303/620-5430, FAX 303/620-5431, e-mail stephens@uscid.org. Website: **http://www.uscid.org**.

ALLOCATING WATER: ECONOMICS AND THE ENVIRONMENT, July 20-22, 2004 Portland, Oregon. – **Deadline: December 1, 2003.** For information contact: Gary Johnson, Idaho Water Resources Research Institute, 208/282-7985, e-mail Johnson@if.uidaho.edu or Ari Michelsen, Texas A&M University, 915/859-9111, e-mail a-michelsen@tamu.edu. Website: **http://www.uwin.siu.edu/ucowr**.

MEETINGS

DARCA ANNOUNCES 2ND ANNUAL CONVENTION

The Ditch & Reservoir Company Alliance, DARCA, is pleased to announce its Second Annual Convention to be held February 26-27 at the University of Northern Colorado in Greeley. Speakers include Justice Gregory Hobbs of the Colorado Supreme Court, John Van Sciver of the Colorado Water Conservation Board, and Nolan Doesken of Colorado State University. Other speakers will address topics such as the financial viability of ditch companies, a review of drowning risks, and a paperless approach to ditch company stock certificates and transfers. DARCA, a nonprofit organization, was incorporated two years ago. Its purpose is to serve as a resource for mutual ditch and reservoir companies, irrigation districts, and water user and private ditch associations in Colorado. DARCA is based in Longmont.

Registration begins soon. For details, visit www.darca.org or contact: Karen Rademacher, 970/535-0690, karen@darca.org.

WELLS – ARE THEY A DEPENDABLE WATER SUPPLY?

Forthcoming Educational Programs – December 4, 2003

The Colorado Water Well Contractors Association (CWWCA) and the Colorado Division of Water Resources are sponsoring a daylong educational program for the East Denver Metro area on December 4, 2003. The emphasis will be on small capacity wells serving domestic or household purposes. The meetings will provide a forum for well drillers, pump installers, engineers, geologists, realtors, planners, sanitarians, attorneys and Division of Water Resources staff to discuss updated information on obtaining well permits, constructing wells in compliance with current rules and satisfying local county rules on the use of wells and septic systems. Speakers will describe where and how to obtain well permits and data for existing wells. The limits on water usage to comply with permit and statutory conditions will be reviewed. Emphasis will be placed on proper well construction and well testing to develop a dependable supply. Local counties permit the septic systems and that may impact where wells can be drilled. Testing of wells for water quality will be discussed.

The meeting will be informal. Questions from the attendees will be encouraged. The meeting will present an opportunity to make valuable future contacts. A brochure containing program details and registration instructions will be available by mid October. Attendance will be limited to 150 registrants on a first come first served basis. The meetings will qualify for continuing education credits for realtors, appraisers, water treatment plant operators and lawyers. Mark your calendars now!

For further information contact CWWCA at 8674 West Warren Drive, Lakewood, CO, 80227, phone 303-986-5035, fax 303-986-8375, e-mail office@cwwca.org.

COLORADO WATER CONGRESS SCHEDULE

Workshops are held in the Colorado Water Congress Conference Room, 1580 Logan Street, Suite 400, Denver, Colorado. CLE credits are typically given for these workshops.

- Revisiting Colorado Water Law Issues will be held on Friday, November 7, 2003
  The School of Hard Knocks in Water Law taught by experts about 70 years young.
- Workshop on Groundwater will be held on Friday, November 14, 2003.

The Colorado Water Congress 46th Annual Convention will be held January 29-30, 2004 at the Holiday Inn Northglenn.
The 2004 Summer Convention will be at the Silver Tree Resort in Snowmass Village, Colorado -- August 26-27, 2004.

See the Colorado Water Congress Web site at **http://www.cowatercongress.org** or contact Dick MacRavey, Executive Director at Phone: (303) 837-0812, Fax: (303) 837-1607, E-Mail: macravey@cowatercongress.org.

CALENDAR

Oct. 22-23	14th ANNUAL SOUTH PLATTE FORUM, PLANNING FOR UNCERTAINTY, Longmont, CO. Contact Jennifer Brown at (970) 213-1618, jennifer@jjbrown.com. Website: **http://southplatte.jjbrown.com/**.
Oct. 22-24	TAMARISK SYMPOSIUM, Grand Junction, CO. For information call 303/492-1501.
Oct. 28-30	SEEPAGE FOR EARTH DAMS, Boulder, CO. Contact: Assoc. of State Dam Safety Officials, Inc. Phone 859/257-5140, FAX 859/323-1958, e-mail info@damsafety.org. Website: **http://www.damsafety.org**.
Oct. 29-30	GETTING IT DONE: THE ROLE OF TMDL IMPLEMENTATION IN WATERSHED RESTORATION, Stevenson, WA. Contact: Kelly Newell at 509/335-5531, E-mail watercenter@wsu.edu. Website: **http://www.swwrc.wsu.edu/conference2003.**
Nov. 3-7	7TH BIENNIAL CONFERENCE, INTEGRATING SCIENCE AND MANAGEMENT ON THE COLORADO PLATEAU, NORTHERN ARIZONA UNIVERSITY, FLAGSTAFF, AZ. Contact: David Mattson, Phone 928/556-7466 x245, David.Mattson@nau.edu; David Fiss, Phone 928/523-7087, David.Fiss@nau.edu. Website: **http://www.usgs.nau.edu/conf2003/**.
Nov. 4-8	NALMS 2003: PROTECTING OUR LAKES' LEGACY, 23rd International Symposium, Mashantucket, Ct. Co-Chairs: Amy Smagula, Phone 603/271-2248, E-mail asmagula@des.state.nh.us; Neil Kamman, Phone 802/241-3795, E-mail neilk@dec.anr.state.vt.us.
Nov. 7	REVISITING COLORADO WATER LAW ISSUES, Denver, CO. See Colorado Water Congress Website at **www.cowatercongress.org** or contact Dick MacRavey at Phone 303/837-0812, FAX 303/837-1607, E-mail macravey@cowatercongress.org.
Nov. 14	WORKSHOP ON GROUNDWATER, Denver, CO. See Colorado Water Congress Website at **www.cowatercongress.org** or contact Dick MacRavey at Phone 303/837-0812, FAX 303/837-1607, E-mail macravey@cowatercongress.org.
Nov. 16-18	116TH ANNUAL MEETING, NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES, New Orleans, LA. Contact NASULGC at Phone 202/478-6050, FAX 202/478-6046, E-mail am03@nasulgc.org, Website at **http://www.nasulgc.org/am2003**.
Nov. 17	APPLYING THE ASCE STANDARDIZED REFERENCE EVAPOTRANSPIRATION EQUATIONS, San Diego, CA. Organized by USCID. For information and to register, go to **http://www.uscid.org/evap.html**. Contact: Larry Stephens, E-mail stephens@uscid.org.
Dec. 4	WELLS -- ARE THEY A DEPENDABLE WATER SUPPLY? For further information contact CWWCA at 8674 West Warren Drive, Lakewood, CO, 80227, phone 303-986-5035, fax 303-986-8375, e-mail office@cwwca.org.
2004	
Jan. 29-30	COLORADO WATER CONGRESS ANNUAL CONVENTION, Northglenn, CO. See Colorado Water Congress Website at **www.cowatercongress.org** or contact Dick MacRavey at Phone 303/837-0812, FAX 303/837-1607, E-mail macravey@cowatercongress.org.
Feb. 25-26	APPLICATION OF TECHNOLOGY TO WATER MEASUREMENT AND MANAGEMENT, Scottsdale, AZ. Contact USCID by phone at 303/628-5430 or e-mail Larry Stephens at stephens@uscid.org Final program and online registration form will be available this fall on the USCID website -- **www.uscid.org**.
Feb. 26-27	2nd Annual Convention, Ditch & Reservoir Company Alliance (DARCA), Greeley, CO. Registration begins soon. For details, visit www.darca.org or contact: Karen Rademacher, 970/535-0690, karen@darca.org.

Colorado State University
Colorado Water Resources Research Institute
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