



COLORADO WATER

*Newsletter of the Water Center
at Colorado State University*

AUGUST 2000

INSIDE:

*New Water Plaza
celebrates CSU's
rich water heritage*

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(Photo courtesy of John Eisele, Photographic Services, CSU)

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EDITORIAL

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**CSU WATER CENTER/CWRRI MOVES --
LOCATION CLOSER TO NEW CSU WATER PLAZA**

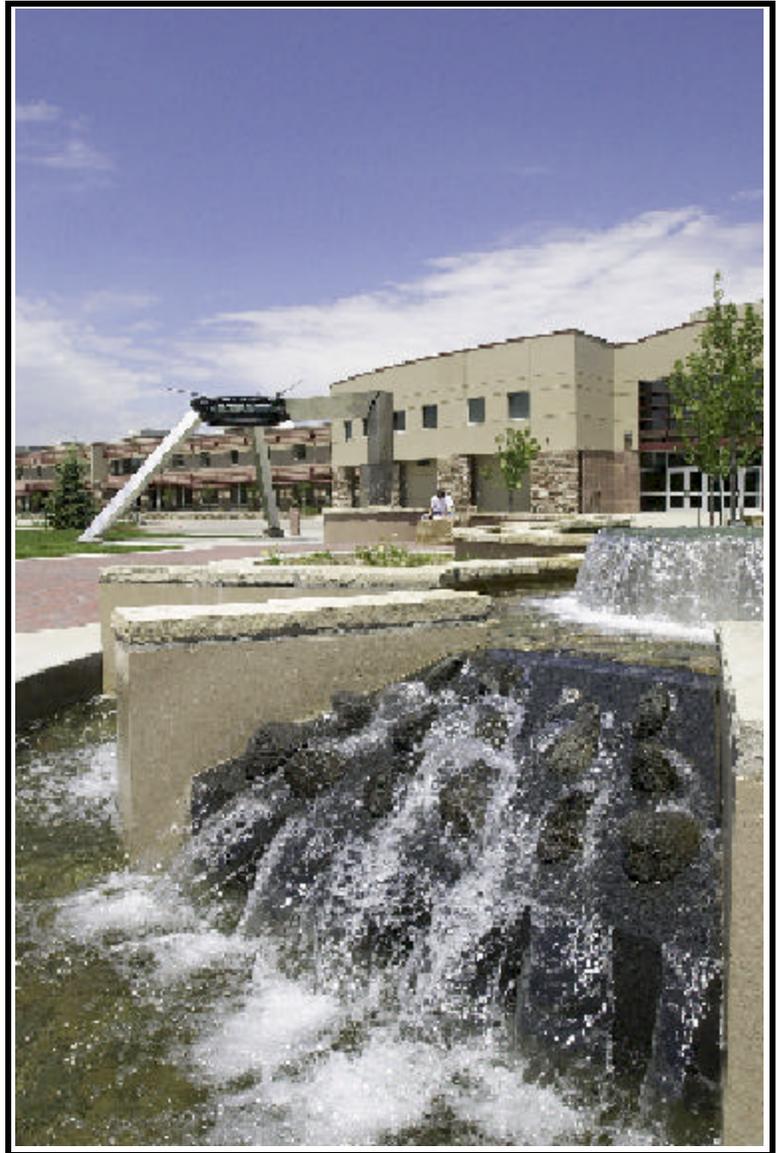
Editorial by Robert C. Ward, Director

Colorado State University will dedicate its newly remodeled Engineering Building October 13, 2000. The remodeling included the creation of a Water Plaza to acknowledge CSU's long and rich 'water tradition.' The Water Plaza is located in a quadrangle created by the Natural Resources building on the south, the Glover Building on the West, the Engineering/Physics Building to the North, and the Fishery and Wildlife Biology Building to the East. These buildings, and those nearby, house a large majority of CSU's 100-plus 'water' faculty.

The CSU Water Center and Colorado Water Resources Research Institute will move to new offices in Room 102, E-Wing, Engineering Building – and just off the Water Plaza, on August 9. The new location brings the current programmatic focus of CSU's water expertise, the Water Center, in close proximity to the physical representation of CSU's water tradition, the Plaza. The CSU Water Center will also be located much closer to the students and faculty that are critical to the water education and research coordination mission of the Center.

On page 4 of this issue is an article describing the artistic representations contained in the design of the Plaza's water feature and landscaping. The features of the Plaza symbolize the use of water by humans and the ecosystem. Its flowing water makes the area a very pleasant place to sit and reflect upon the efforts Colorado citizens have devoted over the years to develop and manage Colorado's limited water resources.

Please stop by the CSU campus and visit the new Water Plaza and the new offices of the CSU Water Center and Colorado Water Resources Research Institute. At a time



*Colorado State University's New
Water Plaza*

when water management in Colorado increasingly is challenged by drought, floods, water quality questions, ecosystem needs, and growing populations, it is encouraging to see Colorado's higher education system recognize its long and rich connections with the water management needs of Colorado's water users and managers.

FEATURE

SYMBOLISM CHARACTERIZES CSU'S NEW WATER PLAZA

by Emile Hall

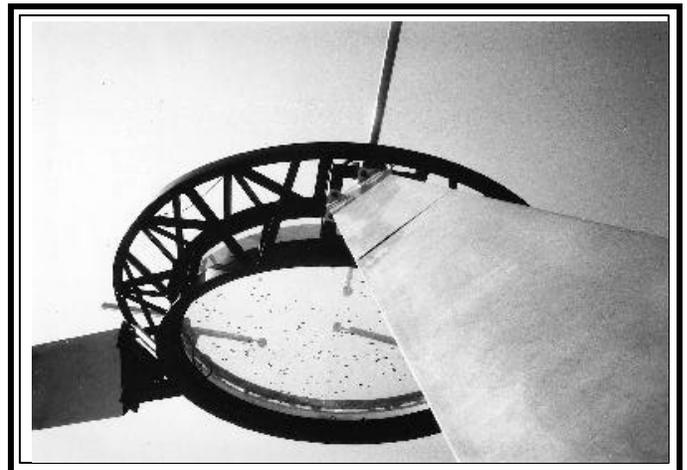
Look at the recently completed fountain in the Water Plaza and you will see...

- ◆ An artistic representation of the hydrologic cycle
 - ◆ A depiction of the systems of water use from collection and storage to distribution and recharge
 - ◆ A tribute to the rich water science and policy history at CSU
 - ◆ A common symbol for a common study, situated at the heart of Engineering, Natural Resources, Forestry and Fishery and Wildlife Biology

Just as the hydrologic cycle is continuous and unifies various forms of the landscape, the study of water unifies various departments at Colorado State University. In fact, CSU has well over 100 faculty who apply their disciplines to water; offers more than 150 upper-level courses that deal with water; and operates 16 centers and institutes that involve dimensions of water. In the past some of the great thinkers in water studied and taught courses at CSU. The desire to celebrate CSU's past, present and future activities relative to water instigated the development of a central water feature on campus — The Water Plaza.

The highest point of the fountain, which artist William Jackson Maxwell entitled the "Water Drum," serves as the water source for the fountain and thus represents the source for water, or the sky. Some have suggested that the structure resembles the mountains and the source could be interpreted as Colorado's glaciers and high mountains. Either way, the water drum as the sky or the glaciers symbolizes the source of water.

The artist intended for the drum sticks that create the wave patterns, another feature of the Water Drum, to represent the various departments engaging in water related activities at CSU. One of the original architects for the Plaza also suggested that the drum is linked to the Native American tradition of the rain dance, reflecting aspects of Colorado's history and climate. The drum also demonstrates some of the physical features of water such as wave patterns, the ability to create a lens and the rainbow color effect. The water from the source then rains into the meandering stream.



The Water Drum

The concrete streambed is representative of the complex structures of water transportation around Colorado. This meandering concrete trough symbolizes Colorado's various ditch companies and major water projects, such as the Colorado-Big Thompson project. At the same time it displays native cobbles found in local streams and rivers, a reminder of the importance of natural resources. The combination represents the changes in water resources management over the past century. Studies once focused predominantly on supply development and traditional engineering approaches are diversifying to studies of the affects of our management choices on the environment. Working toward a sustainable balance between necessary structures of water development (the concrete ditch) and the natural world (the cobbles) is one current challenge in water resources management.

The stream leads to a metaphorical dam and storage element of the design. Here the flow is augmented by water bubbling up from the circular, stainless steel water basin at the end of the stream. The basin represents another source of water - the ground. The stored water exits through a Parshall Flume or one of three 'weirs'.

An example of the Parshall Flume, a device for measuring water developed in 1925 by CSU professor Ralph Parshall, is displayed in the fountain. The flume provides a practical method of measuring the discharge of streams and ditches and is still used in all parts of the world. "Although Parshall and his colleagues made many other contributions, the flume that bears his name resulted in more favorable attention to the irrigation program at the College than any other single research development." (Corey, No Date) Along with visually depicting an example of CSU's water history, this portion of the fountain exhibits three 'weirs' illustrating different water effects.

One is an artistic example of a spillway with energy dissipaters. Another depicts sheet flow. The third is a series of steps. The water is then collected below and recycled through the system to represent the water cycle in nature.

The large circular designs and broad strips in the concrete walkways depict the aerial view of

Colorado's landscape, a result of various irrigation patterns on agricultural lands. CSU, as Colorado's land grant college, began to focus on irrigation engineering through the influence of Elwood Mead, for whom Lake Mead is named. Mead established the nation's first program of study in irrigation engineering at CSU in 1884 and eventually became the nation's most famous irrigation engineer. Other water-related agricultural contributions include work done in the early 1900s at Akron, Colorado to determine the water requirements of various crop plants and weeds. Two well-known agronomy papers were published from this work: one by Briggs and Shantz (1916) and the other by Shantz and



The Metaphorical Stream



The Parshall Flume

program within the Earth Resources Department originated within what was the Forestry and Range Management Department in 1958. However, Colorado State University's interest in the subject of watershed management dates back to 1947 when Dr. H.G. Wilm offered the first collegiate course in watershed management. (Dils, No Date) Along with Natural Resources, the Forestry, Fishery and Wildlife Biology and Engineering Buildings all surround the Plaza.

Piemeisel (1927). New questions related to irrigation and water requirements are the subjects of investigation within several departments at CSU today.

The Plaza is surrounded by many of the disciplines related to water. The flagship program in watershed education is housed at the south end of the Water Plaza. The watershed science

The elements of the Water Plaza represent the continuous hydrologic cycle, Colorado's man-made systems of water

use, and the rich past, present and future of water studies at CSU.

Sources:

Corey, A.T. No Date. Engineering for Agriculture at Colorado State University. Department of Civil Engineering, Colorado State University.

Dils, Bob and Jim Meiman. No Date. Early History of the Watershed Science Program at Colorado State University. Department of Earth Resources, Colorado State University.

Thanks to Gerry Bomotti, Tom Kehler, Joe McGrane, Dr. Dan Smith and Dr. Freeman Smith for their contributions to this article.

RESEARCH



BOULDER RESERVOIR – An Important Water Resource

Boulder Reservoir Watershed Conditions—Boulder Reservoir, part of the Colorado-Big Thompson and Windy Gap Water Projects, is a multi-use reservoir used for drinking water, irrigation and recreation. It also currently supplies 20 percent of Boulder's drinking water. At this time, Boulder Reservoir is mesotrophic, which means the reservoir is in fairly good condition. The goals of the Boulder Reservoir Watershed monitoring program are to develop baseline trends, evaluate point and non-point sources of pollution, determine when change has occurred and make recommendations to preserve water quality and Boulder Reservoir trophic condition.

Increased nutrient loading, especially phosphorus, from land use within the Boulder Reservoir Watershed and along the Boulder Feeder Canal (BFC) will accelerate the eutrophication (rich in nutrients; lack of oxygen) process. With phosphorus being the most important nutrient for phytoplankton growth in the reservoir, it is important to look at the phosphorus loading rates. The greatest total phosphorus contributions are from the BFC, due to the large annual flow from the canal vs. the small western tributaries. During the initial 1995 Farmer's Ditch spring start-up flush, a high total phosphorus number was observed, indicating that spring ditch and canal start-up flows contribute high avoidable amounts of total phosphorus and sediment to Boulder Reservoir.

It is good management practice to divert, if possible, these initial ditch cleaning flows around Boulder Reservoir, an opportunity available with Farmer's Ditch but not with the feeder canal. The highest dissolved ortho phosphorus loading rates are also observed from the canal, due to the fact that 80 to 90 percent of the flow into the reservoir is

from the BFC. It is very important to track available ortho phosphorus throughout the year in all tributaries, because this variable appears to control the phytoplankton biomass and trophic condition of Boulder Reservoir at any point in time.

Dr. Paul Kugrens of CSU's Biology Department performed monthly phytoplankton counts from November 1993 through 1998. During this time period 89 different species were observed. Greens dominated (66 percent) followed by bluegreens (31.5 percent), golden browns (1.6 percent) and Cryptomonads (0.9 percent). The bluegreen algae appeared in Boulder Reservoir in 1996 and has been detected consistently since that time. Five of the eight major phytoplankton population peaks from 1993 through 1998 have occurred in the fall. The other large peaks were observed in late July, early March and June.

Total organic carbon (TOC) values averaged 3.7 mg/L from 1994 through 1999, with peaks as high as 5.2 mg/L during June 1995. This increase in reservoir TOC may be related to the 1995 spring runoff flooding. After June 1995, values gradually dropped back down below 3.7 mg/L. Fecal coliform bacteria counts in the surface and bottom reservoir samples near the plant intake structure show higher numbers at the bottom. The last two summer bottom counts were consistently above 10 cfu/100mls from July through November. The EPA ICR considers counts above 20 a contaminated drinking water source.

Six summer monthly counts over the last two years have exceeded this limit. Fecal coliform bacteria are not a health concern because they are easily disinfected at the water plant; however, they are an indication of animal or human

fecal contamination possibly containing protozoans and viruses which are resistant to disinfection and can't always be removed 100 percent of the time at the water plant.

BFC Flows and Water Quality—BFC flows are very important to Boulder Reservoir for two reasons: they dilute total dissolved solids within the reservoir; and help circulate the reservoir during the summer months, preventing anoxic

conditions near bottom sediments. In an annual basis total dissolved solids (TDS) peak in April prior to the BFC input, and are at their lowest levels in October after the low TDS canal water deliveries are complete. High summer canal flows through the reservoir mean lower TDS levels prior to the winter canal shutdown. Canal flows also help circulate the reservoir, maintaining dissolved oxygen near the sediments.

RECOMMENDATIONS FOR WATER QUALITY PROTECTION

- ◆ ***Canal and reservoir operational procedures need to be formalized to maintain the lowest possible dissolved solids and adequate dissolved oxygen levels in the reservoir.***
- ◆ ***Wetlands constructed along Dry Creek would help remove nutrients. Nutrients would be consumed and converted to TOC prior to entering the reservoir and would not be available for TOC production within the reservoir, thus reducing disinfections by-product precursors.***
- ◆ ***Divert the Farmer's Ditch spring-cleaning flush around Boulder Reservoir in order to avoid unnecessary high phosphorus and sediment loads.***
- ◆ ***Encourage open-space managers to plant grass-hay crops rather than annuals. Grass-hay require less maintenance (e.g., pesticides, fertilizers, water and tilling).***
- ◆ ***Post the BFC and Farmer's Ditch as part of the Boulder Reservoir drinking water supply watershed to discourage dumping.***
- ◆ ***Construct BFC sedimentation basins prior to the reservoir to accommodate the spring-cleaning flush and provide a way to isolate accidental spills.***
- ◆ ***Divert all 43 stormwater outfalls over or under the Boulder Feeder Canal. This would reduce storm water nutrient, sediment and microbiological loads to the reservoir. Work with county planners and developers to ensure that storm water runoff issues along the canal are addressed early on in the planning process.***
- ◆ ***Inform people recreating in the Boulder Reservoir Watershed that the reservoir is a major drinking water supply for Boulder.***
- ◆ ***Inform supporters of the Boulder Feeder Canal trail system of the increased water quality risks to this very important City of Boulder water supply.***
- ◆ ***Continue to evaluate multi-use recreational activities on Boulder Reservoir to predict future impacts.***



WATER QUANTITY AND QUALITY MANAGEMENT AND POLICY IN WESTERN IRRIGATED AGRICULTURE

by

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Department of Agricultural and Resource Economics, Colorado State University

COLORADO AES PROJECT 678

The overall objectives of the project are to:

Measure the economic costs and benefits of alternative means for firms to meet state, regional, and national goals for balancing the allocation and quality of water supplies under existing and emerging technologies available to them.

Evaluate alternative policy instruments available to government entities to achieve state, regional, and national goals for water utilization in private and public uses.

The development of water resources has played a vital role throughout the history of agriculture in the western United States. To successfully grow most crops, irrigation is needed to augment the precipitation received in this arid to semi-arid region. In Colorado today, over 3 million of the 11 million acres of cropland are irrigated. The water resources that service these irrigated acres once seemed abundant, but are now viewed as increasingly scarce. Production agriculture now accounts for about 90 percent of the consumptive use of water in Colorado. Further, irrigated agriculture has been implicated as a source of non-point pollution of ground and surface water resources. The documented effects of irrigated agriculture on water quantity and quality have made irrigation management an important issue, both from the producer and societal perspective.

Historically, the allocation of water in Colorado

has been primarily an agricultural problem. However, as the State's economy continues to diversify and the demand for water changes, the value of water in historic uses relative to new uses also changes. With developed water supplies being fully allocated in most basins and potential new supplies becoming increasingly difficult to obtain, increased demands, such as expanding municipal use, increasingly are being met with transfer from some other use. Water requirements for endangered species loom as a new potential water demand. River corridor restoration to supply amenity and natural values has also increased in emphasis in Colorado. Because of the relative values in use, agriculture has become a primary source for such transfers.

The interaction of agricultural water policies, commodity prices and non-point source pollution is an important area for study. Policy makers and producers alike are struggling to find solutions to these problems that are effective, profitable and socially acceptable. Solutions are necessarily difficult to identify, because it is difficult to predict economic and environmental outcomes of the complex biophysical systems and to integrate these factors with social concerns.

This project has developed and applied economic techniques to identify opportunities for increasing the benefits to the citizens of Colorado from: (a) using existing water supplies more efficiently and (b) maintaining adequate quality of those water resources. Economic analysis can identify opportunities that will be profitable for farmers while protecting the public interest. Since much of the value of water is not reflected in markets, the economic analysis also involves "shadow pricing" private and public values of water in a myriad of uses. In this way the total economic value of the water in alternative uses can be compared in a commensurate fashion.

A number of studies have been conducted under the umbrella of this project, in many cases leveraging on other AES projects. A sampling of these studies includes the following:

A dynamic optimization model of center-pivot irrigation in north-eastern Colorado was used to evaluate management of water and nitrogen to maximize economic returns and minimize groundwater leaching. The impacts of several policy options were reviewed with policies that restrict water use substantially superior to policies that limited nitrogen fertilizer or crop output.



A study of center pivot-irrigation was published, which examined how uniformity of irrigation applications affects optimal water application rates in northeastern Colorado. A dynamic optimization model showed that profit is maximized in non-uniform systems by applying water above “agronomic rates, which can lead to excessive nitrate

leaching into the groundwater. Failure to account for non-uniform application underestimates nitrate leaching. Investments in technologies that make irrigation more uniform can reduce leaching and conserve water by better matching application rates to crop needs and soil type.

A statewide mail survey was conducted with Colorado irrigators to determine how they make irrigation decisions. Statistical summaries indicate that few producers use the water-saving technologies available to them. Statistical summaries indicated that water source, region, crop, and other site and operator characteristics greatly influence adoption. In most cases, less than 50 percent of farmers have adopted improved technologies. These results are being used by campus researchers in an effort to better match research and extension efforts to clientele needs.

Analytical Hierarchy Process (AHP) and Conjoint analysis were applied to determine how irrigators weighed economic and environmental tradeoffs when investing in irrigation systems. Farmers in northeast Colorado were found to place the most weight on profit, but they also place a heavy weight on risk and soil conservation.

A contingent valuation study was conducted on the value of removing dams to increase anadromous fish populations in the Pacific Northwest. Surveys were designed and mailed to households as part of a study for the U.S. Army Corps of Engineers on the economic benefits of removing four dams on the Lower Snake River to recovery threatened and endangered salmon.

Households in the South Platte Basin were surveyed for their willingness to pay a higher water bill for increasing instream flow, water quality and increasing ecological integrity of the South Platte River. The average value

was \$21 per month. Comparison of this annual value for all households living in counties adjacent to the South Platte River showed benefits greater than the average cost to purchase water and restore riparian vegetation.

With the support of a cooperative SARE grant, interviews of feedlot managers began to establish potential impacts of alternatives in manure management on water quality.



Colorado's South Platte River

An economic conjunctive use model was constructed for irrigated portions of the San Luis Valley in Colorado. The model was used to identify and evaluate management alternatives for coping with severe and sustained in the Rio Grande basin. Results underscore the importance of the buffering provided by the shallow aquifer in supporting irrigated agriculture.

A study is currently underway to evaluate alternatives to meet instream flow demands for endangered species in the central Platte basin. Alternatives have been screened and categorized. Hydrologic and economic modeling efforts are nearing completion.

For a detailed summary of accomplishments from this project and a complete listing of publications, refer to the Colorado Agricultural Experiment Station web page at <http://www.colostate.edu/Depts/AES>.



SELLING XERISCAPE

by Robert Cox,

Colorado State University Cooperative Extension
Horticulture Agent, Jefferson County



Discussing the benefits of Xeriscape with Colorado water professionals may be a classic case of preaching to the choir. However, while the Xeriscape concept is recognized by most

Coloradans, it often is misunderstood and is not yet widely embraced. Those who have utilized Xeriscape on their property likely already have some understanding of water as a natural resource and its importance to Colorado, a land where life is written in water.

Twenty years ago, representatives from Denver Water, Colorado Nursery Association, Associated Landscape Contractors of Colorado, Colorado State Cooperative Extension and the Rocky Mountain Sod Growers Association met to set goals to reduce domestic water use to maintain landscapes. From these meetings came the newly-coined term Xeriscape. In the ensuing 20 years, Xeriscape went national — there are active organizations promoting Xeriscape in virtually every state.

Recent growth in Colorado has municipalities scrambling to ensure future water supplies. Drought task forces have been established to determine how agriculture and horticulture industries should cope with an extended drought. Promoting Xeriscape and similar water conservation programs is one key to coping. However, Xeriscape may be a hard sell: the public sees snow on the mountains and reservoirs full of stored water. This year, reservoirs may be drawn down fast because of below-normal snow pack and above-normal temperatures. Extended drought, heat and little winter snows raise prospects for water shortages this summer and next.

Some past efforts by the public to conserve water through Xeriscape may have failed to convince observers because the concept wasn't employed properly. For example, a homeowner who installed a Xeriscape and then failed to maintain it at all sent the message to neighbors, "Xeriscape looks too wild and it's mostly weeds."

Homeowners who took out all of their plants and turfgrass, replacing them with plastic, gravel and a yucca — actually creating a zero-scape — sent the message to neighbors, "Xeriscape is uninteresting and makes your house too hot." These rock landscapes have another disadvantage: any rainfall was shunted by impermeable plastic into the street instead of soaking into the soil. Poor Xeriscape efforts like these have, in some cases, lead to community opposition to plants that don't require much water. For example, there are homeowner's associations with covenants forbidding anything but Kentucky bluegrass in front yards.



Unfortunately, the public may view Xeriscape only as water conservation strategy that potentially lowers water bills. Perhaps we must keep reminding them of other monetary, time and environmental benefits. For example, Realtors affirm that an attractive landscape or Xeriscape can add 10-18 percent to the value of a home. Xeriscapes generally require less pruning, pesticide application, fertilization and mowing than conventional landscapes.

One of the seven principles of Xeriscape is the appropriate use of turfgrass in the landscape, because turfgrass usually is the most water-consumptive element of a Xeriscape. Areas with a steep slope or other features that make turfgrass maintenance difficult should be planted with trees, shrubs, perennials or ground covers instead.

Another principle of Xeriscape is to use mulches. An organic mulch of wood chips, for example, helps retain soil moisture so plants need water less often. An organic





mulch also will keep the ground cooler and promote denser root systems underneath the soil surface. As it decomposes, it improves soil texture and water permeability. Mulches can, in effect, make less xeric plants part of a Xeriscape.

Colorado State Cooperative Extension has seven fact sheets that discuss Xeriscape and provide plant lists:

- No. 7.228 *Xeriscaping: creative landscaping*,
- No. 7.229 *Xeriscaping: trees and shrubs*,
- No. 7.230 *Xeriscaping: ground cover plants*,
- No. 7.231 *Xeriscaping: garden flowers*,
- No. 7.232 *ornamental grasses*,
- No. 7.233 *Wildflowers in Colorado*, and
- No. 7.234 *Xeriscaping: retrofit your yard*.

More information about low-water plants is available through Planttalk Colorado, a 24-hour phone and Web site service sponsored by Colorado State Cooperative Extension, Denver Botanic Gardens and the Green Industries of Colorado. The fact sheets and information about Planttalk Colorado are available by calling or visiting your local Colorado State Cooperative Extension office, usually listed in the county government section of the local phone book.

Some plants suitable for a Xeriscape are:

Apacheplume (*Fallugia paradoxa*) — This native shrub of the rose family will grow to about 6 ft. high and wide. It has attractive white, 5-petaled flowers from June - August, followed by feathery, pink-plumed fruits that give the shrub its common name. Stems have white, shreddy bark. Leaves are very small and divided into 5 lobes. Apacheplume is very drought-tolerant when established. It should be planted in full sun, in a well-drained soil, and never planted in bluegrass, fescue or rye lawns, as these grasses require more water than Apacheplume can tolerate.

Little Bluestem (*Schizachyrium scoparium*) — This high plains native bunch grass grows to about 30 inches. It develops attractive seed heads and foliage turns orange to russet red in fall. It looks good mass-planted or as a single specimen. It needs full sun and well-drained, dry soils.

Penstemon, Rocky Mtn (*Penstemon strictus*) — This native perennial has glossy leaves. Flowering stems to 30 inches develop in June and flowering continues into July. Flowers are purplish-blue and attract many bumblebees and honeybees. Plant several in a 10-square foot area for a massed effect. Rocky Mountain penstemon grows best in soil that drains well in full sun to part shade.

COLORADO CLIMATE



Be sure to take a look at the new color version of *COLORADO CLIMATE*! In each issue, the reader will find climate-related topics of interest.

COLORADO CLIMATE, by Colorado State Climatologist Roger A. Pielke, Sr. and Colorado Assistant State Climatologist Nolan J. Doesken, is an updated version of an earlier publication with the same name. It was published monthly from 1977 through 1996 with the support of the Colorado Agricultural Experiment Station and the Colorado State University College of Engineering. The new version will appear four times a year.

Subscriptions: Colorado Climate newsletter is published quarterly. \$15/year for four issues.

Contact the Colorado Climate Center at 970/491-8545 for more information.



**UPPER SOUTH PLATTE WATERSHED PROTECTION
AND RESTORATION PROJECT**
U.S.D.A. Forest Service Conducts Environmental Assessment

by

Fred Patten, USDA Forest Service, Pike National Forest
Steve Culver, USDA Forest Service, Pike National Forest
Jim Thinnes, USDA Forest Service, Pike National Forest

The Forest Service proposes to carry out four forest restoration activities as part of the Upper South Platte Watershed Protection and Restoration Project. To perform these projects, the National Environmental Policy Act (NEPA) requires that the Forest Service conduct an environmental assessment (EA) to gather enough information to decide whether or not an environmental impact statement (EIS) must be conducted.

The EA will be performed quickly and will consist of site visits, team meetings, data gathering, and analyses. Agencies will be contacted for input, and public meetings will be held to solicit public comments. The EA will focus on key issues designed to provide the Forest Service with the information needed to determine whether environmental impacts are significant enough to require an EIS.

NEPA Timeline for Environmental Assessment

- EA released to public - July 2000
- End of public comment period - August 2000
- Forest Service issues finding of no significant impact (FONSI) or notice of intent (NOI) to perform EIS - August 2000
- End of decision appeal period September 2000
- Project implementation if FONSI is issued - October 2000

Forest Service Proposes Four Activities

Vegetation treatment, road reclamation, trail improvements, and Buffalo Creek burn area restoration activities are proposed to aid in restoring the Upper South Platte Basin area. All four activities are designed to reduce sediment problems in the basin.

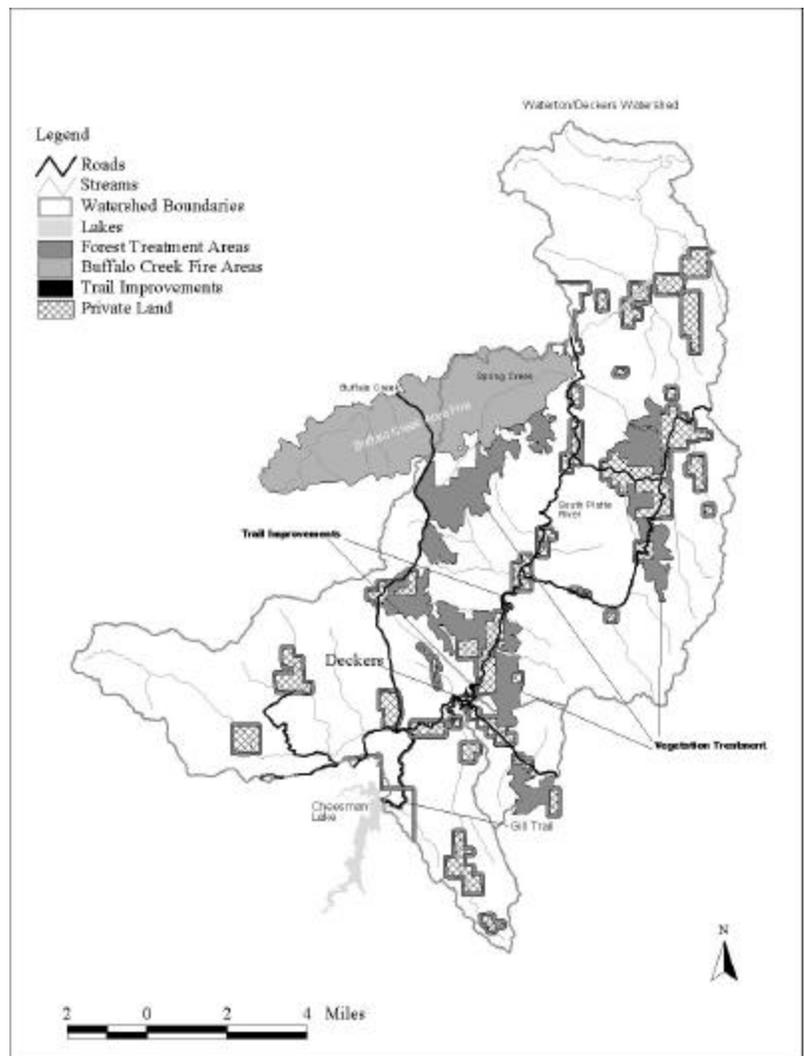


Fig. 1. Map of Project Area

Vegetation Treatment

The vegetation treatments would involve cutting trees and removing them by using a combination of thinning and creating clear-cut openings. Conventional, ground-based



logging systems would be used in areas without existing roads to move logs to existing roads. Forwarders would be used in areas without existing roads to move logs to existing roads. Mechanical treatments and prescribed fires would be used to reduce residual

slash, seedlings, and saplings. Some areas within the vegetation treatments would be thinned, others would be converted to openings, and some would be left untouched. The vegetation treatments would reduce the risk of large-scale fires and subsequent erosion in the watershed. Such erosion can potentially threaten property and human life, as well as magnifying soil and water quality problems.

Current forest conditions, combined with greater human use of forestlands, have dramatically increased the risk of loss of life and property from wildfires in recent years. Past fire control, logging, and grazing allowed smaller, thin-barked trees to proliferate, yielding relatively dense, even-aged, closed-crown forest conditions throughout the ponderosa pine Douglas-fir forest. Because of the current makeup of the forest,

it is no longer subject to frequent, less catastrophic fires and floods. For this reason, and others, the current forest is not sustainable.

The forest previously had many open spaces interspersed throughout the large ponderosa pine and Douglas fir forest. The present conditions foster a much higher risk of cata-



Fig. 3. Buffalo Park circa 1900

strophic fire than pre-settlement conditions. Because prescribed fires cannot be used to modify the forest structure. The existing small trees permit surface fires to climb into the tree canopy and become crown fires. Wildfires can spur high-intensity crown fires under hot, dry, and windy conditions.

The 1996 Buffalo Creek fire clearly demonstrated the potential devastation that another large-scale fire could cause. It burned almost 10,000 acres in less than 11 hours and eventually burned a total of 12,000 acres. The fire destroyed several homes and essential forest cover on soils subject to high erosion. Heavy rainfall and floods following the fire resulted in two fatalities and caused substantial erosion and sedimentation. The fire also caused severe impacts on downstream reservoirs that supply water for the Denver metropolitan area. Nearly 75 percent of the water used by 1.5 million



Fig. 2, Buffalo Park 1999



Denver metropolitan residents comes from or is transmitted through this river drainage. The Denver Water spent nearly a million dollars on water quality cleanup and dredging operations in Strontia Springs reservoir after the flood. The Board anticipates

spending an additional eight million dollars on future cleanup, dredging, and water treatment modifications in the next 10 years because of the Buffalo Creek fire.

Recreational resources, including the highly regarded South Platte River trout fishery within the project area, also need protection. The Forest Service proposal would also increase forest diversity, increase resistance to large-scale forest pest epidemics, and improve biological diversity, therefore, enhancing wildlife habitat.

Road Reclamation

The proposed road reclamation would reduce road-related sediment coming from low standard, classified, and unclassified roads. Many low-use or closed roads have accelerated soil loss, and increased sediment deposited in streams reduces aquatic habitat productivity.

Many of these roads were used for fire suppression, timber harvest, and mineral exploration. Expanding off-road vehicle use has widened some roads or created new ones. Most of these roads are poorly sited and maintained, and they were not intended for long-term use.

Project area soils have high erosion potential when exposed to rain. Roads compact soil, resulting in less water percolating into the soil. Roads can increase the amount of water running on the surface, and this can lead to rill and gully formation during rainfall or snowmelt. Roads can also change natural runoff patterns with undesirable results. Poorly maintained drainage ditches and culverts can also cause slope failure and erosion.

South Platte River Access Trail Improvements

Proposed trail projects include improving the Gill Trail and river access trails to the South Platte River below Deckers. The proposed river access work would improve safety, reduce trail-related sediment, restore disturbed habitat, and provide more parking and trails at several locations that offer fishing access.

Just an hour from Denver, the South Platte River receives

almost half a million visitors each year. Past efforts have protected and restored riparian habitat at many sites along the river that were damaged by vehicle traffic. With so many people using this river, foot traffic has also begun to impact the riparian areas. Anglers and other river users have created an extensive network of social trails that take visitors from parking sites to the river. These trails wind through the willows like a maze, often overlapping each other. Many of these social trails are on steep riverbanks that are often unstable and subject to erosion. Once the route becomes too steep or unstable, it is abandoned in favor of a new, temporarily more stable, route. As this process continues along the riverbank, it causes riparian vegetation loss, reduces riverbank stability, and increases sediment delivery to the river.

The Gill Trail improvements would include expanding the existing trailhead at Wigwam Campground, constructing a new trail between the end of the Gill Trail and Cheesman Dam, upgrading the original Gill Trail to make it safer and to provide sustainable conditions, constructing safer and sustainable river access trails to the South Platte River, constructing stairways on the steepest trail sections, and reclaiming social trails using conventional methods.

The Gill Trail traverses the Cheesman Canyon and provides access to a nationally known fishery along the South Platte River. Approximately 25,000 hikers use the trail to reach the Historic Cheesman Dam and enjoy the natural rugged canyon scenery. There have been no major trail improvements for 40 years. Crumbling side-slope trails have caused numerous braided routes and excessive erosion. Many social trails have developed as alternate routes to Cheesman Reservoir, and some sections are dangerously unsafe. The excessive and braided trails also cut through habitat used by an endangered butterfly, the Pawnee montane skipper, killing the plants on which it depends.

Buffalo Creek Burn Area Revegetation

This project would reestablish riparian and forest communities within the Buffalo Creek burn area to reduce erosion and stream sediment loading. Four years after the Buffalo Creek fire, much of the burn area remains barren and is a major source of sediment. The fire and subsequent flooding events decimated stream channels and riparian areas along much of Buffalo and Spring Creek. Large areas next to these streams are poorly vegetated sediment deposits that are easily eroded during high runoff. Periodic high flows continue to carry these sediments downstream to the main stem of the South Platte, adversely affecting



downstream water quality and fish habitat. Replanting the floodplains and riparian areas would increase their stability and their potential for trapping and storing sediment.

Additional tree planting in the upland burned areas would also reduce sediment entering the streams, complement the riparian restoration, and provide upland floral diversity.

Agencies Join Together to Improve Forest Conditions

The Upper South Platte basin is a critical watershed in Colorado. Most of the river basin is located within the Pike National Forest, southwest of Denver. The South Platte River is also a major recreation area. The Forest Service has joined the Colorado State Forest Service, Denver Water, and other

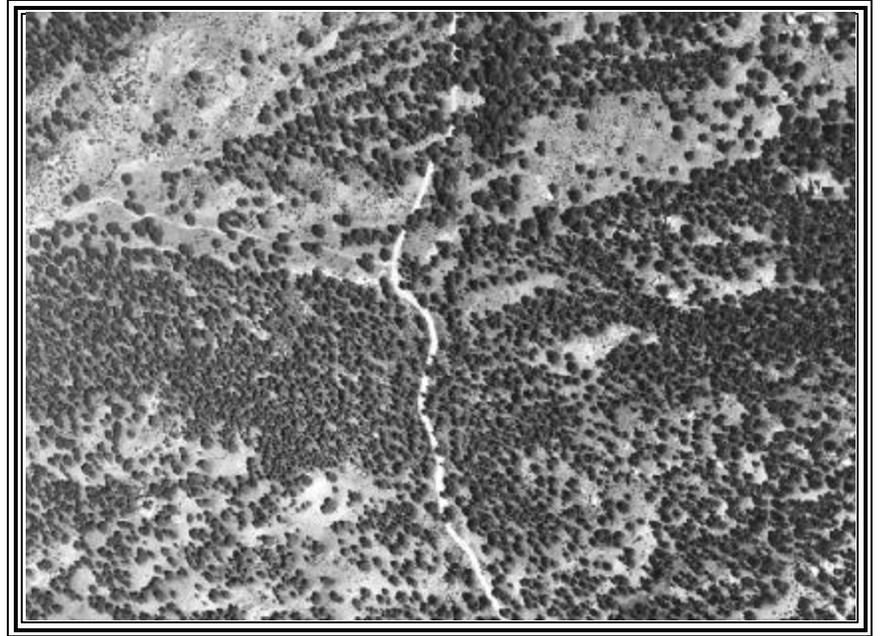


Fig. 4. Historic Mosaic Condition

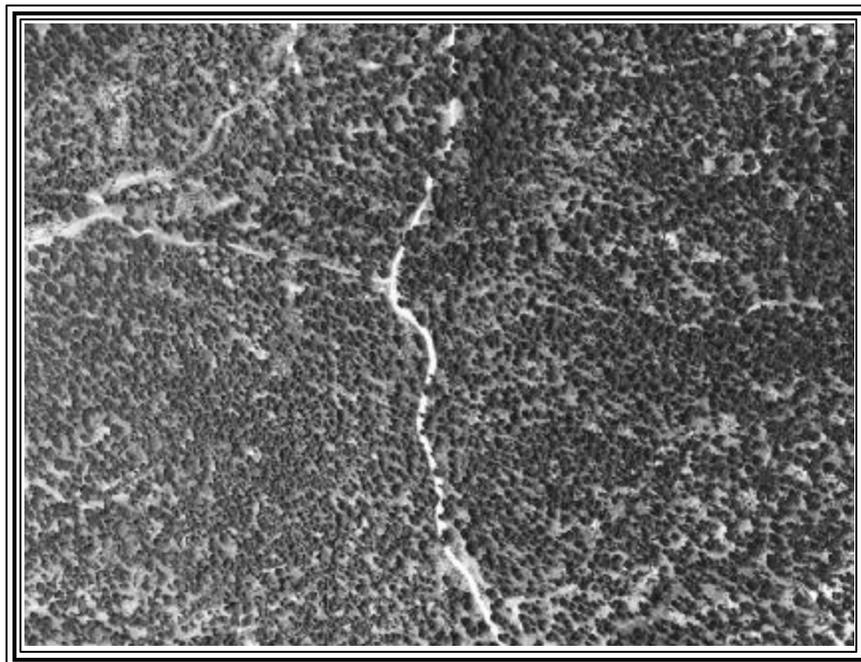


Fig. 5. Current Condition

federal and state agencies, local governments, and interested parties to plan, implement, and monitor restoration projects in the basin. This collaborative, innovative approach is designed to assess forest conditions and implement management actions on a landscape level on both public and private lands within the basin.

The restoration team has five broad goals:

- 1) Protect water quality for all users.
- 2) Reduce risks of large catastrophic wildfires.
- 3) Reduce risks to human life and property.
- 4) Create sustainable forest conditions.
- 5) Integrate research, monitoring, and management.

To help meet these goals, the Forest Service wants to treat 18,000 acres of dense forest, remove (road reclamation) 25 miles of unnecessary, non-system roads, improve 7.5 miles of Upper South Platte River access trails, and plant 30 acres of riparian and 1,000 acres of upland habitat in the Buffalo Creek burn area. The project area primarily encompasses the Waterton/Deckers and Horse Creek watersheds and the Buffalo Creek burn area in Jefferson and Douglas counties, 15 to 20 miles southwest of Denver. Watersheds with the highest fire and erosion risks are the primary targets for restoration actions.

The work proposed in this EA would occur on national forest lands. It is part of the first phase that the agencies intend to implement on federal land. Future Forest Service activities will be based on the outcome of planning, monitoring, and research in the Upper South Platte Basin and evaluated in more detail in subsequent NEPA documents.

MEETING BRIEFS



CSU HOSTS THREE CONCURRENT CONFERENCES

ASCE Watershed 2000:
Science and Engineering Technology for the New Millennium:

ASCE Operations Management 2000:
Operations to Meet Complementary and Conflicting Needs of Stakeholders

U.S. Committee on Irrigation and Drainage:
Challenges Facing Irrigation and Drainage in the New Millennium

by Cat Shrier

The week of June 19 brought hundreds of water resources professionals to Fort Collins to attend conferences taking place on the Colorado State University campus. Several CSU alumni began with attendance at the CSU Alumni Water Symposium on June 20, discussed below, and then stayed for the opening reception of the three conferences. The conferences included two sponsored by the Environmental and Water Resources Institute of the American Society of Civil Engineers and one by the U.S. Committee on Irrigation and Drainage. Proceedings for all conferences were made available to attendees, and participants were encouraged to attend sessions of the other conferences.

The keynote addresses were made in a joint opening plenary session, moderated by Neil Grigg, Professor of Civil Engineering. Following welcoming remarks by CSU

Vice President Jud Harper, the participants heard from two keynote speakers. The USCID Keynote Speaker was Fernando J. Gonzalez, Senior Irrigation Advisor at the World Bank. Mr. Gonzalez spoke of the challenges ahead for irrigation and drainage professionals in the face of growing population and changes in land use and irrigation practices. The EWRI Keynote Speaker was Charles F. Wilkinson, Moses Lasky Professor of Law at the University of Colorado-Boulder (see page 19).

With sessions on topics ranging from wetlands management, to fire impacts on hydrology, to infiltration issues, to GIS applications in watershed studies, these combined conferences gave participants an opportunity to learn about aspects of water resources and water quality that they might not normally hear about in their respective professional arenas.

Alumni Water Symposium Celebrates CSU's Contributions to the World

by Cat Shrier

The predominance of Colorado State University (CSU) alumni in water agencies and water industries in several countries around the world – including South Korea, Taiwan, and Brazil – is testimony to the excellent recruiting and teaching done by CSU's faculty in the 1950s, 1960s, and 1970s. The panel speaking at the 2000 CSU Alumni Water Symposium featured four alumni who reminded the attendees of the contributions made by CSU in many parts of the world and recommended ways in which CSU can produce water engineers who can continue to make important contributions to society. The symposium was

held June 20 on the Colorado State University campus in Fort Collins.

Following introductory remarks by Professors Neil Grigg and James Ruff of the Civil Engineering Department, panel members made their presentations followed by discussions with the audience. The panel and discussion were moderated by Dr. Evan Vlachos, with his insightful commentaries.

First to speak was Dr. Luis E. Garcia, a leading water



Clockwise from left: CSU Alumni Kay Force and Steven Sherrow; former CSU President Ray Chamberlain and David Woolhiser, retired USDA water leader; Prof. Jose Salas, Civil Engineering Dept., and Luis E. Garcia, water specialist with the Inter-American Bank; Prof. Neil Grigg and Prof. Emeritus Art Corey, Civil Engineering Dept.; Prof. Maurice Albertson, Civil Engineering Dept., and Subin Pinkayan, international “water diplomat.”



specialist with the Inter-American Bank (IAB). Dr. Garcia completed his undergraduate education in Guatemala and his master's degree at UC-Berkeley before coming to CSU to do his Ph.D. He later became president of Central American University. He has been with the IAB for the past 15 years. Dr. Garcia focused on water in Latin America, where "...the problems of the past persist while new problems are appearing." He noted several past examples where projects suffered because of a lack of understanding of politics and community interests by engineers, and how important it has become for engineers to adopt a new approach to water problems. He also recalled past instances where engineers were working separately on several projects in the same basin, and cited the lack of project coordination by international aid organizations. These problems, he noted, led to a change in the approach and perspective held by organizations such as his. Rather than the old project-by-project engineering approach, water professionals are learning to use a systems approach in dealing with the world's water problems.

The next to speak was Dr. Subin Pinkayan, who received his Ph.D. in 1965 under advisor Dr. Vujica Yevjevich. Dr. Pinkayan returned to Thailand in 1966, where he held several positions in government, academia, and consulting. He was elected to Parliament in 1980, and held a series of positions as government minister. He also taught at the Asian Institute of Technology and founded the Southeast Asia Technology Company consulting firm, "SEATEC." Through his positions, he developed his skills as a "hydro-diplomat," since he worked on several important water projects involving trans-boundary water systems. In particular, he discussed the challenges of the Mekong River Basin, which runs through southern China, Burma, Laos, Thailand, Cambodia, and Vietnam. Dr. Pinkayan stressed the growing need for hydro-diplomats who can work on water concerns that require communication and cooperation across borders.

The third panel speaker was Dr. Ray Chamberlain, Emeritus Faculty of Civil Engineering and President of CSU from 1969 to 1979. Dr. Chamberlain was the first student to receive a Ph.D. from CSU and was an advisee of Professor Maurice Albertson. Dr. Chamberlain plays an active role in shaping transportation policy in Washington, DC. He noted that in other countries the majority of legislators are engineers, but in the United States, very few engineers are members of Congress or other decision-making bodies. In his own area of transportation engineering, Dr. Chamberlain's concern that we are under-investing in basic and applied research on infrastructure led to his work on major transportation legislation, including the "Intra-modal

Surface Transportation Efficiency Act". CSU and other schools are "...doing a superb job of training engineers to be problem-solvers," he said, but engineers also need to learn to be managers – managers of people and the sociopolitical process. Dr. Chamberlain called upon engineers to play a more meaningful role in public policy, especially those in their senior years who "have too much energy to retire."

The final member of the panel was Dr. Bill Price, a native Coloradan who received his Ph.D. in Agricultural Engineering from CSU before going to California. He then worked with David Lillienthal at the Tennessee Valley Authority, and exported what he learned about River Basin Planning to the rest of the world through his position with the World Bank, from which he has retired. Much of his work with the World Bank focused on the problems of the Ganges Basin, an area of rapid population growth. He pointed out that, by 2040, India's population is expected to surpass China's. In addition, Indonesia is now number four in the world in population size, and Bangladesh is also experiencing rapid population growth. As his presentation illustrated, population growth in these areas and around the world has led to a reversal of the ratio of population to irrigated acreage. Worldwide, the ratio of irrigated acreage to population increased steadily until about 1980, at which point the ratio began to decrease. Currently, the ratio is at about the same level as it was in 1960. He pointed out that there remain many challenges for agricultural engineers in the future. Dr. Price also noted the changing face of engineers: by 2030, it is estimated that the majority of the world's engineers will be foreign-born and female.

The panel discussion ended with a summary by moderator Evan Vlachos, who noted that all of the speakers addressed the transformation of engineering in water resources, including changes in population, changes in approaches to problems, and changes in the definition of sustainability. Although engineers have dealt with "systems" for many decades, Dr. Vlachos noted that those with which engineers must now work have expanded in time and space. More countries around the globe have begun to adopt water-intensive cultures complete with washing machines and dishwashers and lawn sprinklers. Dr. Maurice Albertson, Professor of Civil Engineering, noted during the discussion period, two-thirds of the world's population – 4 billion people out of 6 billion – still live in villages, with no significant improvement in their standard of living. A conclusion from the event was the hope that the 120 faculty members in water-related disciplines at CSU will prepare future students for the challenges ahead while taking with them the lessons from students of the past.

**ACHIEVING SUSTAINABILITY IN AN ERA
OF ON-RUSHING DEVELOPMENT:
REALISTIC GOAL OR MIRAGE?**

By Charles F. Wilkinson

(Excerpted from a presentation by Charles F. Wilkinson, Moses Lasky Professor of Law, University of Colorado, at the American Society of Civil Engineers Meeting, June 21, 2000, Fort Collins, Colorado.)

The Post-World War II Era

I imagine that many of you, like myself, have spent a great deal of time reading and talking about the 19th century West. It has been time well spent, for our world has rarely, if ever, seen such a fireworks display of courage, treachery, ambition, romance, greed, inspiration, and lessons learned, both good and ill. But it seems to me more likely that, when the histories have been written, the post-World War II era – the one that we are still in – will be judged at least as decisive, for it is in our time that we have overwhelmed the land. It is a difference in kind, not degree, from any time past.

The Modern Policy Framework

I believe that years from now people will look back to the late 1980s and early 1990s as a pivotal time when our society began, in a concerted way, to make its stand about this earth and its creatures. By about the mid-1980s, new data reached the public consciousness – about global warming, depletion of the ozone layer, and rain forest destruction. In the American West, endangered species catapulted into public view in an unprecedented way. I think of the sharpest defining moment as being the Forest Service's draft EIS on the spotted owl, released in 1986. It generated the most comments of any Forest Service EIS ever released. Then, in 1989, the salmon runs plummeted with the low water in the Columbia. All of this in the lush Pacific Northwest, our most environmentally sensitive region. Then the Rio Conference further galvanized opinion and concern.

I believe, especially given the way that stresses on the lands and water have accelerated so quickly, and on such a large scale, that in many respects we have responded admirably.

Look at the specific water reforms that westerners have accomplished in just a generation. Wide-open dam building has given way to the building sentiment toward dam removal that may surge if the four lower Snake River dams are breached in the name of wild salmon, Indian treaties, and free rivers. In 1998, in the most noticed of the many alterations we have

. . . years from now people will look back to the late 1980s and early 1990s as a pivotal time when our society began, in a concerted way, to make its stand about this earth and its creatures.

made to dam operations, Secretary Babbitt ordered a large released out of Glen Canyon Dam to mimic more closely the high spring runoff down through the Grand Canyon. Nearly every western town and city has brought back the river within its limits through greenways and parks. We take seriously riparian zones, water conservation, the Endangered Species Act, acid mine drainage, and TMDLs. The still-young instream-flow programs are gradually taking hold; some of the land trusts and the even newer water trusts are purchasing senior rights, stream access is increasing; and public-interest water organizations now monitor the state systems in Oregon, Washington, Colorado, and Montana. Montana is determined to bring a halt to mining by cyanide heap-leaching because of a big mine proposal near the beloved Blackfoot. In a brand new movement that may or may not take hold, but that surely shows our citizenry's willingness to volunteer time to the waters we love so, local watershed councils have sprung up in every western state. The progress on our rivers is coming achingly slow – the old legal doctrines are deeply entrenched, and so are the vested rights they created – but the progress is determined, creative, and real.

In a sense, the largest trend is the way that water law has opened up. Traditionally, water policy has always been a closed system. Individual developers, not any government or sense of a larger public good, controlled the rivers.

Government was needed only to fund and build projects for individual developers. Water was water, separate from land, separate from wildlife, separate from social constraints, largely separate, in fact, from economic constraints. Then, beginning most notably in the late 1970s and 1980s, the public showed its determination to become involved in water decisions – a shift away from the right of individual water developers to make unilateral decisions toward a fuller recognition of the public interest. Although there are plenty of remnants of the idea that water policy is a closed domain, the dominant approach now is to treat water as one organic part of natural resources policy, of social policy.

We have begun to change the way we make natural resource decisions. The traditional structure has had two main layers: general federal laws – the Federal Power Act, the Reclamation Acts, the Taylor Grazing Act, and modern federal statutes such as NEPA, the Clean Water Act, and the NFMA; and general state laws, such as water laws and state forest practices acts, which typically were much looser. In many cases, however, we have broken the traditional mold and moved into much more flexible, creative, and individualized approaches focusing on specific natural systems, usually a watershed, so that decisions on land and water are bound together. The federal government is less dominant, sometimes serving mainly as a convenor. The states and the third group of sovereigns, the tribes, have become much more active. The new approach is collaborative, with all affected governments, interest groups, and disciplines at the table.

We have made impressive progress in this kind of decisionmaking, which is local and not national, particular and not general, open and not closed, creative and not cookie-cuttered, and messy and not neat. You can see it at Lake Tahoe, on the Truckee River, in the Sacramento Bay Delta, at Mono Lake, in the Grand Canyon, at Yellowstone, on the Clark Fork in Montana, on the Columbia, on the Umatilla River, in the rivers where the new watershed councils are at work, and at numerous other places. Collaboration does not work in every situation. There are times and places where it breaks down or never gets started. But we have responded to changing times and have opened up the process to try to achieve a much broader sense of the public interest. This new way of making decisions about western watersheds is a real

accomplishment we ought to take pride in.

Sustainability

Collaboration, therefore, is an important element of modern natural resources policy. But collaboration is just a process, and policy must always have a substantive goal. Otherwise, we are rudderless.

In Aldo Leopold's terms, a land ethic requires the preservation of "land health." As he wrote in *A Sand County Almanac*, "Health is the capacity of the land for self-renewal. Conservation is our effort to understand and preserve this capacity."

Today, we use the term sustainability to articulate Leopold's land ethic and our commitment to long-term land and water health. The goal of

sustainability, according to the general definition of the Brundtland Commission Report of 1987, is to "meet the needs of the present without compromising the ability of future generations to meet their own needs" — a blood commitment that they will have the same or greater bounty with which we have been blessed. We should strive to live within our ecological means because failing to do so means passing on a burden of sacrifice and loss to other people, people who actually will inhabit our places. Though we do not know them, passing the burden to them would show no respect, love, or morality, precisely the qualities our species values so.

High-sounding words, exactly the kind of talk that causes some people to say that sustainability is vague, all puff and no substance. But it is worthwhile to look closely at sustainability and at some of the many different venues where people are hard at work putting sustainability into practice, on the ground, as a working policy.

I think of sustainability as operating on two levels. First, sustainability has great appeal as a broad societal objective — as a symbol, as a statement of some of the fundamental values we hold as a people. Sustainability has this appeal because it combines the philosophical and moral force of fairness to future generations with the practical edge of being necessary to our economic and social well being. In this broad, symbolic sense, sustainability embodies a shared national goal in much the same way that freedom and equality do. Such broad formulations — idealistic and never fully attainable, yet undeniable in their essential truth — are

At its core, sustainability is a moral idea, premised on intergenerational equity, the ethical obligation to those still to come . . .



critical for setting an agreed-upon context for making public choices on difficult and contentious issues.

I referred to people who say sustainability is vague, and so in many ways it is. It is young, but freedom and equality were young once too. But both, while maintaining their symbolic force, have also matured into specific programs, including voting rights acts, the right to peacefully protest, fair housing laws, and scores of others.

Sustainability, like freedom and equality, also operates on a more down-to-earth level and has been gaining specificity quite quickly. The objective of sustainability – what it is we will strive to sustain – is expansive. We mean to sustain the traditional commodity-oriented outputs – megawatts, board feet, acre-feet, animal unit months, visitor days, and so forth – but we refuse to define our future in those terms alone. Modern sustainability goes further and also seeks to sustain such things as salmon, elk, eagles, and wolves; less dignified creatures such as voles; species diversity generally; good rafting water, long vistas and archaeological sites; tribal, ranch, and farm communities; and solitude, beauty, and wonder.

Yet, the truest way to understand what sustainability means comes not from these kinds of descriptions, though they help, but from seeing how sustainability has actually been implemented in real places. It is through real-world efforts that you best understand and define sustainability and how it differs from traditional approaches.

Take the Northwest Forest Plan, President Clinton's 1993 initiative in the federal, tribal, and private forests west of the crest of the Cascade Range. One aim is to sustain ancient forests, salmon, and other species, including the spotted owl. The plan also strives to sustain scaled-back but stable timber and commercial fishing industries. This comprehensive plan may be the most extensive effort in sustainability ever undertaken, and the people of the Northwest are well familiar with it. Some like it. Some would like to see it improved, which may well happen. But you don't hear many say that the Northwest Forest Plan is vague.

Two other examples – in addition to the several efforts I have already alluded to – are useful to show that we comprehend the specifics of sustainability not so much in broad, classroom-type formulations, as in real efforts in real places.

Compare the rivers of the Northwest to the two great rivers of the Southwest, the Colorado River and the Rio Grande, where sustainability must be fundamentally different than in the Northwest because the place is different. In the Colorado River watershed, the ESA recovery efforts are directed at endemic species such as the humpback chub and the

pikeminnow rather than the salmon and steelhead. In terms of economic sustainability, there is no commercial fishing industry, Indian or non-Indian, but there is a thriving rafting industry. The Colorado must deal with interbasin diversions and transfers from the Upper Basin to the Lower Basin, difficult policy issues for which there are no direct analogies in the Columbia and

other rivers of the Northwest. In a uniquely compelling setting, in modern times the Southwest and the nation have made the implicit, but still firm, decision to sustain the living Colorado River through the Grand Canyon, the magnificent archaeological sites near the canyon floor, and the sheer canyon walls themselves with all the 1.7 billion years of world history they display to us by never, despite all the many proposals over the years, plugging the Grand Canyon with any dam.

Over on the Rio Grande, Hispanics in Northern New Mexico present a unique issue of cultural sustainability by arguing against large-scale downstream water transfers to Albuquerque that might jeopardize the continued existence of their acequia associations, the traditional water distribution collectives. As a mayordomo from an acequia in the Chama Valley told me, "Since a ditch system must be maintained by the collective labor of its users, each time a parcel loses its water rights, a proportionate amount of labor and ditch fees is also lost to the system as a whole ... Each member is a link in the chain of community water use and control, and each time a member and his quota of water and labor are lost, the overall chain is weakened."

And so the vagueness of sustainability begins to dissipate when we examine not just broad philosophical concerns, but also the growing number of sustainability efforts being

We recognize three aspects of sustainability: ecological, economic, and cultural. We increasingly focus on a place, usually defined by natural, rather than political, boundaries, and usually, especially here in the West, a watershed.

adopted and implemented in actual watersheds.

No one can say whether westerners will be using the term “sustainability” generations from now. My guess, though, is that they will and that it will be the overarching framework for our relationship with the natural world for our careers and beyond. That is not because sustainability holds out some automatic solution, but because the idea of committing ourselves to the people of the future and making the difficult choices of what we are willing to sustain offers a sensible way, at once idealistic and practical, for public bodies and plain citizens to conceive of, and build toward, a fair and promising future.

The Uses of Science

Grazing Reform — In grazing reform, much of the attention given to the 1995 Bureau of Land Management grazing regulations has involved the resource advisory committees. Those regulations, however, also require state and regional rangeland health standards that are science-based. They are quite detailed and ambitious in their effort to establish scientific standards for rangelands and the watercourses that nourish them. These are some of the requirements:

At a minimum, state or regional guidelines developed under paragraphs (a) and (b) of this section must address the following:

Maintaining or promoting adequate amounts of vegetative ground cover, including standing plant material and litter, to support infiltration, maintain soil moisture storage, and stabilize soils.

Maintaining or promoting subsurface soil conditions that support permeability rates appropriate to climate and soils.

Maintaining improving or restoring riparian-wetland functions including energy dissipation, sediment capture, groundwater recharge, and stream bank stability.

Maintaining or promoting stream channel morphology (e.g., gradient, width/depth ratio, channel roughness and sinuosity), and function appropriate to climate and landform.

Another effort to introduce science-based management into public lands is the work of the Committee of Scientists, in which I took part as a member of the Committee. The National Forest Management Act of

1976 required a committee of scientists to advise the Forest Service on its initial NFMA regulations (the diversity provisions in the Forest Service regulations are based on recommendations by that original committee). In 1997 Secretary Blackman appointed a new committee of scientists to give advice on new NFMA planning regulations. The committee filed its report in March 1999, and in October 1999 the Forest Service issued proposed regulations, which have received public comment and are now under final consideration.

The proposed regulations, which are based in substantial part on the committee’s recommendations, provide in the preamble that “sustainability should be the guiding star for stewardship of the national forests,” and then set out quite specific procedures to be followed in attempting to achieve sustainability and each of its three components – ecological, economic, and social. Chapter Two of the committee’s report discusses the policy of sustainability (the committee preferred that term over “sustainable development”), and much of the rest of the report discusses how sustainability might be implemented in specific and practical ways. The standards for species viability, in particular, are quite demanding. This reflects the committee’s view that sustainability has importance as a broad, social objective, but that sustainability also must gather specific, applied meaning by being put to work in actual, on-the-ground situations.

Committee of Scientists Report — The Committee of Scientists report goes beyond most statements of sustainability in that it gives primacy to one of the three components – ecological sustainability. This “ranking” is not due to a sense that the ecological component is somehow more important than the economic and social components (obviously, economic and social well-being is of great importance to people). Rather, the reasoning is that, in order for social and economic benefits to be

A central aspect of modern natural resources policy in general, and of sustainability in particular, has been the question of the integration of science into law. This recent movement has proceeded on several fronts, of which I will mention two.

sustainable, they must necessarily depend upon the integrity of the water, soil, vegetation, and air that healthy ecosystems provide. Put differently, the Committee of Scientists clearly expects that the national forests will continue to provide economic goods and services, but it also believes that an environmental baseline should first be established to ensure that such economic benefits can be provided over time. Refining the idea of sustainability in this way gives an edge to the doctrine and offers guidance to land managers in a way that a policy like multiple use-sustained yield management does not.

This primacy of ecological sustainability has been controversial, a flash point in discussions of the Committee of Scientists' report. In addition to believing that this approach is the right one for the national forests, committee members several times expressed their hope that – even if the committee's approach toward sustainability is not adopted by the Forest Service in the final regulations – the report's formulation of this critical issue would serve the function of placing it on the table for debates over sustainability, not just in the national forests, but in future decisionmaking over natural resources generally.

Conclusion

The pressure to supply water for urban growth continues to build. Seven western states are among the ten fastest-growing states. Under current trends, California is projected to grow by more than 50 percent, or 17 million people, by the year 2025. Several of the other western states are projected to grow at even faster rates. That is 2025. What about 2050?

We know we can produce enough molecules of water for population growth in virtually any magnitude imaginable. But we also know that we can never escape the glare of John Wesley Powell's stern visage. Thirteen percent of the West is desert and most of the rest of it is arid. Water is scarce,

distinctive, and valuable. Yes, we can bring enough water to the cities for the new subdivisions, but is this the wisest use and are we willing to bear the costs? This century will bring different specifics than the last one, but if we have learned any lesson, it is that from now on we must ask the question we never bothered to ask in water policy during the Big Build-up: we can do it, but is it worth it?

Science can help us address that question. Probably like yourselves, it is not clear to me how much science is the right amount. I don't know, for example, if the Committee of Scientists report, of which I am proud to have been a part, hit the right balance. Maybe it calls for too much science. Time will tell. But I do believe we must do better at incorporating the science of ecology, with its many branches, and a broad-gauged and rigorous notion of sustainability, into public policy.

Perhaps even more fundamentally, we need to appreciate that, if there is one thing that can bring us together in the West, it is a river. This is ironic, for traditionally water has been divisive out here. Yet, increasingly it has been a unifier. When people listen, they can understand why the farmers, the cities, the tribes, the conservationists, care about water. And we love rivers. We love the rapids and riffles, the bends and bars, the swamps and sloughs. Most of the disciplines we represent here discourage the use of words like "love," but we need to use them; the word love is often accurate when it comes to water and provides important data. For who of us here does not have a favorite backcountry creek, a favorite river in town, maybe many of them, that we love? So, treat our rivers wisely – that is, democratically, sustainably, and with love – and the answers will come and the answers will involve not just rivers, but the region as a whole, for the destiny of the American West always has been, always will be, tied to the water that is at once so scant and so sacred.

. . . the destiny of the American West always has been, always will be, tied to the water that is at once so scant and so sacred.

MOUNTAIN RIVERS

by Ellen Wohl

What are the physical processes operating in mountain rivers and how do we know them? "Mountain Rivers" answers these questions and more. Here is the only comprehensive synthesis of current knowledge about mountain rivers available. Discussions on fluvial geomorphology and physical processes, from the scale of drainage network development to bedload movement, complement summaries of mountain river chemistry and ecology. With its fine illustrations and references, hydrologists, geomorphologists, civil and environmental engineers, biologists, resource planners, and their students will find this book an essential resource. Published by the American Geophysical Union Press, Water Resources Monograph 14, 320 pp., cost \$39 (\$27.30 for AGU members). ISBN 0-87590-318-5. Copies can be ordered via e-mail (orders@agu.org), or from the AGU website (<http://www.agu.org/cgi-bin/agubookstore>).



Colorado Water
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CU Water News



WATER AND GROWTH IN THE WEST: NRLC CONFERENCE EXPLORES PROBLEMS AND SOLUTIONS

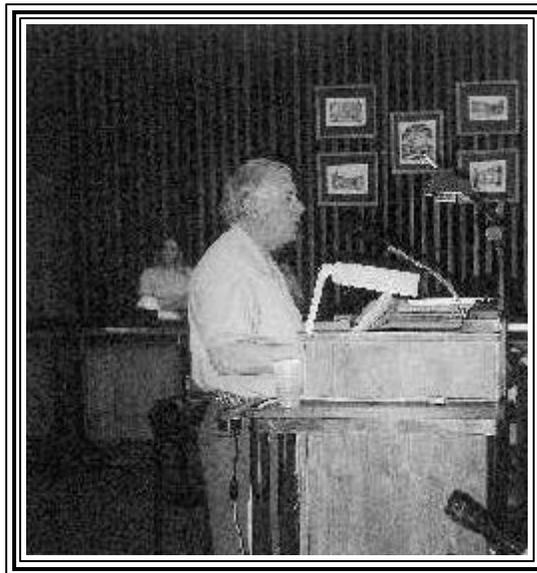
In June the Natural Resources Law Center, University of Colorado, hosted its twenty-first summer conference, Water and Growth in the West. Conference participants included scientists, planners, attorneys, and policy makers who posed (and tried to answer) the questions: "How bad are the problems?" and "Where do we go from here?"

On Tuesday evening, early arrivals to Boulder were treated to a book reading, signing and wine reception featuring newly released books by NRLC associated authors. Readings included: Jim Corbridge and Teresa Rice, *Colorado Water Law*; Bob Frodeman, *Earth Matters*; Larry MacDonnell, *From Reclamation to Sustainability*; and Charles Wilkinson, *Fire on the Plateau*.

Wednesday morning the Conference officially began with a welcome from Harold Bruff, the Dean of the University of Colorado School of Law. On Wednesday and Thursday conference speakers addressed: trends in growth and its impact on water use; legislative roles in managing water use; impacts of use on minority and Native American communities; and case studies. Friday, speakers focused on growth and water in Colorado as a window on the West. While the program format emphasized prepared presentations – supplemented by materials in the conference notebook – the conference was not all speeches. Lively audience participation punctuated the courtroom sessions.

Several speakers discussed past and future trends of growth and water use. William Riebsame, Professor of Geography University of Colorado, presented a broad picture of demographic, economic, and cultural trends in the West. He concluded that the West would continue to rapidly grow as people spread to new areas embracing spacious lifestyles. Gary Weatherford, attorney with Weatherford & Taaffe, discussed planning for hydrocommons units, composed of a river basin and dependent communities, to create an extensive water market. David Davis, Deputy Director of Office of Wetlands, Oceans, and Watersheds for EPA, identified the problem of

unplanned urban sprawl that leads to non-point source runoff. He suggested adopting a smart growth watershed approach and using TMDLs to budget pollution for the watershed. Dan Tarlock, Professor at Chicago-Kent School of Law, argued that groundwater shortages do not limit growth, but may help distribute it. He stressed the need for a reliable source of future water. Finally, Roger Pulwarty, Program Manager for National Oceanic and Atmospheric Administration's Office of Global Programs, explained climate variability with clarity and humor. Pulwarty cautioned that a climatic shift could produce water quantity patterns not contemplated in water plans.



Dan Tarlock, Professor at Chicago Kent School of Law

Larry Morandi, Director of the Environment, Energy and Transportation Program at the National Conference of State Legislatures, and Holly Doremus, Professor at University of California-Davis School of Law, explored how legislation relates to water management in the West. Morandi categorized new state smart growth legislation as: 1) Requiring local governments to consider water

in planning; 2) Requiring subdivisions applicants to prove there is sufficient water; or 3) Leveraging state financial assistance to hold local governments accountable for planning. Doremus explained that local governments might be hampered in efforts to manage development by liability under the Endangered Species Act.

Jerilyn DeCoteau, Director of the Indian Law Clinic University of Colorado, and David Benavides, Community and Indian Legal Services of Northern New Mexico, addressed the effects of development on Indian and Hispanic water control. DeCoteau argued that states overdeveloped their resources and now look to Indian tribes to protect remaining resources, preventing tribes from developing and achieving financial security. Benavides explained that communal water control is an important aspect of Pueblo and Hispanic culture, but noted that New Mexico law has privatized rights of Hispanic acequias. While Hispanic communities built acequias to provide water in common to local residents, the law has

weakened community control by allowing the water rights to be severed from the land without concurrence of the community.



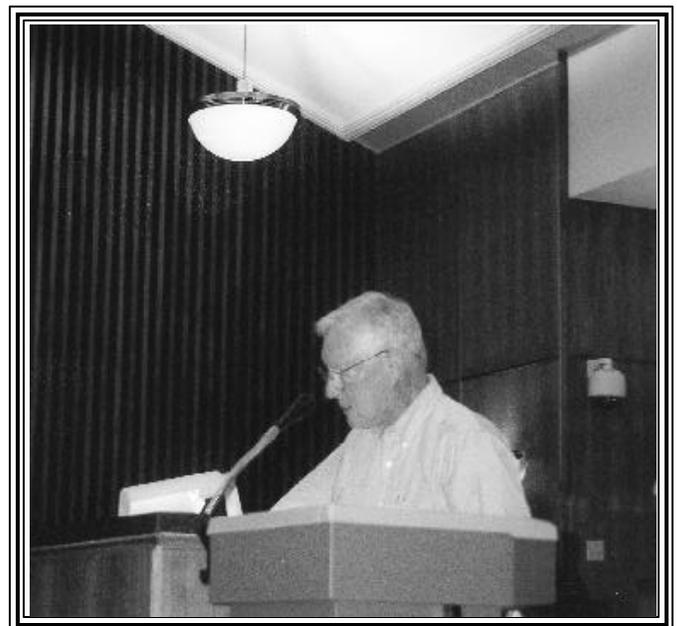
Janet Neuman discusses difficulties faced by the Oregon Water Trust

Several other speakers presented lessons learned from specific case studies. Janet Neuman, Professor at Northwestern School of Law at Lewis and Clark College, discussed the difficulties faced by the Oregon Water Trust in purchasing senior water rights for in-stream flow protection. She simply captured sentiments of several speakers, concluding that, "not connecting land use planning and water planning is just plain dumb." Rita Pearson, Director of Arizona Department of Water Resources, described groundwater protection efforts in five diverse Active Management Areas that give Arizona the flexibility to address very different problems and local water practices. Bruce Driver, Director of the Land and Water Fund of the Rockies, analyzed environmental ethics in the context of urban centers, concluding that cities can be good environmental stewards by mitigating past damage and curtailing sprawl even if they do not limit growth. Greg Thomas, President of Natural Heritage Institute, warned that California has depression islands from groundwater mining and proposed importing water to refill aquifers and store for dry years. Ed Harvey, Managing Director of BBC Research and Consulting, evaluated several case studies, concluding that communities can have both water supply planning and growth management and that rural areas need more than water supplies to financially

develop. Finally, Jerome Muys, attorney with Muys & Associates, commented on Lower Colorado River Basin municipal responses to water allocations based on overestimated future supplies.

Friday brought another warm summer day, new attendees, and a focus on water and growth in Colorado. Jim Corbridge, Professor at University of Colorado School of Law, kicked off the day with the keynote address *Growth in Colorado and the West: Trends and Issues*. Corbridge focused his presentation on three general lessons: 1) Water management does not work as a tool to restrict growth; 2) Water distribution organizations see their role as providing water, not controlling distribution; and 3) Coordinated solutions are needed. Corbridge also addressed a variety of possible new sources of water, existing laws and agreements, lifestyles and cultures, drought and climate change. Following his speech, friends and colleagues honored retiring Professor Corbridge with stories and praise.

The discussion of Colorado growth and water continued with Jim Lochhead, attorney with Brownstein Hyatt & Farber. Lochhead examined water in the South Platte/ Front Range corridor, calling for conjunctive use, an open process, and new dialogues. Next, Taylor Hawes, Co-Director of the Northwest Colorado Council of



Jim Corbridge gave the keynote address, Growth in Colorado and the West: Trends and Issues

Government's Water Quality and Quantity Committee, presented a view of growing demands placed on the Colorado Headwaters largely from external visitors, especially tourists from the Front Range. She praised the problem solving skills of the Upper Colorado River Project. Eric Kuhn, General Manager of the Colorado River Water Conservation District, followed with an examination of development and water transfers on the West Slope, recommending conjunctive uses. Next, John Hill, attorney with Bratton and McClow LLC of Gunnison, provided an admittedly biased perspective on the Union Park project, soon to receive a Colorado Supreme Court ruling. As a local resident, Hill reported that citizens largely oppose the project, concluding that Union Park will not be built until it is absolutely necessary. Don Ament, Colorado Commissioner of Agriculture, stressed the value of agriculture to Colorado's economy and standard of living – "you eat everyday." He argued that long-term agriculture in Colorado is threatened by many factors including the need of aging farmers to sell water rights to fund their retirement.

The afternoon session on Friday continued the dialogue. Ken Salazar, Colorado Attorney General, began by discussing the state's role in water resource planning. Salazar warned that costs are extremely high in terms of time and money, but cooperation is the key to achieving future water goals. Next, Doug Kemper, Manager of Water Resources for the City of Aurora, discussed the Eagle River Assembly, a group of major water rights holders who are collaborating to resolve transbasin transfer conflicts. Subsequently, Peter Binney, Study Manager for the South

Metro Water Supply Study Board, encouraged cooperative regional planning in the Denver basin to meet long term water demands without depleting groundwater. He cited a three way agreement among the South Metro Water Supply Study Board, the Denver Water Board and the Colorado River Water Conservation District as an example of effective cooperation. Next, Marc Waage, Manager of Raw Water Supply for Denver West, analyzed a series of Cooperative Operating Agreements along the Northern Front Range. He questioned Denver's ability to distribute water in dry years and emphasized the need for new facilities. Finally, Lori Potter, attorney with Kelly Haglund Garnsey & Kahn L.L.C., and Michael Freeman, attorney for Earthjustice Legal Defense Fund, examined environmental consequences of water management in the context of the City of Denver's Diligence/Augmentation case and the Arapahoe Basin ski area snowmaking litigation. They predicted a shift in emphasis from water quantity to water quality issues.

Between sessions attendees also had a chance to debate contentious issues, exchange business cards, and enjoy beautiful Boulder summer weather. Wednesday evening, the Center hosted a barbecue on Flagstaff Mountain. Everyone enjoyed great food while watching the sunset over the city. Thursday evening, Hydrosphere Resource Consultants, Ltd. sponsored a reception that provided another opportunity for sharing ideas and meeting new people. Overall, the conference was a great success.

PROFESSOR CHARLES HOWE HEADS COMMITTEE ON PRIVATIZATION OF WATER SERVICES

While it holds great promise for improving water service delivery, the long-term consequences of U.S. water service privatization are not clear. Dr. Charles Howe of the University of Colorado is chairing a committee that is reviewing water service privatization in the U.S. including economic, regulatory, public service and public health, environmental, and water quality implications. The committee, established under the auspices of the National

Research Council's Water Science and Technology Board (WSTB), held its third meeting in Indianapolis, Indiana on June 8-9.

Professor Howe is a faculty member in the Department of Economics at the University of Colorado and Director of the Environmental and Behavior Program.

The Water Science and Technology Board (WSTB) is a unit of the National Research Council (NRC), which serves as an independent advisor to the federal government on scientific and technical questions of national importance. The NRC, jointly administered by the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine, brings the resources of the scientific and technical community to bear on national problems through its volunteer advisory committees.



Colorado Water
Resources Research Institute



CSM RECEIVES DOCTORAL FELLOWSHIPS FOR HYDROGEOLOGY RESEARCH

Colorado School of Mines (CSM) has been awarded doctoral fellowships from the prestigious Graduate Assistantships in Areas of National Need (GAANN) program of the U.S Department of Education. The fellowships will be awarded to about six prospective Ph.D. students conducting research in the general area of computational contaminant transport processes. Students are expected to combine field or laboratory research with mathematical modeling, and are expected to teach upper level undergraduate courses. The philosophy of this GAANN program is to produce university faculty to serve in the field of computational geosciences. The GAANN fellowships include full payment of tuition and fees, an annual stipend, and some funds for research supplies and travel for up to four years. The principal investigator is Dr. John McCray, an assistant professor in the Department of Geology and Geological Engineering (<http://www.mines.edu/~jmccray/>). Program faculty include Drs. Ning Lu assistant professor in the Engineering Division (<http://egweb.mines.edu/ninglu/>), and Tissa Illangasekare, professor in the Environmental Science and Engineering Division www.mines.edu/Academic/envsci/people/faculty/tillanga01.html.

Students will also be affiliated with the International Ground Water Modeling Center at CSM. Fellowships are still available for students enrolling in spring and fall semesters of 2001. For more information, contact Dr. McCray

College of Engineering and Applied Science Continuing Engineering Education Program FALL 2000 Schedule of Courses

Floodplain Delineation Using HEC-RAS

NCES 8320 – This hands-on, three-day course is designed to provide engineers, planners and other professionals involved in major drainage ways, floodplain delineation and other flood problems with a practical working knowledge of the latest version of the HEC River Analysis System (HEC-RAS). HEC-RAS is a Windows-®based PC program that computes steady-flow water surface profiles for subcritical, supercritical and mixed-flow regimes. The program was designed to replace HEC-2, and future editions will provide unsteady flow and sediment transport capabilities based on a single definition of river-reach data. This course will present what is new in Version 3.0 of the program, and cover river modeling, bridge and culvert hydraulics, GIS, HEC-2 data import, and floodway analysis. Each participant will receive a training certificate, a copy of the software, plus the User's and Hydraulics Reference Manuals. Instructors: Vernon Bonner, P.E., and James C.Y. Guo, P.E., Ph.D. Guest Speaker: John Y.D. Liou, P.E., Ph.D.

Dates: Aug. 16-19,2000 (Wed.-Fri.) Times: 8 am-4:30 pm (Wed. & Thur.), 8 am-3:30 pm (Fri.)
Location: Auraria Campus, downtown Denver Cost: \$895 — 2.0 CEUs

Western Water Rights and Water Engineering

NCES 8380 – This six-week, 16-hour course is designed for people who are interested in water resources. This course will emphasize Colorado water rights, but examples from other western states will be included. You will acquire valuable information in: development of the water rights doctrine; water institutions in Colorado; water rights changes, transfers, administration, and plans for augmentation; and the implications of the above factors for water resource management. The course will be taught from a professional engineering point of view, not a legalistic perspective. Instructor: Cheryl Signs, P.D.

Dates: Sept. 26-Oct. 31, 2000 (6 Tuesday Evenings) Time: 5:30-8:10 pm
Location: Auraria Campus, downtown Denver Cost: \$495 — 1.6 CEUs

For further information on any of the programs or to be added to a general mail list, contact the Continuing Engineering Education Program office: Phone: 303/556-4907, Toll Free: 877/8590-7304, E-Mail: csanders@carbon.cudenver.edu,
Website: www.cudenver.edu/public/engineer/cont

RESEARCH AWARDS AT COLORADO UNIVERSITIES

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, CO 80523

Title	PI	Dept	Sponsor
Status/Conservation of Mountain Plover	Wunder, Michael	FWB	DOI-USGS
NATO Advanced Research Workshop: Decision Support Systems for Integrated River Basin Management & Shared Water ...	Fontane, Darrell	Civil Engr.	NATO
Forest Management, Water Yield, & Water Quality: A State of the Art Assessment	Ward, Robert	CWRRI	No. Colo. Water Cons.Dist.
Fish Screen Efficiency Testing	Bestgen, Kevin	FWB	Metro Wastewater Rec.Dist.
Training Livestock Producers to Make Better Manure Management Decisions to Protect Water Quality	Davis, Jessica	SCS	Soc. for Range Mgmt.
Advanced Hydrometeor Identification of Severe Storms During STEPS ...	Bringi, Viswanathan	ECE	NSF
Technical Assistance for Monitoring of Performance in the Wildhorse Watershed	Valliant, James	CBE	NE Prowers Soil Cons. Dist
Technical Field Support for Wetland Management at Fort Drum, New York	Shaw, Robert	Forest Sciences	DOD-ARMY
GOCO/DOW FY 2000	Klein, Mary	FWB	CDOW
Water Quality Monitoring System Effectiveness Evaluation: Denver Water Case Study	Loftis, Jim	CWRRI	DOI-USGS
Forest Management, Water Yield, & Water Quality: A State-of-the-Art Assessment	Ward, Robert	CWRRI	DOI-USGS
Distribution, Habitat & Life History of Brassy Minnow in Eastern Colorado	Ward, Robert	CWRRI	DOI-USGS
Description & Interpretation of Salinization in the Lower Arkansas Valley	Ward, Robert	CWRRI	DOI-USGS
Sample Design & Analysis of Spatial Snowpack Properties	Elder, Kevin	Earth Res.	USDA-USFS-RMRS
Climate Ecosystem Interaction on East Asian Steppes: Implications of Climate Change & Land Use Intensity	Ellis, James	NREL	NSF
Studies of Homogenous & Heterogeneous Ice Formation in Upper Tropospheric Conditions	Demott, Paul	Atmos. Science	NSF
Fundamental Studies of Aerosol/Boundary Layer Cloud Interactions and Development of Parameterizations...	Cotton, William	Atmos. Science	NSF

FEDERAL SPONSORS: BLM-Bureau of Land Management, COE-Corps of Engineers, DOA-Department of the Army, DOE-Department of Energy, DON-Department of the Navy, DOT-Department 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, USBR-US Bureau of Reclamation, USDA/ARS-Department of Agriculture, Agricultural Research Service, USDA/NRS-Department 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 Department of Natural Resources, CDPHE-Colorado Department 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., CIRA-Cooperative Inst. for Research in the Atmosphere, DARE-Dept. of Agric. & Resource Economics, FWB-Fishery & Wildlife Biology, HLA-Horticulture & Landscape Architecture, NREL-Natural Resource Ecology Lab, NRRT-Nat. Resources Recreation & Tourism, RES-Rangeland Ecosystem Science. University of Colorado: AOI-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, 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.

Title	PI	Dept	Sponsor
Clouds & Ocean-Atmosphere Interactions in the Pacific Basin	Randall, David	Atmos. Science	DOE
Coordination of Central U.S. National Institute for Global Environmental Change (NIGEC) Integrated Assessment	Elliott, Edward	NREL	Univ. of CA-Davis
Parameterizing Subgrid-Scale Snow-Cover Heterogeneities for Use in Regional & Global Climate Models	Pielke, Roger	CIRA	DOC-NOAA
Effects of Competition from Hatchery Juvenile Chinook Salmon on Threatened Wild Late-Fall Run Chinook...	Fausch, Kurt	FWB	DOI-USBR
Water Quality Monitoring System Effectiveness	Ward, Robert	CWRRI	Denver Water
Application of LES to Understanding and Parameterizing the Arctic Cloudy Boundary Layer	Cotton, William	Atmos. Science	NASA
Interaction of the Cloudy Arctic Boundary Layer with Variable Surface Conditions ...	Randall, David	Atmos. Science	NASA
Utah-Wyoming Mountains Ecoregion Data	Klein, Mary	FWB	Nature Conservancy
Salinity Studies	Gates, Timothy	Civil Engr.	Bent Soil Cons. Board
Support for Threatened and Endangered Species	Shaw, Robert	Forest Sciences	USDA-USFS-RMRS
Recreation Instream Flow & Reservoir Assessment Truckee River (California/Nevada)	Aukerman, Robert	NRRT	DOI-USBR
Development of a Next-Generation Atmospheric General Circulation Model	Randall, David	Atmos. Science	DOE
Center for Earth Atmosphere Studies Tropical Efforts	Kummerow, Christian	Atmos. Science	NASA
A Synthesis of Data, Model-based Analyses & Refinements of Possible Management Scenarios	Hobbs, N Thompson	NREL	DOI-USGS
Constraints & Opportunities for Riparian Willow	Cooper, David	Earth Res.	DOI-NPS
Developing a Decision Support System for the South Platte Basin	Ward, Robert	CWRRI	Various "Non-Profit" Sponsors
Characterization & Improvement of Earth Observing Systems Land Products...	Hanan, Niall	NREL	Univ. of Nebraska
Rocky Mountain Network Inventory & Monitoring Program	Stohlgren, Thomas	NREL	DOI-NPS
Rio Grande Channel Maintenance Mode	Abt, Steven	Civil Engr.	DOI-USBR
Studies of Ice Nucleating Aerosol	Rogers, David	Atmos. Science	NASA
Inventory & Monitoring Natural Resource Status	Hannah, Judith	Earth Res.	DOI-NPS
Regional Forest-ABL Coupling: Influence on CO2	Denning, A Scott	Atmos. Science	Univ. of Minnesota
Inventorying & Monitoring Natural Resources	Loftis, Jim	CBE	DOI-NPS
Park County Biological Assessment	Spackman, Susan	FWB	Various "Non-Profit"
Consumptive Water Use & Irrigation Efficiencies in Mountain Meadows	Smith, Danny	SCS	Upper Gunnison River Water Cons. Dist.
Moisture Migration and Heave in Expansive Soils at the Tracon Building at Denver International Airport	Nelson, John	Civil Engr.	DOT-FAA
Atmospheric CO2 Inversion Intercomparison Project	Denning, A Scott	CIRA	DOC-NOAA
Applied Research in Support of Implementation of National Weather Service's Advanced Hydrologic Prediction	Adams, Christopher	CIRA	DOC-NOAA
Grassland Response to Precipitation Manipulation	Burke, Ingrid	Forest Sciences	NSF
Water Quality & Ecosystem Studies in Northwest Alaska	Binkley, Daniel	Forest Sciences	USDA-USFS
Tropical Rainfall Measuring Mission Sounding Studies	Johnson, Richard	Atmos. Science	NASA
Comprehensive Statewide Wetland Characterization & Classification	Culver, Denise	FWB	CDNR
Snow Distribution & Runoff Forecasting, Kings River Basin, California	Elder, Kevin	Earth Res.	DOD-ARMY
Population Dynamics of Mountain Plovers	White, Gary	FWB	DOI-BLM
Inventory of Water-related Structures Along the Cache la Poudre River Corridor	Alexander, Ruth	History	DOI-NPS
Colorado pikeminnow abundance estimation	Bestgen, Kevin	FWB	DOI-USBR

Title	PI	Dept	Sponsor
Evaluation of Stage fluctuations on Colorado Pikeminnow	Bestgen, Kevin	FWB	DOI-USBR
Seed Money for Evaluation of Wetscape in the Devils Lake Area	Garcia,Luis	CBE	DOI-USBR
CAREER: Genetic Engineering Approaches for the in Vivo Study of Plant Metabolism of Selenium & Other Oxyanions	Pilon-Smits, Elizabeth	Biology	NSF
Analysis of Data from Tropical Rainfall Measuring Mission...	Rutledge, Steven	Atmos. Science	NASA
Reclamation Plan for Summitville Super Fund Site	Redente, Edward	RES	CDPHE
Initial Implementation of a Monitoring Programs for Evaluation of Restoration Activities	Bestgen, Kevin	FWB	DOI-USBR
Larval Fish Laboratory Involvement in Implementing Recovery Actions for the Endangered Fish...	Bestgen, Kevin	FWB	DOI-USBR
Evaluation of Interspecific Sensitivity to Dietary Selenium Exposure: Razorback Sucker versus Flannelmouth...	Beyers, Daniel	FWB	DOI-USBR
Assessment of Drifting Larval Fishes in the Yampa & Green Rivers	Bestgen, Kevin	FWB	DOI-USBR
Testing a High-Sensitivity ATR-FTIR Water Monitor for Ionic CWA Breakdown Products	Strauss, Steven	Chemistry	DOD-ARMY
Incorporating New EOS Data Products into Models to Improve Estimates of Biogeochemical Processes	Randall, David	Atmos. Science	Univ.of Ca-Berkeley
Ecological Effects of Reservoir Operations on Blue Mesa Reservoir	Johnson, Brett	FWB	DOI-USBR
Riparian Vegetation Studies on the Green & Yampa Rivers	Cooper, David	Earth Res.	DOI-USBR
Applying Pam to Control Soil Erosion in Furrows in Western Colorado	Pearson, Calvin	Fruita Research Center	DOI-USBR
Yampa River Non-native Fish Control: Northern Pike Spawning & Nursery Habitat Evaluation	Hawkins, John	FWB	DOIUSBR
Dam Foundation Erosion Study	Ruff, James	Civil Engr.	DOI-USBR
Assessment & Prediction of Effects of Selenium on Razorback Sucker	Beyers, Daniel	FWB	DOI-USBR

**UNIVERSITY OF COLORADO
BOULDER, COLORADO 80309**

Title	PI	Dept	Sponsor
Information Management of Hydrologic and Reservoir Data for Support of the Lower Colorado River Operations and Planning	Zagona, Edith	CADSWES	USBR
International Research Workshop on Integrating GIS and Environmental Modeling: Problems, Prospects and Research Needs	Parks, Bradley	CIRES	EPA
Assessing Future Stagility of US High Plains Landcover: Integration of Process Modeling with LANDSAT, In Situ Modern and Paleoclimate Data	Goetz, Alexander	CIRES	NASA
Application of Satellite SAR Imagery in Mapping the Active Layer of Arctic Permafrost	Zhang, Tingjun	CIRES	NASA
Standard Global Snow Cover Products from Satellite Remote Sensing	Armstrong, Richard	CIRES	NASA
Advancing Glaciological Applications of Remote Sensing with EO-1	Serreze, Mark	CIRES	NASA
A Regional, Integrated Monitoring System for the Hydrology of the Pan-Arctic Land Mass	Stroeve, Julienne	CIRES	NASA
Evaluation and Error Assessment of Operational Passive Microwave Sea-Ice Algorithms	Barry, Roger	CIRES	NASA
Snow and Ice Distributed Active Archive Center	Barry, Roger	CIRES	NASA
Understanding the Physical Basis of ENSO, ENSO Predictability, and the Relationship to Intraseasonal Variability Using a Hierarchy of Coupled Atmosphere-Ocean Models	Moore, Andrew	CIRES	NSF

Title	PI	Dept	Sponsor
Inuit Knowledge of Climate Change in the Eastern Canadian Arctic	Barry, Roger	CIRES	NSF
Ecophysiological Roles of Plants, Mycorrhizae, and Soil Microbes in Early Spring Nitrogen Dynamics	Schmidt, Steven	EPOB	NSF
Labrador Sea Variability Over Decade to Millennial Time Scales	Overpeck, Jonathan	IAAR	NSF
Nature of Late Pleistocene Climatic Ameliorations in Eastern Beringia	Elias, Scott	IAAR	NSF
Impact of Water Quality on the Inactivation of Bacterial and Viral Pathogens	Amy, Gary	CEAE	U.S. Filter



WATER NEWS DIGEST

by *Emile Hall*

AWARDS

River plan wins national honor

The Roaring Fork and Frypan Rivers Multi-Objective Planning Project was given the Local Award for Excellence for a Plan during the annual conference of the Association of State Floodplain Managers. The project's report and accompanying digital maps already are being used as models for a study on the Rio Grande River in Colorado's San Luis Valley, and also are being examined by New York City's water department as it prepares to study its watersheds in nearby mountains. The Colorado Water Conservation Board (CWCB) and the Colorado River Water Conservation District (CRWCD) have agreed to house the digital mapping element of the plan at the CRWCD offices in Glenwood Springs. The CWCB obtained funding from the State Legislature for the investigation of problems related to flooding after 1995 flooding hit Basalt and other areas of the two rivers. The BRW consulting firm conducted the study, with the help of the Ruedi Water and Power Authority. While river instability was the most significant issue that was explored, recreation, transbasin diversions and water quality also were examined. Accompanying digital map layers were developed to display information including areas of high river instability, stream gauge locations, major in-stream diversions and public access for fishing and boating. For more information about accessing the map information, contact Don Meyer at the river district, 945-8522.

Glenwood Post, 6/23/00

BIOLOGY

DOW biologists snatching toads to revitalize population

Boreal toads - *bufo boreas boreas* - live at elevations between 7,000 and 12,000 feet. They are important to ecosystems and biologists who study them because they are an indicator species, meaning their demise can be indicative of a larger underlying problem affecting their habitat. Problems can range from pollution to the effects of encroachment of humans on their habitat. What's affecting toad populations in Colorado, however, isn't so much development, as many believe, but a fungus. Chytrid is a water-borne fungus that spreads via direct contact from toad to toad and by a spore that moves short distances through the water. Researchers have yet to determine how the fungus travels from one geographical area to another, so they don't know how it arrived in Colorado. Toads from 12 different sites throughout Colorado are being taken to a rare-aquatic species hatchery in the San Luis Valley. The John W. Mumma Native Aquatic Species Restoration Facility, which opened earlier this month, plans to restore Colorado's threatened and endangered fish, amphibians and mollusk populations. Researchers will study the chytrid fungus that was just last year found to be responsible for a worldwide decline in the toad population. Scientists are also working on a treatment to kill the fungus.

Summit Daily News, 7/10/00

BYPASS FLOWS

District, forest work together on bypass flows

Controversy over water language in a proposed White River National Forest management plan has prompted a neighboring forest to undertake a collaborative effort to avoid a similar dispute. The Grand Mesa-Uncompahgre-Gunnison National Forest has formed a public task force that will provide input on how to resolve questions over the agency's desire for bypass flows on its lands. Peter Kasper of Delta, a member of the Glenwood-based Colorado River Water Conservation District board, told fellow board members that he is serving on a group that includes Forest Service, water and other interests and will look at water needs in the forest and how to meet them. Initial discussions have been general, as the agency hasn't yet been ready to talk about specifics, Kasper said.

Glenwood Springs Post, 7/20/00

Low water at John Martin Reservoir allows for maintenance

Incredibly low water conditions at John Martin Reservoir will allow for maintenance on the 16 tainter gates. In early July, for the first time in six years, the water level dropped below the upper gates. Personnel from the U.S. Army Corps of Engineers (COE) will open the gates in groups of four to perform the necessary maintenance. As of July 10, the reservoir had 215,400 acre-feet of water behind the dam, with 109,000 acre-feet belonging to Kansas, approximately 6,000 belonging to the Division of Wildlife and the remainder belonging to Colorado. Additionally, 1,250 cfs (cubic feet per second) were being released, with about half going to Colorado and the other half to Kansas. The COE stated this was the fourth week more than 1,000 cfs of water was released. It believes the large amounts of water being released daily will continue through Oct. 1. Just a year ago, the reservoir hit a peak elevation of 3,860.45 feet. Heavy rains in April and May caused the reservoir to swell, and during its peak, 2,750 cfs of water was being released.

La Junta Democrat, 7/14/00

Water level drops at Horsetooth

Horsetooth Reservoir's water level was expected to drop to at or below restricted water levels after Labor Day in preparation for extensive dam modernization work set to begin in October or November and continue over the next three to five years. However, drought conditions have accelerated the draining process because of an increased need for water by farmers, according to the Northern Colorado Water Conservancy District. "It's going down, right down," said Brian Werner, a spokesman for the district. "We're bringing it down about a half-foot a day and will be doing that for the next two weeks." The current elevation of Horsetooth Reservoir is 5,384 feet, or about 47 percent of its capacity. It was at its highest elevation in March, when the reservoir was at 5,413 feet. Werner said it's likely the reservoir could drop to 5,378 feet by the end of July. This fall the U.S. Bureau of Reclamation begins a 3-to-5-year project to modernize the reservoir's four dams.

Fort Collins Coloradoan, 7/21/00

PEOPLE

Marc Reisner Memorial

Marc Reisner, writer, conservationist and lecturer, died July 21, 2000 of cancer at his Marin County home. He was 51. Reisner wrote and lectured extensively on environmental issues, but he was best known for his 1986 book, "Cadillac Desert," a wake-up call about the West's scarce water resources. It stimulated a campaign for water policy reform that continues to the present. The book was the basis for a \$2.8 million documentary film series, which was first shown on national Public Broadcasting stations in 1997. The film won a Columbia University/Peabody Award. "Cadillac Desert" was ranked by the Modern Library as 61st among the 100 most notable nonfiction English language works published in the 20th century. Reisner also wrote "Game Wars," (1991) and co-wrote the "Overtapped Oasis" (1989). He is remembered as a person determined to mitigate the environmental problems he wrote about. He actively pursued protecting and restoring aquatic environments through involvement with the Pacific Coast Federation of Fishermen's Association, the Ricelands Habitat Partnership, the Natural Heritage Institute and other groups. He lectured extensively on environmental issues; last year Reisner stimulated thoughts as the keynote speaker at CSU's Student Water Symposium. Recently, Reisner was awarded a Pew Fellowship in marine conservation. He intended to use the funds to restore native salmon habitats in California. His elegantly written books, essays and articles will be missed, as will his conviction for western water and wildlife issues.

San Francisco Chronicle, 7/24/00

RECREATION

John Martin park plan open for discussion

State and federal officials hosted a public meeting in July to discuss the proposed Colorado State Park at John Martin Reservoir. Area legislators, local elected officials, and representatives from the State Department of Natural Resources (DNR), the U.S. Army Corps of Engineers (COE), the Colorado Division of Wildlife and Colorado State Parks were available to answer questions. The parks department is negotiating with the COE for a recreational lease on part of the John Martin project, including the Lake Hasty area below the dam, the northeast shore of the reservoir from the dam westward to the waterfowl closure line, and the lake's surface. The John Martin proposal carries with it \$5 million in state GOCO funding that would go toward a visitors center, restrooms, parking, camping sites and other amenities. Greg Walcher, DNR director, said in an interview that the COE already has signed a letter of intent to turn over all recreation management and development to the state while maintaining management of existing physical resources. The deal would be nearly identical to those that govern Chatfield, Cherry Creek and Trinidad reservoirs and state parks, Walcher said. There will be additional public meetings in August to determine how the state can best develop and manage the park in cooperation with local businesses, residents and community leaders.

Pueblo Chieftain, 7/12/00

Water board seeks ways to secure future of High Line Canal

The High Line Canal wends its way through 66 miles of Denver's urban area. Every day, thousands of metro area residents hike, walk, jog or bike along the path that runs beside it. The canal is a much-loved feature of the Denver metropolitan landscape, one that is destined to change over the next decade. Four years ago, the Denver Water Board adopted a policy statement that states future growth in its service area is to be supplied first by conservation; second by the construction of a plant to recycle water to a non-potable standard for industrial and outdoor use; and, only as a last resort, from the construction of new facilities. As a result of this policy, Denver Water has been looking for efficiencies in its own system that save water, and an obvious candidate is the High Line Canal. A group is already in place to explore what the future of the canal might be. Funded by a

GOCO grant, the Future Management Study group, in cooperation with Denver Water, is conducting a number of studies to determine how best to preserve this important recreational corridor.

Denver Post, 6/4/00



WATER ADMINISTRATION

Water district weighs taking reins to Fry-Ark project

The Southeastern Colorado Water Conservancy District wants to take over operations and maintenance of the Fryingpan-Arkansas Water Project from the U.S. Bureau of Reclamation. At a special meeting Thursday, district board members agreed to proceed with a feasibility study to find out how much money the district would save and what exactly would be involved. The project collects Western Slope water and moves it to cities and farmers in the Arkansas Valley. The district collects a property tax in nine counties in the valley to pay for the project, which includes Lake Pueblo, Twin Lakes Reservoir and several other facilities. Last year the district paid USBR about \$600,000 for operations and maintenance of the project, but that amount also includes a share of overhead expenses at USBR area and regional offices in Loveland, Denver and other locations. Consultants, hired by the district to research the issue, said other water districts that have taken over their own operations and maintenance work have saved anywhere from 5 to 30 percent of what they had been paying USBR. The bureau would still oversee the project and keep control of water scheduling and power generating in project facilities, USBR area manager Gerald Kelso said. District board members will continue the discussion in September.

Pueblo Chieftain, 6/30/00



WATER DEVELOPMENT/SUPPLY

Administration supports scaled-down version of Animas-La Plata Project

Legislation authorizing a scaled-down version of the long-delayed Animas-La Plata water project (S2508) recently received strong, if conditional, support from the Clinton administration. Since 1868 the United States has failed to meet its treaty obligations to the Colorado Ute tribes. The legislation, designed to satisfy those obligations, would authorize construction of a dam and reservoir capable of a 57,100 acre-feet per year diversion. Out of those 57,100 acre-feet, the Southern Ute and Ute Mountain Ute Indian tribes would each get 16,525 acre-feet per year; the Navajo Nation would get 2,340 acre-feet per year; the San Juan Water Commission would get 10,400 acre-feet per year; the A-LP Conservancy District would get 2,600 feet per year; the state of Colorado would get 5,230 acre-feet per year; and, the La-Plata Conservancy District of New Mexico would get 780 acre-feet per year.

The legislation and its companion measure in the House have gone through a series of committee approvals over the past few months. Work is underway to resolve three issues the administration has with the legislation: environmental compliance language; deauthorization of the original A-LP project; and repayment obligations. The environmental compliance language of concern states that, in the event of litigation challenging the adequacy of the environmental analyses on the project, the government may assert that the A-LP project settles the Utes' water claims "in a manner that provides the most benefits to, and has the least impact on, the quality of the human environment." Opponents are concerned that the proposed language limits court challenges under the National Environmental Policy Act, the law requiring the A-LP environmental review. The second issue is that of rescinding previous congressional authorization for the larger A-LP project. Finally, there are concerns about the repayment by the non-Indian partners in A-LP of their share of the project's costs up front, before final costs have been determined.

Committee action - The Senate Indian Affairs Committee approved the A-LP bill on June 14, 2000. The Senate Energy Committee also has jurisdiction over A-LP, and may choose to consider the project or it may go directly to the Senate floor. On June 30, 2000 the Environmental Protection Agency gave preliminary approval to the proposed A-LP project. In a June 23 letter, EPA Acting Regional Administrator Rebecca Hammer notified Pat Schumacher, the Bureau of Reclamation's southern division manager, that the 120,000-acre-foot reservoir was the least environmentally damaging alternative to resolving Colorado Utes' senior water rights. The reservoir was chosen over a nonstructural alternative that proposed the federal government buy agricultural water rights and transfer them to the tribes for municipal and industrial uses. Opponents of the project accuse USBR of attempting to make the reservoir option more attractive than other options. On July 14, 2000, USBR issued a final environmental report on the A-LP project again declaring that filling a reservoir the best way to settle Southern Ute and Ute Mountain Ute tribal claims. After the controversial environmental compliance wording in the House form of the A-LP bill was removed, the House Resources Committee approved it by voice vote on July 19, 2000.

Durango Herald - 6/8/00; 6/14-15-16/00; 6/30/00 7/15/00; 7/19/00; 7/20/00, Denver Rocky Mountain News Washington Bureau - 6/15/00, Denver Post - 7/20/00

Water Districts looking for agreement with Denver

Local water districts in Eagle County, which include the Eagle River Water and Sanitation District, the Upper Eagle Water Authority and Vail Resorts, currently lack an arrangement with Denver about its water rights in the Vail Valley. Local water officials are looking for an arrangement similar to memoranda of understanding they have with other cities. "Denver owns significant water rights in Eagle County," says attorney Glenn Porzak, whose firm represents the three organizations. If these projects were put in place, Denver "would basically seek to take all of the remaining flows, particularly in the spring and the early summer," he said. Denver currently has four major somewhat inter-related projects on the drawing board, according to David Little, manager of water resources for Denver Water. The projects would use a gravity diversion facility at the headwaters of the

Eagle River, one at the headwaters of the Piney River and a third diversion facility at the water reservoir in Wolcott. These three collections would then be pumped from Wolcott over Vail Pass and into the Dillon Reservoir. Denver Water has had these projects on the drawing board since before 1974, when the group commissioned a study to see what it could do with its water resources in the Vail Valley. Use of these water rights is not expected until at least 2030, Little said, but local water officials are somewhat uneasy. Eagle River Water and Sanitation District General Manager Dennis Gelvin said the districts contacted Denver Water to set up a joint meeting, but a date has not yet been set. The district would like something similar to the arrangement it has with Colorado Springs and Aurora, a memorandum of understanding among the three cities, which came about after an effort to acquire Eagle Park Reservoir. Without it, the local districts could have possibly conflicted with water rights owned by the two cities. But now, Colorado Springs and Aurora water officials yielded some of their water rights to the Eagle River Water and Sanitation District. Colorado Springs and Aurora also agreed to limit future diversions from the Eagle River basin to less than one-third of what they could have developed, Porzak said. They also abandoned any rights to develop within the wilderness area so that any future development would be placed somewhere between Climax and Camp Hale. What Aurora and Colorado Springs got in return was the commitment by the Eagle River Water and Sanitation District that they would not oppose the permitting for any future project that was environmentally and politically reasonable.

Vail Daily, 7/21/00

River district chips in for Ruedi economic study

The board of the Colorado River Water Projects Enterprise, part of the Colorado River Water Conservation District (CRWCD), has agreed to approve in concept spending up to \$16,000 for a study of the impacts of Ruedi Reservoir and the Fryingpan River on the area economy. The total study cost is estimated at \$30,000, and plans are for Homestake Partners, which consists of the cities of Colorado Springs and Aurora, to fund the other \$14,000. The Roaring Fork Conservancy, a local non-profit organization concerned with river issues in the Roaring Fork Valley, will conduct the study over 18 months. The study comes amid longstanding tensions between water users such as angling outfitters and reservoir operators, who are trying to put the facility to other uses. River district officials and other local water interests hope the study will be only one in a series aimed at evaluating Ruedi's future, and operations there that would harm or hurt the local economy. The economic study could prove helpful to the U.S. Bureau of Reclamation as it conducts environmental impact analysis on a proposal that would lay out Ruedi's participation in the endangered fish program over the next 12 years. Until now, the releases have been conducted on a year-to-year basis. The study also could have implications for a conceptual proposal by Aurora and Colorado Springs to use Ruedi Reservoir water to meet their growing municipal needs. As an alternative to other water projects, the cities are studying the possibility of pumping Ruedi water over the Continental Divide each winter. The diversion could cut wintertime flows in half on the lower Fryingpan, and some anglers already fear that flows are too low that time of year for the fish. The river district is not endorsing the pumpback project, and Aurora and Colorado Springs have emphasized its tentative, long-term nature. A Colorado Division of Wildlife official has said DOW scientists probably would be involved in analyzing the impacts of such a proposal before any decision on it would be made. Eric Kuhn, CRWCD manager, wrote in a memo to river district board members that another question with Ruedi is how to address repayment issues associated with the 12-year endangered fish contract. Interest, operation and maintenance costs need to somehow be addressed, he said.

Glenwood Springs Post, 7/20/00

Aurora water bid goes to court

State Water Court case No. 96CW15, now four years in the works, centers on Aurora's proposal to tap into the South Park aquifer beneath County ranchlands and then refill the underground "reservoir" in wet years. The attorney for the Sportsman's Ranch, Aurora's partner in the South Park Conjunctive Use Project (CUP), calls it "...the vanguard of a new era." But fearing that the project will drain their water from underneath them, dozens of objectors have lined up against the so-called CUP, including the federal government, the state engineer, the Denver Water Board, water-conservancy districts, local ranchers and homeowners, and two Park County boards set up by separate taxes that voters approved in 1997. "This is the Owens Valley of Colorado," said Jeff Kahn, an attorney whose firm represents the Upper Colorado Water Conservancy District and Park County. He referred to the battle over water for Southern California depicted in Marc Reisner's famous book "Cadillac Desert." Considered a potential landmark in Colorado's water law, the case that Aurora will present to Judge Jonathan Hays relies almost entirely on unproven computer models to demonstrate that no other water supplies will be dried up inadvertently in tapping the aquifer beneath the Sportsmen's Ranch. But opponents, representing virtually all of the state's major water interests outside of Aurora, say the computer models are badly flawed, the hidden system underground would fail to work as intended, the city doesn't own sufficient water rights to refill the aquifer when necessary, and the project most certainly would harm other water users. The debate centers on using the aquifer as underground storage and supply: unseen, difficult to measure and a potential drain on water from nearby wells and streams that are also connected to the aquifer.

Denver Post, 7/11/00

Longmont adopts water supply rule

The Longmont City Council has adopted minimum standards or "benchmarks" for water supply, sewer infrastructure and water quality. The city will use a rule formally requiring that the city have enough water to meet projected demand 10 years in the future, based on a severe, 100-year-drought scenario. The requirement exceeds that of some other cities on the Front Range, which use guidelines based on surviving a 20-year or 50-year drought. For water quality, the city will use state and federal requirements as benchmarks.

Boulder Daily Camera, 7/13/00





WATER QUALITY

New non-point source pollution rules adopted

The Clinton administration recently adopted new rules on non-point source pollution that would force states to limit water pollution from fertilizer, animal waste, lawn herbicides and other indirect sources flowing into polluted waterways. In the past, pollution controls were aimed mainly at point source polluters such as sewage treatment plants, factories and other facilities piping pollutants directly into rivers and streams. Carol Browner, EPA administrator, said non-point source pollution is the "greatest remaining threat to America's waters." The EPA's new non-point source regulations prompted Republicans and major business groups to attach a "rider" to an unrelated military and emergency spending bill supported by the administration. The rider was intended to ban the EPA from spending any money promulgating a new clean water regulation. In response, President Clinton delayed signing the spending bill until the EPA had finished the rule, so congressional language barring new rules would not apply to what the EPA had already written. The EPA compromised on the final version of the rule by dropping the requirements for federal permits, and delaying the effective date of the rule until Oct. 1, 2001.

Boulder Daily Camera - July 12, 2000

Council opposes 20-acre well development

Raising concerns about drilling densities, the deterioration of the county road system, and the quality of aquifers, the Rifle City Council on June 21 unanimously passed a resolution formally opposing 20-acre natural gas well spacing. The council said it is the desire of the City to not allow 20-acre natural gas well spacing in the area south of the Colorado River between Rifle and Parachute. The city wants to protect the Beaver Creek watershed south of town. Although it is not the primary source of water for the community, the small water plant can produce up to one million gallons a day. Typically, in Spring and Summer, it produces between 300,000 and 500,000 gallons per day. However, it serves an important secondary function. It is also the insurance policy in case something were to happen to the Colorado. The Colorado Oil and Gas Conservation Commission will hear comments on two applications at a public hearing August 21 and 22, and a final determination will be made at the September COGCC meetings.

Rifle Citizen Telegraph, 7/5/00

Tainted land, water vex area farmers

Salty land and high groundwater tables have ruined enough farm ground in the lower Arkansas Valley to force at least a few farmers to consider using their irrigation water on new land. Jim Valliant, an irrigation specialist with Colorado State University, hosted a meeting on the subject June 8. He said he estimates the loss of cropland due to salty conditions at between 10 and 15 percent of the valley's roughly 250,000 farmable acres. Water in the river is relatively clean between Leadville and Pueblo, but starts absorbing salts at an exponential rate as it flows downhill to Kansas. One study showed river water readings of only 500 parts-per-million of salts at Pueblo accompanied by readings of 1,500 ppm at La Junta and 4,000 near Lamar. Salt levels over 2,000 ppm start hurting the yields of crops like alfalfa and corn, according to Valliant. A recent CSU study showed that yields in "a high percentage" of fields are lower because of salt damage. Part of the reason the river gets saltier is because of the irrigated farming the river sustains in the valley. Irrigation water that isn't used by the crops flows back to the river with all the salts and other chemicals it absorbs flowing down the ditches and across the fields. Ordinarily, salts that are left behind in cropland can be rinsed below the crops' root zone, but that isn't happening in more and more fields. Instead, high groundwater tables leave the salt at the surface where it hurts plants and concentrates because sun and wind evaporate away the pure water. With more and more land turning a crusty white, Valliant said he thinks the situation has become a crisis. One way to avert it, he said, is to allow farmers to turn their existing water on new, un-irrigated lands, using new and more efficient irrigation techniques. For example, Valliant said a farmer below an irrigation canal could stop watering their old fields, plant them with a salt-tolerant grass and use the water above the canal where there's never been farming. If the farmer used techniques such as low-flow center-pivot sprinklers or buried drip lines, they could use less water and improve the water quality in the river. A fight in water court is probably likely, given that other farmers will worry that the return flows from a new farm won't contribute as much to the valley's overall water supply. Farmer Ed Blackburn said canal companies down the river may assume the return flows will flow back into the farmer's canal instead of straight to the river, as they used to. There's also a potential problem with Colorado water law, which doesn't allow someone who starts using less water to keep any of the water they save. Regardless, Valliant said something has to be done or the valley's agriculture economy is headed downhill along with the crop yields. Rocky Ford farming equipment dealer Jim Moreland agreed. "If we don't do something pretty quickly," he said, "we're going to lose the assets to have an agricultural economy."

Pueblo Chieftain, 6/9/00

Residents say Rito Seco water plan will contaminate water supply

Nearly 100 people attended a public hearing in late June to criticize a plan by the Battle Mountain Gold Co. to discharge treated water into Rito Seco Creek in the San Luis Valley. The hearing was held by the Water Quality Control Division of the Colorado Department of Public Health and Environment. Battle Mountain Gold Co. no longer operates, and last Aug. 20 the company was issued a notice of violation and ordered to stop discharging into the stream. Residents said that discharge from the mine's west pit is contaminating the water supply with elements such as cyanide, manganese, sulfates, fluoride, iron, aluminum and copper. Leroy Medina, president of the San Luis Water and Sanitation District, suggested that the state require the company to drill wells on Shalom Ranch and monitor them. The manager of the state health department's water quality protection section said such wells should be closer to the mine's west pit from which the discharges are occurring. No one was present from Battle Mountain Gold.

Pueblo Chieftain - 6/30/00



West Rifle groundwater pilot project planned by DOE

A pilot project to help determine whether contaminated groundwater underneath a 238-acre parcel west of Rifle can be cleaned of high levels of vanadium is planned for this fall, according to U.S. Department of Energy (DOE) officials. Until results are gathered, a final environmental assessment will be withheld. Meanwhile, city of Rifle and Garfield County officials continue to work with DOE to extend municipal water and sewer service to the New Rifle uranium mill tailings site, which is felt to be a prime location for future development. The project manager for the DOE's prime contractor said the pilot project will involve pumping contaminated groundwater to the surface, treating it with a still-to-be-determined method, then returning the water underground. He said vanadium tends to bind to soils, so the 6-9 week pilot project will help determine if the mineral can be removed without more extensive actions. Vanadium is one of several contaminants of concern at the site, the result of past uranium processing operations. The others are uranium, molybdenum, selenium, ammonia, fluoride and arsenic. Treatment is believed possible by allowing the estimated 600 million gallon plume of contaminated groundwater to naturally leach into the Colorado River over the next 100 years. However, since vanadium sometimes binds to the soils, leaching may not remove it to safe drinking water standards during that period. The plume, less than 30 or 40 feet below the surface, extends about three miles west from the New Rifle site. Water in the plume flows southwest at an average of 300 feet per year. No immediate health threats exist, since the contaminated groundwater is not used for consumptive purposes. The DOE last year estimated an engineered pump and treat process to remove all the contaminants would cost between \$10 million and \$40 million, while natural flushing would likely cost \$1.5 million over 100 years. Several years ago, around three million cubic yards of tailings from the New and Old Rifle sites were trucked by DOE contractors to the Estes Gulch disposal cell, about nine miles north of Rifle. The tailings were then encapsulated to prevent any further environmental concerns. The groundwater cleanup project is the second stage in the Uranium Mill Tailings Remedial Action program. The smaller Old Rifle site east of the Colorado River bridge has an estimated 70 million gallons of contaminated groundwater. It could be declared clean within ten years. Zoning language is under development by the county that would prevent use of the contaminated groundwater for drinking, but still allow its use for irrigation and such. The proposed agreement would likely require anyone who develops property adjacent to the New Rifle site to use a reverse osmosis water treatment process if groundwater is to be consumed. The DOE is to pay for those units, but is hesitant to accept responsibility for the vanadium collected. Ownership of the New and Old Rifle sites is planned to be transferred from the Colorado Department of Public Health and Environment to the city through a quit claim deed, but liability concerns must be addressed first.

Rifle Citizen Telegram, 6/14/00

County wants more studies on infill wells

La Plata County wants more information on methane gas and better monitoring of water being injected into aquifers before new coal-bed methane gas wells are approved. County officials hope the Colorado Oil and Gas Conservation Commission attaches conditions to infill applications that would allow one gas well every 160 acres instead of one every 320 acres. The application could result in more than 630 new wells in southern La Plata County. Chief among the county's 18 proposed conditions for the wells is the need for more computer models of expected effects on methane seeps and water aquifers near the Fruitland Outcrop. Those models would determine where additional drilling can safely occur, said the county's oil and gas technical adviser. The county is advocating that more models be created in the 3M Coalbed Methane Reservoir Model. The 3M study, which stands for mapping, modeling and monitoring, is funded by the Southern Ute Indian Tribe, COGCC and Bureau of Land Management. The county also wants monitoring plans for wells used to dispose of water extracted from the ground during gas production. Disposal wells are used to reinject the billions of gallons of water extracted during production back into the ground. Water produced during pumping can only be injected into aquifers where existing water is of poorer quality. This should mean that reinjection increased water quality, but that has not necessarily been the case, he said.

Durango Herald, 6/12/00

American Soda granted key drilling permit by EPA

More than a year after starting the permitting process, American Soda, L.L.P. recently received their final permit. The U.S. Environmental Protection Agency gave final approval to a mining permit called an underground injection control permit. American Soda will use hot water under high pressure to solution mine up to 1.4 million tons a year of nahcolite from wells on 1,000 acres of federal lands in Rio Blanco County. The nahcolite will be refined into soda ash and baking soda and transported through a 44-mile long pipeline to the former Unocal shale oil upgrade plant north of Parachute. From there it will be loaded onto rail cars and trucks for shipment to market. Soda ash is used to make glass and other products.

Rifle Citizen Telegram, 7/12/00

Kansas decries Arkansas River water quality

Kansas is complaining about the quality of Arkansas River water and may seek federal intervention to get it improved. Pat Edelmann of the U.S. Geological Survey told Directors of the Southeastern Colorado Water Conservancy District at their monthly meeting that he and state health and water officials met recently to discuss the news, which could have an enormous impact on the Arkansas Valley. Kansas is said to want the river's sulfate concentrations reduced to the recommended drinking-water threshold of 250 milligrams per liter, Edelmann said. He added that would be hard to do, because the river usually holds concentrations of 2,000-3,000 milligrams per liter at the state line. Reducing the concentrations could not be done by halting farm operations or any other measure, short of processing river water through a desalinization plant, he said. It's not clear how Kansas could or will pursue the cleanup demand, which would not be part of the pending lawsuit between Kansas and Colorado over Arkansas River flows.

Pueblo Chieftain, 6/16/00



CALLS FOR PAPERS



CALL FOR POSTERS

**Money Flowing Through the South Platte Basin:
The Business of Water**
11th Annual South Platte Forum — Oct. 24-25, 2000
Raintree Plaza Conference Center
Longmont, Colorado

Accelerated, relentless growth is rapidly changing the South Platte Basin. Water is more valuable than ever before. This increased value of water, coupled with the changing landscape, puts a new focus on the economic factors that determine how our limited water supply is allocated and reallocated. The 11th Annual South Platte Forum will present multi-disciplinary dialogue to explore these issues around the "Business of Water." You are invited to submit a one-page abstract to the organizing committee for a planned poster presentation. The posters can focus on water habitat, quality, quantity, economic, supply, demand and agriculture issues. The posters will be displayed during breaks and an informal social hour on October 24. Poster abstracts are due by September 8, 2000. To submit abstracts or request information, please call or write:

Jennifer Brown
Colorado Water Resources Research Institute
410N University Services Center
Fort Collins, CO 80523-2018
Phone: (970)587-4778 or (970)491-6308
Fax: (970) 491-2293

MEETINGS



COLORADO RIPARIAN ASSOCIATION ANNUAL CONFERENCE
SAN MIGUEL RIVER WATERSHED RIPARIAN AREAS AND WETLANDS
October 4-6, 2000 — Telluride Colorado

The CRA's annual conference will focus on the San Miguel River watershed. The conference will begin with a half-day field trip on the San Miguel River, continue with a full day of presentations at the Telluride Conference Center and end after a half day field trip focusing on wetland restoration at the Telluride Ski area. Early registration (by September 8) is \$85 for non-members and \$110 for non-members (includes one-year membership fee). Register early and plan to enjoy both the conference and Southern Colorado in the fall. For more information contact Alan Carpenter 303-443-8094; atcarpen@bouldernews.infi.net.



CONFERENCE ON TRANSBASIN WATER TRANSFERS
June 27-30, 2001 — Denver, Colorado

The conference will feature five half-day Technical Sessions, a Poster Session, and a one-day study tour to see two major Colorado transbasin water projects. Contact: Larry D. Stephens, Phone 303/628-5430, FAX 303/628-5431, E-mail stephens@uscid.org. See the USCID web page at www.uscid.org/~uscid. Conference sponsored by U.S. Committee on Irrigation and Drainage. Co-Sponsors are the Bureau of Reclamation, Garrison Diversion Conservancy District and Northern Colorado Water Conservancy District.



COLORADO WATER CONGRESS

2000 Summer Convention
Manor Vail Lodge, 595 East Vail Valley Drive, Vail, CO
August 24-25, 2000

CWC Workshop – A Review of Federal Environmental Laws
CWC Conference Room, 1580 Logan St., Suite 400, Denver, CO
November 15, 2000

Colorado Water Law Seminar
CWC Conference Room, 1580 Logan St., Suite 400, Denver, CO
September 11-12, 2000

CWC 43rd Annual Convention
Holiday Inn – Northglenn, I-25 & 120th Ave., Northglenn, CO
January 25-26, 2001

For details and registration forms see the CWC web page at <http://www.cowatercongress.org> or contact the Colorado Water Congress at 303/837-0812.



Money Flowing Through the South Platte Basin: The Business of Water

11TH ANNUAL SOUTH PLATTE FORUM, October 24-25, 2000

Raintree Plaza Conference Center, Longmont, Colorado

KeynoteSpeakers: ✓ Governor Richard Lamm ✓ Bill Jackson, Greeley Tribune ✓ David Robbins, Hill and Robbins

To request information about the conference, contact:

Jennifer Brown
Colorado Water Resources
Research Institute
410N University Services Center
Fort Collins, CO 80523-2018

Phone: 970/587-4778
or 970/491-6308

FAX: 970/491-2293

Changing conditions in the South Platte: Can we supply the demand?

Dr. Evan Vlachos, Sociology Department, CSU

Dr. Marie Livingston, Economics Dept., UNC

Eric Wilkinson, No. Colo. Water Conservancy District

Steve Board, HydroLogic Technology

The skyrocketing price of water -- Are we getting soaked?

Frank Jaeger, Parker Water and Sanitation District

Mike Applegate, Larimer/Weld Water Issues Group, Tuttle Applegate

Everett Schneider, WW Auctions and Real Estate

How much green to keep it clean?

Dr. John Loomis, Dept. of Agricultural and Resource Economics, CSU

Laurie Rink, Mile High Wetlands Group

Jack Odor, Groundwater Appropriators of the South Platte (GASP)

Bob Sanderson, Ducks Unlimited

Growing crops or growing houses -- Rural vs. urban water competition

Barbara Kirkmeyer, Weld County Commissioners

Dr. Marshall Frasier, Dept. of Agricultural and Resource Economics, CSU

Tom Pointon, Arkansas Valley



WATER SUPPLY

June saw the expected dramatic declines in stream flows after early peaks in May, resulting in many water users calling for their storage rights from reservoirs. These combined declines in water supply translated into lower SWSI values in all river basins, except the South Platte. Absent significant rainfall, reservoir levels are anticipated to continue to decrease and refilling in preparation for next season is unlikely. The water divisions report heavy administration required in response to the below normal water supplies.

The Surface Water Supply Index (SWSI) developed by this 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 stream flow, reservoir storage, and precipitation for the summer period (May through October). During the summer period, stream flow is the primary component in all basins except the South Platte basin, where reservoir storage is given the most weight. The following SWSI values were computed for each of the seven major basins for July 1, 2000, and reflect conditions during the month of June.

Basin	7/1/00 SWSI Value	Change from the Previous Month	Change from the Previous Year
South Platte	1.5	+0.2	-0.2
Arkansas	0.9	-1.3	-1.6
Rio Grande	-3.1	-1.2	-5.0
Gunnison	-1.4	-2.4	-3.0
Colorado	-0.9	-0.7	-2.1
Yampa/White	-2.6	-3.7	-3.4
San Juan/Dolores	-1.7	-1.9	-3.2

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

Colorado Water Conservation Board Basin Meetings Coming this Summer and Fall

The Colorado Water Conservation Board (CWCB) will be holding a series of open house meetings from August through December 2000. The meetings, to be held in locations throughout the state covering each of Colorado's eight major river basins, will each be hosted by the Board Member representing that basin, along with CWCB staff. Reports on the meetings will be prepared and provided to all of the Board Members, and summaries will be posted on the CWCB web site (<http://cwcb.state.co.us>). These meetings and the subsequent meeting reports will be an important component in the revision of CWCB's long-range plan.

The CWCB was created in 1937 and operates under the direction of a 15-member board. The board is comprised of nine citizen members who represent the eight major river basins and the City and County of Denver, along with the Department of Natural Resources Executive Director, the Commissioner of Agriculture, the Colorado Attorney General, the State Engineer, the Division of Wildlife Director, and the CWCB Director. The current citizen Board Members are:

- Lewis H. Entz, Chair, Rio Grande Drainage
- Robert O. Burr, North Platte Drainage
- Richard Eric Kuhn, Main Colorado Drainage
- David H. Smith, Yampa-White Drainage
- Eric Wilkinson, South Platte Drainage
- Harold E. Miskel, Vice Chair, Arkansas Drainage
- Keith Catlin, Gunnison-Uncompahgre Drainage
- Donald W. Schwindt, San Miguel-Dolores/San Juan
- Patricia Wells, City and County of Denver

The CWCB is required by law to:

- Promote the conservation of the water to secure its greatest utilization;
- Foster and encourage others to conserve, develop, and utilize Colorado's waters; and
- Promote and implement measures to enhance water use efficiency, assure the availability of adequate supplies for future uses and assure necessary water services are provided at a reasonable cost.

The objectives of the Basin Meetings will be:

- to present information on CWCB's mission and programs currently administered by the Board staff – members of the CWCB staff will make presentations on each of the major programs including:
 - Water Supply Planning and Finance
 - Flood Protection
 - Water Supply Protection (including Decision Support Systems)
 - Water Conservation Planning
 - Stream and Lake Protection
- to receive feedback from the public on services CWCB currently provides in the Basin;
- to facilitate discussion between the public and the Board Member and CWCB staff on priorities and future needs of the Basin, and to identify ways the CWCB could help address these needs and priorities; and
- to review and identify additional information needs for the new CWCB River Basin Fact Sheets, currently available in draft form on the CWCB web site at <http://cwcb.state.co.us>

The first two meetings in August have been set as follows:

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| <ul style="list-style-type: none"> • Arkansas Basin Meeting <p>Date: Thursday, August 3
Time: 12:30 pm
Location: Southeastern CO Water Conservancy District Building
31717 United Avenue
Pueblo, CO
Host: Harold E. Miskel, CWCB Member
for the Arkansas Basin</p> | <ul style="list-style-type: none"> • Gunnison Basin Meeting <p>Date: Wednesday, August 16
Time: 2:00 pm
Location: Montrose Chamber of Commerce Building
1519 East Main Street (Highway 50)
Montrose, CO
Host: Keith Catlin, CWCB Member
for the Gunnison-Uncompahgre Basin</p> |
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Times, dates, and locations for these and future meetings will be posted on the CWCB web site as they are confirmed. For more information, call the CWCB at (303) 866-3441 or contact Basin Meeting Coordinator Cat Shrier at cshrier@lamar.colostate.edu.

CALENDAR



Aug. 24-25	SUMMER CONVENTION, COLORADO WATER CONGRESS, Vail, CO. Contact: Dick MacRavey at phone 303/837-0812, FAX 303/837-1607, email macravey@cowatercongress.org , or see website http://www.cowatercongress.org .
Aug. 28-31	INTERNATIONAL CONFERENCE ON RIPARIAN ECOLOGY AND MANAGEMENT IN MULTI-LAND USE WATERSHEDS, Portland, OR. See AWRA webpage http://www.awra.org/meetings/Portland/Portland.html .
Aug. 29-31	GREAT PLAINS DROUGHT WORKSHOP, Rapid City, SD. Contact: FAX 303/445-6683 (U.S. Bureau of Reclamation, Denver Office).
Aug. 29-31	COLORADO GOVERNOR'S CONFERENCE ON EMERGENCY MANAGEMENT, with the CEMA Annual Meeting and Natural Hazards Mitigation Council Annual Meeting, Breckenridge, CO. Contact: Adene Elsner, Colorado Office of
Sept. 6-8	WESTERN WATER LAW AND PROTECTION OF WATER QUALITY, Vancouver, WA. Contact: Western States Water Council, FAX 801/255-9642.
Sept. 14-15	COLORADO WETLANDS MITIGATION BANKING CONFERENCE, Denver, CO. Contact: CLE International, Phone 303/377-6600 in Denver or 800/873-7130, email registrar@cle.com .
Sept. 24-27	2000 ANNUAL FORUM, Ground Water, Source Water and Underground Injection Forum and Technical Exchange Exposition, Ft. Walton Beach, FL. See online conference information at http://gwpc.site.net/meetings.htm .
Sept. 25-30	DAM SAFETY 2000, Providence, RI. See website at http://www.damsafety.org .
Oct. 24-25	11TH ANNUAL SOUTH PLATTE FORUM, Longmont, CO. Contact: Jennifer Brown, CWRRI, at Phone 970/491-1141, FAX 970/491-2293.
Nov. 8-10	NORTH AMERICAN LAKE MANAGEMENT SOCIETY 20TH INTERNATIONAL SYMPOSIUM, Miami, FL. Phone 727/464-4425, FAX 727/464-4420, E-mail pleasure@pinllas.fl.us , or see the NALMS webpage at http://www.nalms.org/ .
Nov. 13-15	ASKING THE RIGHT QUESTIONS: EVALUATING THE IMPACT OF GROUNDWATER EDUCATION, Nebraska City, NE. Phone 1-800-858-4844, 402-434-2740, Fax 402/434-2742, or E-mail cindy@groundwater.org .
Dec. 13-14	GROUND WATER: A TRANSBOUNDARY, STRATEGIC AND GEOPOLITICAL RESOURCE, Assoc. of Ground Water Scientists and Engineers Annual Meeting, Las Vegas, NV. See the webpage http://www.ngwa.org/education/agwse2.html .
Jan. 15-18	CONFERENCE ON TAILINGS AND MINE WASTE '01, Fort Collins, CO. Contact: Linda Hinshaw, Dept. of Civil Engr., CSU at Phone 970/491-6081, FAX 970/491-3584, email lhinshaw@engr.colostate.edu .
Jan. 25-26	SYMPOSIUM ON SPATIAL METHODS FOR SOLUTION OF ENVIRONMENTAL AND HYDROLOGIC PROBLEMS: Science, Policy and Standardization -- Implications for Environmental Decisions, Reno, NV. For information contact A. Ivan Johnson, 7474 Upham Court, Arvada, CO 80003-2758, Phone 303/425-5610, Fax 303/425-5655.

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

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