

Planning for Uncertainty

*Proceedings of the 14th Annual
South Platte Forum
October 22-23, 2003
Longmont, Colorado*



Jennifer Brown, Editor

October, 2003

Information Series No. 97

Sponsored by:

City of Aurora
Colorado Division of Wildlife
Colorado Water Resources Research Institute
Colorado State University Cooperative Extension
Denver Water

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WHO'S RUNNING THIS ECOSYSTEM?

Proceedings of the 13th Annual South Platte Forum

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Jennifer Brown, Coordinator

October 22-23, 2003

**Raintree Plaza Conference Center
Longmont, Colorado**

The research on which this report is based was financed in part by the U.S. Department of the Interior, Geologic Survey, through the Colorado Water Resources Research Institute. The contents of this publication do not necessarily reflect the views and policies of the U.S. Department of the Interior, not does mention of trade names or commercial products constitute their endorsement by the U.S. Government.

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Robert C. Ward, Director**

PREFACE

Welcome to the 14th Annual South Platte Forum, “Planning for Uncertainty.” When we selected this title back in February we were thinking of drought uncertainty. We didn’t realize how much uncertainty would come as spring turned into summer and now into fall. It’s been a crazy year.

“The grass is always greener...,” has never been truer than in 2003. It seems every city and town had different watering schedules and restrictions. Homeowners were confused, some even outraged, about inconsistencies. Those with watering restrictions voiced plenty of complaints. Those without had just as many complaints when their water bill arrived.

Dead grass is nothing when compared to withered, low-yield crops farmers had to pay their mortgage and feed their family. While every year is uncertain in farming, this year dealt some particular blows. The Colorado Supreme Court restricted the State Engineer’s authority to approve supply plans to replace ground water depletions. SB 73 was the legislative attempt to allow wells and farmers to continue operations. Unfortunately, as many as 1000 wells in the basin still don’t have pumping authority and aren’t sure what next year holds.

Cities lost revenue for their water systems by the forced conservation. Small towns lost businesses because the farmers didn’t have money to spend. The landscaping industry took a huge hit. Governments are suing each other. And, unfortunately, the average water user still doesn’t know how the water system in Colorado really works.

But what a great time to be in the water business. Things are ripe for change. Bold new ideas can take hold and good things will come. Everyone will be forced to work together. The public will have to become educated and informed. Hopefully the result will be something future generations point to as genius.

The South Platte Forum is a step in the right direction. You’ve all come together to listen and learn from each other. You’re here to work together for a future that gives us water for crops, drinking, recreating and the environment. In time it can and will be done.

- Jennifer Brown, Coordinator

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

The expressed opinions and information are not necessarily endorsed by the South Platte Forum or any of its sponsoring agencies.



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Planning for Uncertainty: Drought Overview

Robert C. Ward

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The South Platte Forum, in many ways, was created to bridge the gap in understanding between water and wildlife management efforts in the South Platte River Basin. The 'understanding gap' created uncertainty in both managing water and wildlife resources. Through a carefully planned and executed dialogue among water and wildlife managers, the goal was to narrow this 'understanding gap'. The first few years of the Forum it seemed the speakers at the Forum were, in some ways, presenting positions. Slowly, the listening increased and a rich and productive dialogue began, and has continued for a number of years.

The goals of the South Platte Forum, to bridge disciplines and agencies, is representative of a much stronger push to achieve a more integrated approach to meeting the water needs of both humans and nature. Why was it necessary to bring disciplines and agencies together? Over 100 years ago, there was an equally strong push to divide the landscape so it could be 'professionally managed'. The land-grant universities matched the agencies created to manage each part of the landscape (e.g. U.S. Bureau of Reclamation, U.S. Forest Service, U.S. Fish and Wildlife Service, and Bureau of Land Management), by creating majors in the fields of study narrowly supportive of each agency's mission. After 100 years, society deems that we now need to put resource management back together to insure all dimensions work in harmony and meet the expectations of society (as expressed through the political system).

The recent multi-year drought exposed a number of weaknesses in not only our joint efforts to integrate resource management, but also within specific resource management agencies and disciplines. The drought reminded us of:

- Wet and dry cycles occur in a semi-arid climate and we must plan to manage the uncertainty associated with both ends of the precipitation continuum; and,
- Society's water needs and expectations change from drought to drought, adding to the uncertainty managers face during any one drought.

Thus, will a drought plan, prepared with the experience of one drought, be relevant and applicable to a future drought? How does society reduce the uncertainty associated with drought under the above circumstances? What we do see are efforts to obtain much more thorough data on Colorado's water resources along with development of sophisticated decision support tools to analyze the data and support more informed decision-making. Colorado is developing the data, information and management tools needed to reduce uncertainty associated with drought management in the future.



Keynote Presentation

Ken Salazar

Colorado State Attorney General, State Attorney General's Office, 1525 Sherman St., 5th Floor, Denver, CO 80203, (303) 866-4500

Attorney General Ken Salazar will present an overview of the South Platte River water dispute between surface users and well users. He will talk about the litigation and subsequent bill, SB 73, and major water issues facing the state of Colorado.

Keynote Presentation

Dennis Montgomery

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In 1985 Kansas sued Colorado in the U.S. Supreme Court. Kansas claimed Colorado had violated the 1949 Arkansas River Compact by, among other things, allowing Colorado farmers to develop hundreds of wells in the decades after the Compact became effective, thereby depleting the usable Stateline flows of the Arkansas River in violation of the Compact. In previous opinions the U.S. Supreme Court ruled that, while Colorado had not intentionally violated the Compact, it had violated the Compact by allowing depletions to usable Stateline flows and owed Kansas damages for those depletions. Since 1995 the case has focused on two issues: (1) quantifying the amount of the damages and prejudgment interest due to Kansas, and (2) determining whether Colorado had taken adequate actions to bring post-compact well pumping into compliance with the Compact.

On August 21, 2003, Arthur L. Littleworth, the Special Master overseeing the ongoing Kansas v. Colorado litigation, issued his draft Fourth Report. In this draft report he confirmed his earlier ruling in favor of Colorado's position on the amount of damages and prejudgment interest that Colorado must pay and ruled on Colorado's actions to bring post-compact well pumping into compliance with the Compact.

Mr. Montgomery will highlight several recommendations that are of interest to water users in the South Platte River Basin, including the recommendations that (1) the administrative rules for wells adopted by State Engineer Hal Simpson that became effective in 1996, and the replacement water provided thereunder, brought Colorado into compliance with the Compact for the years 1997 through 1999; (2) the State Engineer's Measurement Rules are adequate to determine the amount of ground water use in the Arkansas River Basin and that it is not necessary to require installation of the totalizing flow meters on Colorado wells to ensure compliance with the Compact; (3) the method for calculating potential evapotranspiration in the H-I Model should be the Penman-Monteith method that Kansas proposed, subject to possible future adjustments as more information may be developed; and (4) the Kansas request for appointment of a federal "river master" to supervise future administration should be denied, but the Court should retain jurisdiction for a limited period of time to referee future disputes, if any.



2003 Legislative Summary

Julie McKenna

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(303) 539-1320*

I. Growth & Record Drought

- A. Legislature responds with the introduction of over 30 water-related measures
 - 1. Impact of budget and term limits

II. Water Legislation

- A. Facilitate additional storage
 - 1. Rehabilitation of existing facilities
 - 2. Construction of new storage facilities
- B. Planning
 - 1. SWSI
 - 2. HB 1001
- C. Conservation
 - 1. HB 1001
- D. Financing
 - 1. SB 126, Colo. Water Resource & Power Devel. Auth.
 - 2. SB 236, Water Board Revenue Bond Elections
 - 3. HB 1001, Flexible Use of Water
 - 4. Annual CWCB Construction Fund and CWRPDA bills
- E. Drought response
 - 1. SB 73, S. Platte
 - 2. HB 1320, Drought Loans for Instream Flows
- F. Budget
 - 1. Bills levy fees for service - SB 276, SB 278

III. Implementation of Legislation and Interim Water Committee Activities

- A. Bills
 - 1. SB 276, SB 278 - Fee legislation
 - 2. SB 73, S. Platte
 - 3. HB 1001, Flexible water use
 - 4. HB 1318, Water banking
 - 5. HB 1334, Interruptible Supply Agreements
- B. Interim Committee
 - 1. Tours
 - 2. Anticipated action

IV. 2004 Legislative Session: What can we expect?



State Climate Update

Nolan Doesken

Assistant State Climatologist, Colorado Climate Center, Dept. of Atmospheric Science, Colorado State University, Fort Collins, CO 80523, (970) 491-3690

The March 2003 record breaking (and roof breaking) Front Range snowstorm took a surprisingly large bite out of the "Drought of 2002" and started several of Colorado's river basins on a path toward recovery. A cool, humid spring also contributed. Unfortunately, very hot, dry weather returned in July helping to continue our recent streak of hot summers. This presentation will revisit the climatic conditions associated with recent severe drought conditions and will summarize and describe the weather and water conditions in Colorado during 2003. Guarded "speculation" of what may lie ahead for 2004 will be offered.

Responses by Colorado Producers to the 2002 Drought

Eric Schuck

Assistant Professor, Dept. of Agricultural & Resource Economics, Colorado State University, B334 Clark, Fort Collins, CO 80523, (970) 491-7346

The summer of 2002 brought the worst drought conditions in 500 years to Colorado. As part of their drought response strategies, researchers at Colorado State University and the NOAA Climate Diagnostic Center surveyed producers about their production responses to the 2002 drought and their anticipated production responses in 2003. The results of this survey are summarized and discussed in light of their implications for the effects of future droughts in Colorado.

Food Grows Where Water Flows

Alan Foutz

Producer;; President, Colorado Farm Bureau, (970) 345-6679, afoutz@colofb.com

In a proactive effort, the Colorado Farm Bureau has formed a Water Task Force to work towards legislative and other solutions to address the impacts of Colorado's prolonged drought. Dr. Foutz will present the 2003 task force strategies.



Response of Eastern Plains Stream Fishes to Flow Variability

Kevin R. Bestgen (Presenter) and Kurt D. Fausch

Research Scientist, Dept. of Fishery & Wildlife Biology, 33 Wagar, Colorado State University, Fort Collins, CO 80523-1474, (970) 491-1848

Fishes in Great Plains streams evolved life history strategies to cope with harsh and fluctuating conditions. Such strategies are particularly important when drought limits habitat and environmental conditions approach or exceed physiological tolerances of fishes. Brassy minnow *Hybognathus hankinsoni* studies at multiple scales in the Arikaree River persisted through drought in 2001-2002. At the scale of 4 mile-long segments, deep pools in upstream reaches were important for persistence of brassy minnows in the system. Persistence at the level of individual pools was due to brassy minnow tolerance of high water temperatures and low dissolved oxygen. Repopulation of desiccated reaches was by dispersal from upstream refuges. Suckermouth minnow *Phenacobius mirabilis* was once widespread in the South Platte River Basin but now occurs only in the lower river mainstem and tributary Lodgepole Creek. Analysis of collections records since 1968 revealed dramatic fluctuations in distribution and abundance of suckermouth minnows that may be related to stream flow variability. During drought in 2001 and 2002, suckermouth minnows moved into and persisted exclusively in deep pools in the main stem or in Lodgepole Creek. By spring 2003 suckermouth minnows had dispersed from those refuges. In pre-development times, plains stream fishes likely also underwent considerable shifts in distribution and abundance. Then, fish in dried reaches were quickly re-established from widespread source populations that moved easily through the system. A main difference now is that fewer source populations are available and movement pathways are disrupted. Persistence of plains stream fishes may depend on continued availability of refuges and ability of these species to move considerable distances to reach those areas. Long-term, reliable monitoring data and additional information on the ecology of these species will assist with understanding the level of water and fish management needed for plains stream fishes to persist on this challenging environment.



Distribution of Mayflies (Ephemeroptera), Stoneflies (Plecoptera) and Caddisflies (Trichoptera) of the South Platte River Basin, Colorado, Nebraska and Wyoming: Past, Present and Future

Boris C. Kondratieff (Presenter), Robert E. Zuellig and D. E. Ruiter

Professor and Curator of Entomology, Dept. of Bioagricultural Sciences, 3 Laurel Hall, Colorado State University, Fort Collins, CO 80523, (970) 497-7314

The South Platte River Basin drains about a 6,2937 km² (24,300 mi² mile) area and includes parts of Colorado, Nebraska and Wyoming. Through its 1,689 km (450 mi) course, the South Platte River and its tributaries encompass two major physiographic provinces, the southern Rocky Mountains and the Great Plains. Several workers have documented lists of mayflies, stoneflies and caddisflies of the region. However, to date there has been no formal survey of aquatic insects of the South Platte Basin. The aquatic insect fauna of the accessible montane sections appear to be relatively well collected; whereas, relatively little is known about the plains and some of the more remote mountainous areas. Species records of mayflies, stoneflies, and caddisflies were extracted from the literature and from museum and institutional collections. Each species record was geo-referenced and data based. Currently 260 species of mayflies, stoneflies and caddisflies are known from the South Platte River Basin. Of these 260 species, at least 42, or 16% were originally described from the basin. This is a noteworthy high percentage compared to other western North American drainage basins. To our knowledge no systematic collections of aquatic insects were made in the basin prior to the establishment of irrigated agriculture that began in the 1860's and only a few were made prior to 1920. Other than the classic studies of upper Boulder Creek by Dodds and Hisaw (1925), no comprehensive early studies of aquatic insects of the South Platte Basin is available. The highest diversity of aquatic insects occurs in the middle reaches of the basin where streams transition from the lower mountains and foothills out onto the plains. Historically, the transitional zone at the mountain/plains interface was more diverse than it is today. At least six mayflies and stonefly species recorded in earlier collections along the mountain/plains interface have been extirpated. Expansive urban areas now occur along most regional streams and rivers at or near the plains mountain interface. This combined with past poor land use practices and the advent of irrigated agriculture has permanently altered the natural condition of regional streams and has eliminated or significantly changed these unique aquatic insect communities.



Virtual Rivers of the Colorado Front Range

Ellen Wohl

Professor, Dept. of Earth Resources, 330 Natural Resources, Colorado State University, Fort Collins, CO 80523, (970) 491-5298

The rivers of the upper South Platte drainage basin have cut deep canyons into the mountainous topography of the Colorado Front Range. These mountain rivers have not undergone the obvious river metamorphosis that the lower South Platte has experienced during the past century in which broad, braided channels with little riparian vegetation and highly seasonal flow became narrow, sinuous, densely vegetated channels with less pronounced seasonal flow fluctuations. However, the mountain rivers of the upper South Platte have also undergone dramatic channel change, largely as a result of human land-use practices. The mountain rivers are characterized by steep downstream channel gradients; a coarse streambed substrate of cobbles and boulders that is not mobile under most flow conditions; narrow valleys with minimal floodplains; a flow regime dominated by late spring-early summer snowmelt; and pool-riffle or, in steeper segments, step-pool, channel morphology. These rivers historically had abundant large woody debris and numerous beaver dams, as well as deep pools.

Intensive human impacts to the rivers of the upper South Platte drainage basin began with fur trapping during the first decades of the 19th century. By 1842, John Charles Fremont described mountain rivers with many abandoned beaver lodges, but few active lodges or dams. The extent and intensity of human impacts accelerated with the discovery of placer gold in 1859. A series of localized “rushes” for placer metals continued into the first decades of the 20th century. Other activities such as deforestation for lumber, regulation of flow for reservoirs and diversions, construction of roads and railroads, local urbanization, and tie drives occurred simultaneously with placer mining. Many of these activities continued well into the 20th century, accompanied by increasing urbanization and recreational use of the Front Range. The book *Virtual Rivers* (Yale University Press, 2001) describes in detail the history of land uses and their impacts on the mountain rivers.

The net effect of these activities was to reduce channel and habitat diversity and stability. The mountain rivers of the upper South Plate were naturally stable systems, subject to minor disturbance during the annual snowmelt flood and more substantial disturbance during infrequent flash floods caused by summer thunderstorms. These extreme flash floods largely set the template for valley and channel morphology by generating sufficient stream power to mobilize the large sediment particles that form much of the streambed of the mountain rivers. Between large floods only finer sand and gravel moved over the bed. The effect of activities such as placer mining or tie drives was to dramatically destabilize the streambed sediments, creating a condition analogous to continuous flash floods. The newly mobile sediment preferentially accumulated in pools, reducing pool volume and associated habitat. Riparian vegetation and naturally occurring large woody debris were removed from streams, further destabilizing the channels and reducing habitat and substrate diversity. Although few studies have addressed the biological impacts of these historical human land-use activities, one result may have been to shift aquatic and riparian communities toward species more tolerant of disturbance.



Cumulative Effects of Aggregate Mining Along the South Platte River

Melissa I. Young

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In response to concerns pertaining to potential cumulative effects along the South Platte River attributable to alluvial aggregate mining and reclamation, the Colorado Rock Products Association (CRPA) worked with the United States Army Corps of Engineers (USACE), the United States Environmental Protection Agency (U.S. EPA) and the United States Fish and Wildlife Service (USFWS) (federal agencies) to develop a scope of investigation designed to identify and assess the magnitude and significance of any such effects to that portion of the South Platte River corridor located between the Chatfield Dam spillway in Jefferson County and the confluence of the Cache La Poudre River with the South Platte River in Weld County, Colorado (study corridor).

A report was prepared by a team of wetland scientists, ecologists, wildlife biologists, engineering geologists, hydrologists, planning specialists, and socioeconomists from Savage and Savage, Inc., Tetra Tech RMC, and Leland Consulting Group. Information was collected from public and private sources, including the United States Geological Survey (USGS), USACE, USFWS, Colorado Division of Wildlife (CDOW), Denver Museum of Nature and Science, the University of Colorado and the CRPA membership.

In consultation with the federal agencies, it was determined that the following resources warranted investigation: changes to the geomorphology (stream channel geometry and location) of the river; changes to hydrology in terms of water quantity, quality and flow regime; changes to the type, size

and location of vegetation communities; changes to the nature and areal extent of wetlands; and, changes to the nature and extent of wildlife habitat. The cumulative environmental effects attributable to alluvial aggregate mining within the study corridor on each of these resources was assessed by reference to the magnitude and significance of such effects.

The researchers utilized available geographic information system (GIS) data and the USGS Front Range Infrastructure Resources Project (FRIP) that identified temporal changes in areal extent of various land use categories, case studies and empirical data describing the geomorphic and hydrologic regimes within the study corridor, and published historical and current descriptions of vegetation and wildlife habitats. Data addressing hydrology, economics, and mining and reclamation practices was collected from aggregate producers and interviews with personnel from the federal agencies were conducted to identify specific effects the agencies attributed to aggregate mining within the study corridor. Finally, on-site investigations of several active and reclaimed aggregate mining operations within the study corridor were conducted to evaluate potential specific effects and to assess the success of reclamation and mitigation.

The researchers evaluated three timeframes: the 1950s, the 1970s and the 1990s. Projections based on mathematical modeling were used to project future effects. Historical



context relevant to changes or effects to the environment within the study corridor are also described.

The magnitude of the effects on certain of the resources was assessed in relation to the change to, over time, the areal extent (i.e., acreage) of the resource. Where historic changes in acreage were an ineffective effects indicator, case studies and modeling and habitat suitability indices (H.S.I.) provided the basis for assessing the magnitude of effects. This proved to be the case for measurable effects pertaining to geomorphology, hydrology and wildlife habitat.

The significance of the effects was then evaluated in terms of well-accepted cumulative impact assessment procedures. The cumulative effects assessment considered the baseline condition of the study corridor, assessed current conditions and projected the study corridor condition into the near future. The outcome of measures undertaken by the aggregate producers to avoid, minimize or mitigate such effects was also considered.



Just How Abrasive IS Gravel?

Glenn J. Rodriguez

Aquatic Biologist, Wetlands & Watersheds, US EPA Region 8, 999 18th St., Ste. 300, Denver, CO 80202, (303) 312-6832

An authorization from the Army Corps of Engineers is required for gravel mines to discharge or perform fill activities in waters of the U.S, including wetlands. The principal regulation that must be followed is the 404 (b) (1) Guidelines. These Guidelines follow a sequence of evaluations beginning with only permitting the least environmentally damaging practicable alternative that fulfills the project purpose. Once this has been selected, efforts to minimize adverse impacts to wetlands are undertaken. Finally, performing mitigation must compensate for adverse impacts that are unavoidable. Obtaining a permit is only the first step. Complying with the permit conditions and performing mitigation will carry on well past the mining activity. Additional consideration in an individual permit application (required by the 404 (b) (1) Guidelines) is the evaluation of cumulative impacts. The National Environmental Policy Act (NEPA) also requires evaluation of cumulative impacts. Assessing the cumulative impacts of aggregate mining along the South Platte is a major environmental and policy concern. Examples will be presented to help answer the question: “Just how abrasive is gravel (?)”

Establishing a Uniform Watering Schedule in the Denver Metro Area

Jane Earle

Community Relations Manager, Denver Water, 1600 W 12th Ave., Denver, CO 80254, (303) 628-6312

In the fall of 2002 metropolitan water providers began a series of meetings to determine whether they could agree on a uniform set of watering restrictions for the following irrigation season. The effort followed a year of severe drought in which each water district imposed its own restrictions and schedules leading to confusion on the part of many customers. After weeks of meetings, the utilities were able to agree only on the broadest set of uniform restrictions but achieved a new level of cooperation among water providers.



The Effects of the 2002 Drought on Low Stream Flows

Dick Parachini (Presenter) and Eric Oppelt

Outreach & Assistance Unit Manager, Water Quality Control Division, Colorado Dept. of Public Health & Environment, 4300 Cherry Creek Dr. S, Denver, CO 80246-1530, (303) 692-2000

Many streams in Colorado exhibited historically low flow levels in 2002 as a result of the drought conditions experienced over the last few years. The Colorado Water Quality Control Division was asked to investigate what impact these low flow levels might have on the calculated critical flow conditions used in Colorado Discharge Permit System permits. Two questions were posed to the Division. First, how exceptional were the 2002 flow levels in relation to the historical flow record? Second, what changes should the Division make to the low flow policy to account for the low stream flows of 2002?

Critical flows (i.e. low dilution conditions) are used to establish effluent limits for CDPS Permits to ensure that water quality standards are not exceeded at these low flow conditions. The Division uses historic daily flow records to predict what the low flows will be in the future. The statistical flows used are the acute (1E3) and chronic (30E3) low flows in calculating wastewater treatment facility effluent limits. The Division uses EPA DFLOW software to calculate the 1E3 and 30E3 low flows.

The Division selected 30 USGS gages around the State that all have a continuous flow record of more than thirty years to conduct the low flow study. Flows records were analyzed to determine how the acute and chronic low flows varied as the length of the flow record was changed. Four record lengths were analyzed: The full record, ending in December 2002; thirty years, 1973 through 2002; ten years, 1993-2002; and the latest ten years without 2002, 1992 – 2001. The effects of the 2002 low flow conditions varied from station to station and also varied between acute and chronic flows. For some stations, especially those in the southwest part of the State, the effects were very strong and resulted in dramatic reductions in the calculated critical low flows. For other stations the 2002 flows had little or no effect. Other studies conducted on the 2002 low flows in Colorado have shown similar results.

The Division made the following recommendations to the Colorado Water Quality Control Commission based on the results of this study:

1. To not take any action regarding the calculation of critical flow conditions because flexibility is already allowed by the applicable regulations.
2. To include the 2002 flow measurements as appropriate, valuable and historically consistent flow data.
3. To monitor the 2003 winter flows because the possibility for them to also be low.



Why the Lower Arkansas Valley Water Conservancy District Was Formed

Leroy Mauch

Board of Directors Chair, Lower Arkansas Valley Water Conservancy District, 970 Elm, Rocky Ford, CO 81067

The Lower Arkansas Valley Water Conservancy District (Lower District) was formed to acquire, retain and conserve native water flowing in the Arkansas River and its tributaries; to insure that such water remain in the valley for the socio-economic benefit of the citizens of Pueblo, Otero, Crowley, Bent and Prowers Counties; and to participate in water-related projects that will embody thoughtful conservation, responsible growth and beneficial water usage within the Lower Arkansas Valley.

Rapidly growing areas along the Front Range have turned to the Lower Arkansas Valley as a source of water to meet their needs. Thousands of acres of formerly irrigated cropland have been purchased, the lands dried up, and the water taken out of the valley. Along with the loss of water comes the loss of crops, jobs and the economy they supported. Property tax and sales tax revenues decline, making it harder for local government to provide basic services. These problems are especially acute in rural areas with few other sources of economic activity.

The Arkansas Valley cannot afford to lose more of its precious water resources. The Lower District was voted in by the citizens to take steps to protect the valley's water. With revenues obtained from a mill levy on all real property within its boundaries, the Lower District will work to keep the Arkansas River whole, enhance existing water supplies, support efforts to bring better quality drinking water supplies to the valley, and support and enhance the area's water-related economy.

The district's boundaries include portions of the Southeast Colorado Water Conservancy District but this district is primarily concerned with deliveries of water from the Bureau of Reclamation's Fryingpan-Arkansas Project. The Southeast District's mission is distinctly different from that of the Lower District's, which makes the formation of the Lower Arkansas Valley Water Conservancy District essential to the future well being of the valley.



The Future of Biology in the South Platte Basin: The Not-So-Obvious Effects of the Water Infrastructure on Riparian and Aquatic Ecosystems

David M. Merritt

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Since the recent drought there has been a resurgence of proposals to add new water storage facilities to the 900 dams, over 6,500 points of diversion, and hundreds of miles of ditches and tunnels that currently comprise the water infrastructure of the South Platte River basin. Although the vast majority of dams in the South Platte watershed are small to intermediate in size, most of the research on the effects of dams and diversions on riparian and aquatic ecosystems has been focused on lower elevation reaches downstream of large reservoirs on the plains.

The effects of river damming on hydrology and channel morphology are well-documented for these larger order alluvial rivers, as are the responses of riparian vegetation and aquatic organisms to the past 150 years of modifications. Studies in river canyons and mountain valleys over just the past decade have documented some of the not-so-obvious influences of smaller dams, as well as water diversions, on stream and riparian ecosystems along the Front Range. Findings from these studies shed light on the current demography and distribution of dams and diversions in the South Platte watershed, on the influence that this configuration of development has had on biota, and the potential effects of future development scenarios in the basin.

Such knowledge should be incorporated into the decision making process to inform and direct future projects so that adverse impacts are minimized while the multiple benefits of water development are realized. Historic piecemeal and opportunistic development throughout the network of channels comprising the South Platte River drainage should be replaced with a more sophisticated development plan if we are to sustain the biotic processes that make the South Platte River basin unique.



The Future of Agriculture in the South Platte Basin

Don Ament

Commissioner of Agriculture, Colorado Dept. of Agriculture, 700 Kipling St., Ste. 4000, Lakewood, CO 80215, (303) 239-4104

Commissioner of Agriculture Don Ament will talk about the water wars on the South Platte. He will give an overview of the increased demands due to municipal growth, recreation and endangered species recovery. Commissioner Ament will discuss how these demands, coupled with the severe drought, have caused havoc for the South Platte and its water users. Over time the management of the river has significantly improved. The river now runs year round, not just during the snowmelt; and the substitute supply plan for wells continues to improve. However, our current drought combined with court and legislative action has created a situation that doesn't allow us to maximize the use of the Platte river water. The Commissioner will address potential solutions that include additional storage, private/public partnerships, well augmentation, and the 3-state agreement with Colorado, Nebraska and Wyoming.

The Future of Municipal Water Use in the South Platte Basin

Peter Binney

Director of Utilities, City of Aurora, 15151 E Alameda Pkwy, Aurora, CO 80012, (303) 739-7379

The State of Colorado and local planning agencies have identified major growth in the urban population centers along the Front Range in the next 30 years. That population growth, along with the industries and commerce that develop concurrently with large urban areas, will result in a significant increase in the water demands that must be met by water agencies and special districts.

The Drought of 2002 clearly illustrated the limits of the available water resources to meet the needs of current populations let alone the growth that has to be planned for in future decades. Water agencies in Colorado must prepare the water systems for that growth in demands and innovation and significant capital expenditures will be required if those future communities are to enjoy a reasonable level of service at the tap. Water utility managers must successfully address where that water will come from, how it will be delivered to cities, how major institutional issues that have constrained recent water development projects will be overcome and how these investments will be paid for.

The South Platte basin and its water resources will be severely challenged as issues related to environmental protection, competing uses of water, land use decisions and water infrastructure are addressed. This will require effective forums for understanding alternatives and reaching resolution of regional and local water issues if our towns and cities of the future are to accommodate our children in a manner similar to that we currently enjoy. The author will describe the approaches being used in Aurora to meet future water needs while making more effective use of currently available water sources.



The Future of Instream Flows for the South Platte

Michael F. Browning

President, Colorado Water Trust; Attorney, Porzak Browning and Bushong, LLP, 929 Pearl St., Ste. 300, Boulder, CO 80302, (303) 443-6800

The South Platte River is the most over-appropriated stream system in Colorado. The notions of instream flows and in-channel recreational uses are relatively new and therefore have or will have relatively junior priorities. However, their importance and impact on traditional water uses will only grow over time.

The history of instream flows and in-channel recreational diversions in the South Platte River and its tributaries will be reviewed. This will include a review of the instream flow authority and appropriations of the Colorado Water Conservation Board, the provisions of Senate Bill 01-216 that creates the opportunity for in-channel recreational uses, and the effect of the Platte River Recovery Program.

New legislation passed in 2003 will also be reviewed, including the role of instream flows in water banks (HB03-1318), during times of drought (HB 03-1320 and HB03-1334) and as part of land conservation easements (HB03-1008).

Finally, the role of the Colorado Water Trust and local land conservation trusts in protecting and promoting instream flows and other environmentally beneficial uses of water will be discussed.



Can Tertiary Treatment Wetlands Provide Water Quality Improvements and Reliability to a High-Volume Urban Secondary Treated Wastewater Effluent?

David M. Foss and Wayne F. Lorenz, P.E.

Project Engineers, Wright Water Engineers, Inc., 2490 W. 26th Ave., Ste. 100A, Denver, CO 80211

CBC assigned Wright Water Engineers, Inc. (WWE) the task of determining the efficacy of a wetland to mitigate potential Wastewater Treatment Plant (WWTP) upsets, as well as determining the water quality improvements that a tertiary treatment wetland could provide to their typically high quality WWTP effluent.

The CBC WWTP (actually two plants) performs the unusual role of treating the brewery wastewater, refractory cellulose-based waste, and the municipal wastewater generated by the city of Golden. The combined flow of the two plants is approximately 10 million gallons per day (mgd).

A primary constraint to the wetland feasibility was the land available for the wetland wastewater polishing, approximately 30 acres of valuable Coors property. The design flow across this available land results in a hydraulic retention time of one to two days—on the very low end of typical wetlands implemented for polishing wastewater effluent. As a result, WWE recommended that a pilot wetland be constructed to quantify the wetland treatment capabilities.

CBC concurred, and in a Supplemental Environmental Project with oversight from the Colorado Division of Wildlife, it was agreed to construct a 2-acre wetland that would treat up to 250,000 gallons per day, approximately the land-flow constraint for the full-size treatment of 10 mgd on 30 acres. The pilot wetland cells were constructed and planted during the summer of 2003 and water quality monitoring programs initiated using graduate-student support.

The objectives of the pilot program are to monitor water quality for changes in biochemical oxygen demand (BOD), total suspended solids (TSS), and nutrients phosphorus and nitrogen species. Mean WTP discharge water quality without the wetland treatment are 13 mg/L BOD, 12 mg/L TSS, ~ 1 mg/L- P, 2.7 mg/L NH₃ and 2.6 mg/L NO₃. Expected water quality improvements are TSS to backgrounds levels of 5 to 10 mg/L, 30 percent BOD reduction, 20 to 50 percent decrease in nitrogen species, and perhaps 10 to 30 percent reduction in phosphorus.



CoCo RaHS (Community Collaborative Rain, Hail and Snow Study) – Big Snow Help Us Grow

Nolan Doesken

Assistant State Climatologist, Colorado Climate Center, Dept. of Atmospheric Science, Colorado State University, Fort Collins, CO 80523, (970) 491-3690

The remarkable drought-slowing snow storm of March 17-19, 2003 was captured and analyzed in great detail with the help of hundreds of citizen volunteers participating in the Community Collaborative Rain, Hail and Snow Study at Colorado State University. Maps, photos and data from this remarkable storm will be shown, the CoCo RaHS project will be described, and the plans for CoCo RaHS expansion will be described. At this time, volunteers from over 30 counties in Colorado have joined the project and this number is growing steadily. The project will include volunteers from Nebraska and Wyoming in 2004 and Kansas in 2005.

No-Till Crop Production Under Sprinkler Irrigation in the South Platte Valley

Ardell D. Halvorson, Arvin R. Mosier and Curtis A. Reule

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Irrigated farmers in the South Platte Valley generally utilize intensive tillage practices to manage crop residues and prepare a seedbed for the next crop. This can result in severe wind and water erosion until the next crop is large enough to provide protection to the soil. Tillage also results in the loss of soil organic carbon (SOC) as carbon dioxide to the atmosphere, thus contributing a greenhouse gas to the atmosphere and to global warming potential (GWP). Leaving crop residues on the soil surface by using reduced-tillage and no-till systems can reduce soil erosion, water runoff and SOC loss from irrigated fields. This can result in better water use efficiency, soil quality and environmental quality. The objective of this poster will be to present results from a four year irrigated cropping systems study conducted just north of Fort Collins, Colorado on a Fort Collins clay loam soil under sprinkler irrigation where no-till (NT) cropping systems [continuous corn (C-C), barley-corn (B-C), soybean-corn (S-C), and barley-corn-soybean (B-C-S)] produced under six different nitrogen (N) fertilizer rates are compared with conventional till (CT) continuous corn production. Yield, crop residue levels and residual soil nitrate-N level comparisons will be made between corn grown under CT vs NT corn rotations. Conversion to a NT system has additional benefits such as improved water use efficiency, reduced fossil fuel requirements due to reduced number of tillage operations, less nitrate-N available for leaching and ground water contamination, reduced soil erosion, and increased SOC sequestration. The increase in SOC sequestration with the NT system helps to reduce the net GWP by decreasing the loss of carbon dioxide to the atmosphere, thus minimizing greenhouse gas emissions from irrigated cropping systems.



Colorado's Stream and Lake Protection Program –Celebrating 30 Years of Stream and Lake Protection

Anne Janicki

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Thirty years ago the Colorado legislature recognized “the need to correlate the activities of mankind with some reasonable preservation of the natural environment” and passed Senate Bill 97 authorizing the Colorado Water Conservation Board to “appropriate ... or acquire such waters of natural streams and lakes as may be required to preserve the natural environment to a reasonable degree.” On July 12, 1973, the Board appropriated the State's first “minimum stream flow” water rights on 13 segments of stream in Pitkin County immediately downstream from the Fryingpan-Arkansas diversion structures near Aspen.

These landmark appropriations facilitated settlement of environmental concerns related to that trans-basin diversion project. As then Director Felix Sparks outlined in his presentation to the Board, “We had a handy starting point. That was the Operating Principles for the Fryingpan-Arkansas project. Many years went into the negotiation of those operating principles. They were approved by Congress and made a part of the act which authorized the Fryingpan-Arkansas Project. Consequently, we had minimum stream flows established at particular points. However, those points only affected the release at that given point. It did not protect the stream below the release points....There is nothing to keep someone from picking up that water immediately below that point. The Operating Principles can in effect be destroyed by appropriations made below the release points. We think this recommendation then protects the Operating Principles and carries out what they intended to do.”

Today, Colorado is the leader in instream flow protection in the west. The Board holds appropriations on nearly 1,400 stream segments covering over 8,200 miles of stream, as well as 476 natural lakes in the state. Colorado has protected more miles of stream than all other western states combined. In addition to new appropriations, Colorado also has an active Water Acquisition Program, which allows water right owners to convey an interest in senior rights to the Board to preserve or improve the natural environment. The Board routinely monitors, administers and protects each appropriated or conveyed water right against injury.

Over the past 30 years the Board has worked with various state and federal agencies, as well as citizens and conservation groups to provide streamflow protection in a manner consistent with state law. Actions worth noting include:

Summit County Appropriations – A series of agreements between the Board, Summit County, various municipalities and several ski areas provided the basis for meeting NEPA requirements and allowed those entities to secure Green Mountain Reservoir water service contracts from the Bureau of Reclamation. The agreements also provided instream flow protection for the high quality fisheries in the Blue River watershed.



Hanging Lake and Dead Horse Creek – Acting on recommendations by the US Forest Service, the Board appropriated all of the unappropriated water in the Dead Horse Creek watershed, thereby ensuring that unique hydrologic and geologic setting including Hanging Lake and Bridal Veil Falls will be preserved for future generations.

Boulder Creek Agreement – Both The Nature Conservancy and the city of Boulder conveyed senior water rights to the Board to maintain instream flows in Boulder Creek. Most years the July streamflow in Boulder Creek drops to 1 cfs or less as a result of irrigation demands. The donated rights have allowed the Board to maintain instream flows up to 15 cfs in the segment of stream that runs through town.

Steamboat Lake Agreement – A three-way lease agreement between the CWCB, US Fish & Wildlife Service and State Parks provides the mechanism for water to be released from Steamboat Lake for instream flow use by the CWCB to protect critical habitat for endangered species in the Yampa River.

New instream flow appropriations and water right acquisitions are tools that state and federal agencies, water users and conservation groups can use in Colorado to preserve or improve the natural environment in a manner consistent with state water law.

Water Use in Colorado: Policy Responses to the 2002 Drought

Jessica Sherman and Rebecca Brooke

Summer Interns at the CU Center for Science and Technology Policy Research

Looking at the policy impacts of the 2002 drought is a necessary step in preparing Colorado to deal with future water needs, especially given Colorado's growing population and the unpredictable nature of climate and climate change in the coming decades. Our study includes an examination of responses to water shortage at both the municipal and state level. A review of water-pricing changes in eight Colorado municipalities (Aurora, Boulder, Denver, Fort Collins, Lafayette, Louisville, Thornton and Westminster) over the past year shows a variety of price-signal responses to drought. Water restrictions and conservation incentives likewise vary depending on the individual situations of municipalities. The State response to water shortage has been through policy aimed at funding new water development projects, cloud seeding, water leasing and 'logging for water'. Our research indicates that the 2002 drought has heightened public awareness of water shortage issues and created a momentum to move ahead with significant changes in water policy at both the State and municipal level.



Biographies

Don Ament

Don Ament was appointed Commissioner of Agriculture January 12, 1999, by Governor Bill Owens. Don served 12 years in the Colorado General Assembly, chairing the Agriculture, Natural Resources, and Energy Committee and the Capital Development Committee. Prior to his election to the State Legislature Don served for five years on the State Board of Education, four of them as chairman. He also served 14 years on the RE-1 Valley School Board in Sterling and is a former president of the Colorado Association of School Boards.

Nationally, Ament chaired the American Legislative Exchange Council's Task Force on Agriculture and is considered an expert in areas of water and property rights. Currently he serves as President of the Western United States Agricultural Trade Association (WUSATA) and is the Governor's appointee as Colorado's representative on the Tri-State Platte River Governance Committee with Nebraska and Wyoming.

Commissioner Ament's day-to-day activities include the leadership and support of the Department of Agriculture, representing agriculture on boards and commissions, and promoting the importance of the agricultural industry and the role it plays in preserving our quality of life. Don supports innovative ideas to increase and improve production agriculture and the utilization of computer technology to improve the states' e-commerce.

Ament has lived his entire life in Colorado, graduating with an engineering degree from the University of Colorado. Don continues to farm and ranch in Northeast Colorado. He and his wife, Patty, have three grown children and three grandchildren.

Troy Bauder

Troy is the State Extension Water Quality Specialist in the Department of Soil and Crop Sciences at Colorado State University. Troy received his B.S. degree in agronomy and his M.S. in soil science from CSU. He is responsible for conducting statewide educational and applied research programs on water quality, especially related to protection of ground water quality from impairment to agricultural chemicals as authorized under the Agricultural Chemicals and Groundwater Protection Act (SB90-126). His research and outreach activities include nitrogen management using high nitrate irrigation water, aquifer vulnerability to contamination and factors affecting adoption of BMPs by Colorado producers. Prior to attending CSU Troy received hands-on training in water as a farm hand, landscaper and well repair technician. He is actively engaged in the family farm near Sterling, Colorado.

Kevin R. Bestgen

Kevin Bestgen is a research scientist and directs the Larval Fish Laboratory in the Department of Fishery and Wildlife Biology at Colorado State University. The lab specializes in understanding reproduction and ecology of rare native fishes to assist with their conservation.



Peter Binney

Peter Binney is the Director of Utilities for Aurora, Colorado, a rapidly growing city of 300,000 people. He is a registered professional engineer with more than 25 years of consulting engineering experience. He became director in March 2002. He is responsible for all water, wastewater and drainage facilities in the city. He implemented the drought response programs that were necessary to limit water demands during the 2002 drought and oversaw the development of an additional 35% in water sources in the last year through water rights purchases, leases, interruptible supplies, groundwater development and expansion of the reclamation system. His department also developed a 10 Capital Improvements Program that identified close to one billion dollars in water source development and infrastructure expansion that is needed to meet the city's needs as it doubles in size over the next 30 years. Peter is a member of the American Water Works Association and American Society of Civil Engineers.

James W. Broderick

James Broderick has served as general manager for the Southeastern Colorado Water Conservancy District since November 2002. May 8, 2003, Governor Bill Owens appointed Mr. Broderick to the Colorado River Advisory Council.

Mr. Broderick and his wife Cindy have a daughter, Amy. He is a Pueblo native and graduate of Centennial High School. He has a masters degree specializing in public management and environmental resource planning and a bachelors degree in public administration and policy in environmental science, biology, chemistry, economics and political science.

Mr. Broderick worked for the city of Tucson as a chief operating officer; management coordinator, providing management assistance to division administrators; project manager, working with city council requests and serving as a liaison for local, state and federal agencies; and water administrator, responsible for operations, maintenance and conservation for a territory of 300 square miles and 4,000 plus miles of pipeline, reclaimed pipeline, recharge basins and water banking. He has experience in meter reading, efficiency planning and reengineering for a multi-site operation, and served on a special project to improve customer and community service.

Michael Browning

Michael Browning is a partner in the law firm of Porzak Browning and Bushong LLP, with offices in Boulder and Vail. He has practiced water law in Colorado since his graduation from Yale Law School in 1977. His law firm is active in all aspects of Colorado water development and use, including the promotion of non-traditional uses of water such as kayaking and other recreational uses. Mike is a founding member and current President of the Colorado Water Trust, a new broad based nonprofit organization working on enhancing and preserving Colorado's water based environmental heritage.

Nolan Doesken

Nolan Doesken has been with the Colorado Climate Center in the Department of Atmospheric Science at Colorado State University since 1977. He has a B.S. from the University of Michigan and an M.S. from the University of Illinois. His life-long interest has been climatology and his work in Colorado has involved monitoring current and long term patterns and variations in precipitation, temperature, snowfall and other climate elements. He is involved in monitoring Colorado's varied climate and writes many of the articles published in the magazine "*Colorado Climate*". Part of Nolan's work includes maintaining the historic Colorado State University campus weather station with uninterrupted data going back 115 years. Nolan also helped establish CoCo RaHS (Community Collaborative Rain and Hail Study) to involve the citizens of Colorado in an investigation of localized precipitation patterns.



Jane Earle

Jane Earle serves as Denver Water's community relations manager, administers the agency's public outreach programs and advises management on public sentiment relative to water issues. Earle has been a reporter for *The Daily Oklahoman*, *The Oklahoma Journal*, and *The Denver Post* and editor and publisher of *The Denver Magazine*. Earle worked for KMGH-TV, Channel 7, and served as media advisor and strategist for Richard Lamm's gubernatorial campaign. She spent four years on the national and international lecture circuit, including a stop at Moscow State in Russia, where she stayed to serve as managing editor for the *Moscow Tribune* during Russia's first free parliamentary elections, just as the smoke was clearing from Boris Yeltsin's bombardment of the Russian White House.

The Kentucky native's work has appeared in numerous publications including *Colorado Business*, *The New York Times* and *Ms. Magazine*. She has designed, edited and published a number of others, including *Frontier Magazine*, *Summerscapes* and the *Colorado School of Mines Foundation Newsletter*. Earle graduated Summa Cum Laude with a B.A. from Metropolitan State College. She received a masters degree in public administration from Harvard's Kennedy School of Government in 1990.

Alan Foutz

Dr. Alan Foutz, president of the Colorado Farm Bureau, was born and raised on the eastern plains of Colorado in Akron. He graduated from Akron High School, received a B.S. and M.S. in agronomy from Colorado State University and a Ph.D. in agronomy and plant genetics from the University of Arizona. He taught in the crop science department at California Polytechnic State University at San Luis Obispo for nine years. He retired as an associate professor of crop science. During his tenure, Foutz was secretary to the Academic Senate for five years. He was one of three faculty on campus selected by the faculty and administration to administer grievance procedures and hearings on campus, as well as arrange and facilitate off campus hearings and court dates for the faculty and administration.

In 1982 Foutz returned to the family farm. Today he farms 1800 acres of wheat, no-till sunflowers and millet using continuous farming systems and is a Commissioned Lay Pastor in the Plains to Peak Presbytery of the Presbyterian Church (USA).

Foutz has served as a director, vice-president and president for the Colorado Farm Bureau and the Colorado Farm Bureau Mutual Insurance Company. His past and present board of director service includes American Farm Bureau, Western Farm Bureau Life Insurance Co., American Agricultural Insurance Co., Farm Bureau Life, Western Agricultural Insurance Co., American Farm Bureau Insurances Services and the Farm Bureau Bank. He served as a member of the American Farm Bureau Federation Wheat Advisory Committee and on the National Sunflower Board of Directors. Other boards include the Colorado State University Associate Vice Provost of Agriculture's advisory board and the Mountain States Legal Foundation Board of Directors.

Sharon Harris

Sharon Harris is executive director for the Colorado Nursery Association and the Colorado Greenhouse Growers Association. She's been with CNA for four years and CGGA for two. She was elected the President of Green Industries of Colorado for 2000 and acted in that capacity until February, 2003. During this time GreenCO developed a water strategy, hired consultants and implemented a public relations campaign to mitigate the impacts of the drought on the landscape industry.

In acknowledgement of the work for the industry Sharon was awarded the 2002 Bob Cannon Annual Award by the Associated Landscape Contractors of Colorado and the 2003 Nursery Person of the Year by the Colorado Nursery Association.



Boris C. Kondratieff

Dr. Kondratieff is a professor in the Department of Bioagricultural Sciences and Pest Management at Colorado State University, the Curator of the C.P. Gillette Museum of Arthropod Diversity at Colorado State University and the associate editor of *Western North American Naturalist* and *Perla Newsletter and Bibliography of the International Association of Plecopterologists*. He has a B.S. (1976) in wildlife management from Tennessee Technological University and a M.S. (1979) and PhD (1982) in entomology from Virginia Polytechnic Institute and State University.

Dr. Kondratieff's research has focused on stonefly and mayfly taxonomy, natural history, ecology, and the conservation biology of aquatic insects of National Parks and Military Lands. These studies have been conducted in streams in all regions of the United States and in parts of Mexico and Atlantic Canada. During his career he has described 75 insect species. His comprehensive collecting of aquatic insects across the United States has supported the description of numerous other aquatic insect species. Many of these studies have significantly contributed to the conservation of aquatic insects by providing important species distributional information to scientists and management agencies. Recently he worked on insect inventories of Military Lands in Colorado, Wyoming and Oklahoma, Mount Rainier National Park, and several other National Monuments. These studies have resulted in more than 126 peer-reviewed publications, 62 technical reports and three books including *An Illustrated Guide to the Mountain Stream Insects of Colorado* and *Bagging Big Bugs*.

Rod Kuharich

Rod Kuharich was appointed by Governor Bill Owens as director to the Colorado Water Conservation Board in November 2000. Rod has a bachelors degree in political science from St. Ambrose University and a masters degree in environmental planning from Southern Illinois University. Rod, a father of three, lives with his wife Martha, a second grade school teacher.

Rod started his career as a project manager for the "Phoenix" project, a solar heating demonstration project under a grant from the National Science Foundation. He spent 24 years working for Colorado Springs Utilities in Resource Planning and Development, forecasting natural gas, electric and water demands and planning to meet those demands. He also served as the Colorado Springs Utilities manager of government affairs and was responsible for regulatory and legislative duties as they applied to electric, gas, water and wastewater. Rod has been involved in water court, ground water and surface water issues, water, air and water quality as well as land use regulations.

Rod is anxious to help lead the state's water policy and planning. He said, "It is critical to continue pursuing flood and drought planning and provide technical assistance and funding for water users looking for water supply solutions. The construction loan, instream flow, flood/drought and water supply protection sections all play vital roles in stewardship and development of our water resources. Only through diligence progressive thinking we will ensure that Colorado's present and future water needs are met."

Margaret K. Langworthy

I first went to work for the Regulatory Program, U.S. Army Corps of Engineers, in October 1988, in Jacksonville, Florida. While there, I eventually became involved with ecosystem management meetings on large (+70,000 acres) phosphate mining proposals, complicated development projects and controversial projects. In October of 1999 I relocated to the Denver Regulatory Office, Littleton, Colorado, and haven't quit grinning yet. Educational endeavors include a M.S. in zoology (1977) from the University of Vermont and a B.S. in biology (1973) from the University of Arizona. Previous to the Corps, I worked at the Florida Museum of Natural History, in Gainesville, Florida. While there, I collected mollusks and ecological data in Palawan and offshore islands in the Philippines, collected fossils from Haiti, Dominican Republic, and studied extinct Caribbean sloths.



Leroy Mauch

Leroy was born on the 46th day of the 46th year in Prowers County. After graduating from Lamar High School in 1963, he attended Lamar Junior College for 1 year. Leroy is married to Kathy. They have three daughters, one son and five grandchildren.

Leroy has farmed and ranched five miles north of Lamar his entire life. He is in his ninth year as Prowers County Commissioner and has been board Chairman for the past three years. Leroy is also past board member of the Fort Lyon Canal. He was on the Colorado Counties Incorporated (CCI) Board of Directors for five years where he served as State President in 2001 and also on the National Association of Counties (NACO) Board of Directors for the state of Colorado.

Leroy is the Prowers County representative for the Southeast Colorado Water Conservancy District; serving on the board since 1998. Last year Leroy chaired the successful committee which consisted of a five county intergovernmental agreement to form the Lower Arkansas Valley Water Conservancy District.

Julie McKenna

Julie McKenna has lobbied before the Colorado General Assembly since 1993 with special emphasis on natural resources, water, regulatory affairs, special districts, taxes, and the civil justice system. She has represented the Northern Colorado Water Conservancy District since beginning her Colorado career in 1993. From 1986-1992 she served as a Legislative Assistant to the Honorable Hank Brown during his service in both the U.S. House of Representatives and the U.S. Senate. There she researched, analyzed and developed legislative proposals and tracked legislation in the assigned areas of natural resources, energy, environment, communications and transportation. Some of Ms. McKenna's public affairs accomplishments include assisting in securing federal funding for the I-25/HOV bus lane and the Denver International Airport, and the drafting the 1993 Colorado Wilderness Bill which designated the Rocky Mountain Arsenal as a National Wildlife Refuge.

David Merritt

Dr. Merritt is a riparian ecologist with the Stream Systems Technology Center, U.S. Forest Service Rocky Mountain Research Station, in Fort Collins, Colorado. He holds a visiting scientist position with the Natural Resource Ecology Laboratory at Colorado State University and is a Landscape Ecology Group scientist at Umeå University in Umeå, Sweden. Dr. Merritt's primary interests are the factors that govern riparian plant species diversity in riparian ecosystems, the relationships between fluvial processes, channel morphology, and riparian plant community composition, and the patterns and consequences of plant invasion into riparian ecosystems. The influence of water development (damming and diversion) on such patterns and processes is the main focus of his work. He has a number of published papers and is working on a book chapter on functions performed by riparian and freshwater ecosystems as part of a Scientific Committee on Problems of the Environment project.



Dennis Montgomery

Dennis Montgomery is a shareholder in the law firm of Hill & Robbins, P.C., where his practice emphasizes water law. He received a B.A. from the University of Michigan and a law degree from University of Colorado Law School. Mr. Montgomery has been in private practice with Hill & Robbins, P.C., for more than 20 years. Before entering private practice he was an Assistant Attorney General in the Natural Resources Section of the Colorado Attorney General's Office, where he was head of the Water Unit. Previous to that, he was a staff attorney with the Native American Rights Fund where he was involved in litigation involving Indian water rights and natural resources issues.

Mr. Montgomery was a member of the Colorado Ground Water Commission for two terms and served as Chairman in 1994. In 1985 Mr. Montgomery was appointed as a Special Assistant Attorney General and since that time has assisted David W. Robbins in representing the State of Colorado in the U.S. Supreme Court case, *Kansas v. Colorado*, involving the Arkansas River Compact.

Carl Norbeck

Carl is manager of the Watershed Section of the Water Quality Control Division (WQCD) of the Colorado Department of Public Health and Environment, responsible for water quality monitoring, water quality standards development, nonpoint source controls, financial assistance programs and outreach.

Mr. Norbeck has held a variety of leadership positions in the public, nonprofit and private sectors, including: manager, Outreach and Assistance Unit, (WQCD); coordinator, Clear Creek Watershed Forum; director, Center for Public-Private Sector Cooperation; executive director, Thorne Ecological Institute; senior environmental planner, Lombard North Group; exploration geologist, Amoco Canada; exploration geologist, Pan American Petroleum Corporation; and Communications Officer, U.S. Navy.

Mr. Norbeck has a B.S. in geology from Stanford University and an M.A. in natural resource management/environmental planning from The University of Calgary in Alberta, Canada. He has also taken graduate courses in water resource management/geology at the University of California, Berkeley and post-graduate studies in environmental management and law at Yale University.

Richard Parachini

Richard Parachini works as an Outreach and Assistance Unit Manager in the Water Quality Control Division at the Colorado Department of Public Health and Environment. He has worked for CDPHE for 16 years. He has ten years experience as a Superfund site project manager and four years as South Platte watershed coordinator. He became the unit manager in November 2001. The Outreach and Assistance Unit consists of Financial Assistance Program that administers grants and loans for wastewater, drinking water and nonpoint source projects. It also includes outreach component provided by watershed and nonpoint coordinators that provide a wide range of assistance to local, state and federal interests. He has a B.A. from the University of Northern Colorado in zoology and a M.S. from Colorado State University in range ecology.

Glenn J. Rodriguez

Glenn has been employed by the U.S. Environmental Protection Agency Region 8 for 29 years. He began his career performing water quality studies in support of the Clean Water Act and spent several years implementing testing and quality assurance requirements of the Safe Drinking Water Act. Glenn conducted on-site and off-site aquatic biomonitoring studies in the six-state Region and was the Region's Whole Effluent Toxicity coordinator for the NPDES program. He has been in the Wetlands Unit for 6 years, focusing on wetland monitoring and Section 404 regulatory activities in the South Platte River watershed.



Ken Salazar

Ken Salazar became the 36th Colorado Attorney General in November 1998. He was re-elected for a second term in 2002 with a 20% victory margin. He is the State's chief law enforcement officer and protects the people of Colorado in thousands of criminal and legal matters. He has led efforts to reduce youth and family violence, combat fraud against the elderly and protect Colorado's land and water.

As Attorney General he is the chairman of the Peace Officers Standards and Training Board and the Conference of Western Attorneys General. He chairs the Environment Committee and is a member of the Criminal Law Committee of the National Association of Attorneys General.

He received his political science degree from Colorado College and his law degree from the University of Michigan School of Law. He has honorary doctorate of law degrees from Colorado College and the University of Denver and a distinguished alumni award from the University of Michigan Law School.

Attorney General Salazar is a fifth generation Coloradoan from the San Luis Valley. He has worked as a farmer, small business owner and natural resources lawyer. He served on the Governor's cabinet as executive director of the Department of Natural Resources and chief legal counsel to the Governor. He has served as chairman of the Rio Grande Compact Commission and as a founder and first chairman of the Great Outdoors Colorado Trust Fund. He has practiced water, environmental and public lands law for eleven years in the private sector.

Attorney General Salazar is a member of the American Farmland Trust President's Council and the Board of Trustees of Colorado College. Attorney General Salazar has served on many boards and commissions including the Colorado Water Conservation Board and selection committees for United States Attorney and Federal District Court judges in Colorado.

Some of Salazar's recent community awards include the Colorado Press Association Friend of the First Award and the American Jewish Committee's Judge Learned Hand Human Relations Award.

Eric Schuck

Dr. Eric Schuck is an assistant professor in the Department of Agricultural and Resource Economics at Colorado State University. A native of Washington, he holds degrees in economics from Pacific Lutheran University and the University of Montana. He earned his doctorate in agricultural economics from Washington State University in 1999 and spent two years on the faculty at North Dakota State University before coming to Colorado State University in 2001. His primary research expertise is in the on-farm effects of water policy and water scarcity. He has been published in the Journal of Soil and Water Conservation, Resource and Energy Economics, Ecological Economics, the International Journal of Water Resource Development, and Current Agricultural and Food Issues.



Melissa I. Young

Melissa is the Regulatory Specialist for the Colorado Rock Products Association. With experience in the federal legislative and regulatory arenas, she became the first person to hold this position. She lobbies on a federal and state level and works with federal and state agencies. Previously, Melissa was the government affairs counsel for the Petroleum Marketers Association of America, where she lobbied Congress, prepared comments and testified before federal agencies.

Melissa is a Colorado licensed attorney and received her Juris Doctorate in 1998 from Hamline University School of Law in St. Paul, Minnesota. She graduated from Iowa State University with a degree in psychology and a minor in criminal justice. She has studied at Trinity College in Dublin, Ireland, and at Charles University in Prague, Czech Republic. Prior to her position at PMAA, she lobbied for the beneficial use of water resources at the National Water Resources Association in Arlington, Virginia, and worked in the mortgage industry in Denver, Colorado.

Robert C. Ward

Robert C. Ward is director of the Colorado Water Resources Research Institute and professor of Civil Engineering at Colorado State University. During 2002-03 he is serving as President of the National Institutes for Water Resources – the organization that represents the 54 state-based water institutes created and operated under the federal Water Resources Research Act. As director of CWRRI, Robert works with an advisory committee of Colorado water managers to connect the water expertise of Colorado’s higher education system with their water research and education needs. CWRRI annually operates a state-based water research competition that funds four to five water research projects. He is the author of two books on water quality monitoring and teaches a graduate level course on the subject. He received his PhD degree from North Carolina State University and has been on the CSU faculty for 33 years. His e-mail address is: Robert.Ward@ColoState.edu.

Malcolm Wilson

Malcolm Wilson is a water resource engineer for the Bureau of Reclamation’s Eastern Colorado Area Office in Loveland, Colorado. He has been there for 19 years and his career has spanned design, construction, contract administration, reservoir and system operations and the colorful world of water rights litigation. Malcolm spent many ‘formative’ years recreating along British-built canals in northern India which led him to pursue civil engineering at Cornell University. In 1979 with a BS in engineering and post graduate work in irrigation and drainage, he left the drainage in New York in search of irrigation out west where he worked for two years with the Arizona State Land Department assessing water resources on state lands. Returning to Asia in 1982, he and his wife spent two and a half years in the Peace Corps in Nepal working on design and construction of hill irrigation systems. In 1985 he joined Reclamation and moved to Fort Collins where he and his wife are raising three children to enjoy the Colorado outdoors.



Ellen E. Wohl

Ellen is a professor in the Department of Geosciences at Colorado State University. She has a BS in geology from Arizona State University, and a PhD in geosciences from the University of Arizona. She is a fellow of the Geological Society of America and a member of the American Geophysical Union.

Ellen's awards and honors include: Fulbright-Hays Postgraduate Research Grant, Butler Scholarship, Gladys W. Cole Memorial Award, Japan Society for the Promotion of Science Fellowship, G.K. Gilbert Award, Member of Phi Beta Kappa, Phi Kappa Phi, Sigma Xi. Ellen has received more than \$1,104,306 in grant money and has more than 50 recent publications. She's on the editorial board of *Geomorphology*, and an associate editor for the *Geological Society of America Bulletin*. She's also an officer with the Quaternary Geology & Geomorphology Division, Geological Society of America and a member of the American Geophysical Union Erosion & Sedimentation Committee.

Robert E. Zuellig

Bob is currently pursuing a PhD in Ecology at Colorado State University. His has an A.S. (1997) in aquaculture and fisheries technology from Front Range Community College and a B.S. (1999) in fishery biology and M.S. (2001) in entomology from Colorado State University.

Bob's research has focused on stream insect and fish communities and how they respond and recover from a variety of human induced stressors, such as habitat change due to urbanization and siltation events due to reservoir operations. These studies have been conducted primarily in the cities of Fort Collins and Boulder, Colorado, and on the North Fork Cache la Poudre River below Halligan Reservoir. Bob has worked on aquatic insect inventories of Camp Guernsey, Wyoming; Fort Sill, Oklahoma; and Mount Rainier National Park. He has extensively collected aquatic insects in Colorado, Nebraska, the Ozark Region and parts of Appalachia. Between spring of 2001 and spring of 2003, he was the South Platte Study Unit biologist for the U.S. Geological Survey's National Water Quality Assessment Program. Currently, Bob is working with a team of scientists on an EPA funded project investigating dissolved organic carbon, heavy metal toxicity and ultra violet radiation to determine how they interact to affect stream communities. These studies have resulted in 10 authored or co-authored peer-reviewed publications, popular articles and the book *An Illustrated Guide To The Mountain Stream Insects of Colorado*.

