Navigating the Future

Water Supplies in the South Platte

Proceedings of the 15th Annual
South Platte Forum
October 27-28, 2004
Longmont, Colorado

Jennifer Brown, Editor

Information Series No. 98

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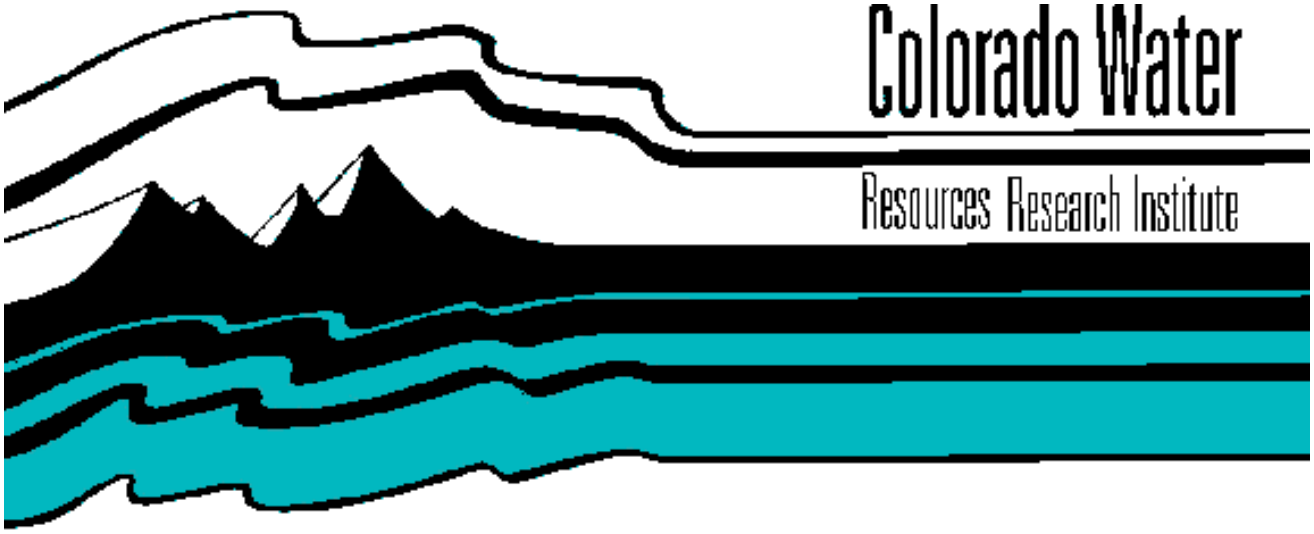
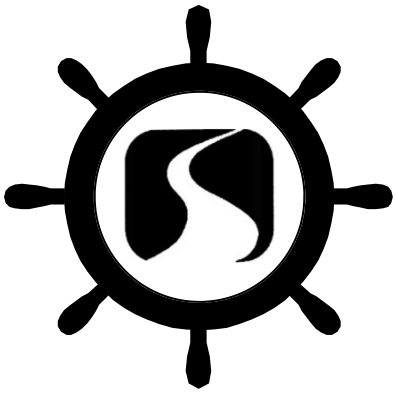


NAVIGATING THE FUTURE

WATER SUPPLIES IN THE SOUTH PLATTE



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October 27-28, 2004

Raintree Plaza Conference Center

Longmont, Colorado

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Colorado Water Resources Research Institute, Robert C. Ward, Director
Colorado State University, Fort Collins, CO 80523-2033

Navigating the Future

Water Supplies in the South Platte

Captain's Log—Wednesday, Oct. 27

0800 Registration & Continental Breakfast

0830 Don Kennedy, Denver Water; South Platte Forum Chair

0845 **Water 2025: Reducing Western Water Crisis and Conflicts**
Maryanne Bach, U.S. Bureau of Reclamation

0915 **Climate and Law: Which Way is the Wind Blowing?**
Moderator: Don Kennedy, Denver Water
How Much Moisture Can We Expect?
Klaus Wolter, NOAA-CIRES Climate Diagnostics Center
Legislative Update
Barbara Biggs, Metro Wastewater Reclamation District

1015 Poster Session & Networking

1045 **Restoring a River: Happy Habitats**
Moderator: Jay Skinner, Colorado Division of Wildlife
Effects of Urban Growth on Stream Ecosystems
Lori Sprague, U.S. Geological Survey
Partnerships in Environmental Restoration
Ralph Roza, U.S. Corp of Engineers
River Channel and Aquatic Habitat Restoration in the Upper South Platte River Drainage
Rod Van Velson, Colorado Division of Wildlife
Lower River Projects and Potential Future Efforts
Bill Goosmann, Colorado Division of Wildlife

1200 Lunch

1230 **An Overview of South Platte Fish and Wildlife Issues**
Ralph Morgenweck, U.S. Fish and Wildlife Service

1315 **"Standards-Schmandards" - The Why and How of Nutrient Standards**
Moderator: Reagan Waskom, Colorado State University
The Regulatory Perspective
Kathy Hernandez, U.S. Environmental Protection Agency
Colorado's Approach to Nutrient Standards
Paul Frohardt, Colorado Water Quality Control Commission
Controlling Undesirable Effects of Nutrients in Colorado Waters
William Lewis, University of Colorado

1445 Poster Session & Networking

1515 **A Date with PAM (Polyacrylamide Additives)**
Moderator: Troy Bauder, Colorado State University
PAM—One of Irrigation's Most Versatile Tools
Rick Lentz, USDA Agricultural Research Service
Project PAM
Kathy Holley, U.S. Bureau of Reclamation
Effectiveness of PAM Treatments in Reducing Post-Fire Erosion
Daniella Rough, Colorado State University

NAVIGATING THE FUTURE

WATER SUPPLIES IN THE SOUTH PLATTE

Captain's Log—Thursday, Oct. 28

0800 Registration & Continental Breakfast

0830 **Whose Thirst is First? Future Water Supply and Development**
Moderator: Carl Brouwer, Northern Colorado Water Conservancy District
Planned Storage Projects and Section 404
Tim Carey, U.S. Corp of Engineers
Colorado's Statewide Water Supply Initiative - Helping Ensure Colorado Will Have Adequate Water for Our Citizens and the Environment
Rick Brown, Colorado Water Conservation Board
Facing Our Interdependent Future: Connecting Agricultural Land with Municipal Water Supply
Douglas Kemper, City of Aurora

0945 Poster Session & Networking

1015 **Whose Thirst is First? Future Water Supply and Development**
Science to Policy: Bridging the Troubled Waters
Janet Bell, Jefferson County Planning and Zoning
The Rural/Urban Farm Water Model - Changing the Paradigm
Frank Jaeger, Parker Water and Sanitation District
Water Supply Development in the South Metro Area
Pat Mulhern, Mulhern MRE, Inc.
Water Supplies for Well Augmentation in the Lower South Platte
Jon Altenhofen, Northern Colorado Water Conservancy District

1150 Lunch

1220 **The Journey to Sustainability**
William Alley, U.S. Geological Survey

1305 **The "State" of Water Issues**
Moderator: David Little, Denver Water
Wyoming Water Issues
Mike Besson, State of Wyoming
Nebraska Water Issues
Ann Bleed, Nebraska Department of Water Resources
Colorado Water Issues
Steve Sims, Colorado Attorney General's Office

Mark Your Calendar!!

The 16th Annual South Platte Forum
October 26-27, 2005
Location TBA

Fill out your evaluation and help select the topics!

Wednesday, Oct. 27, 8:45 a.m.

Water 2025: Reducing Western Water Crises and Conflicts

Maryanne C. Bach
Regional Director, U.S. Bureau of Reclamation, Great Plains Region, 316 N. 26th St., Billings, MT 59101, 406-247-7600, mbach@gp.usbr.gov

Water is the lifeblood of the West and the foundation of its economy. It is also the scarcest resource in some of the fastest growing areas of the country. Water 2025 is intended to focus attention on the reality that explosive population growth, the emerging need for water for environmental and recreational uses, and the national importance of domestic production of food and fiber from western farms and ranches is driving major conflicts between competing uses of water. Water 2025 provides the basis for public discussion in advance of water crises and sets forth a framework for meeting water supply challenges in the future.

On June 21, 2004, Interior Secretary Gale Norton announced more than $4 million in water conservation grants under the Water 2025 Secretarial Challenge Grant Program. The 2004 grants from the Bureau of Reclamation are funding 19 projects in ten states which will make more efficient use of existing water supplies through water conservation, efficiency and water market projects. The total investment for all projects selected for grants is more than $39 million, which includes the matching contributions of non-federal partners. The President's Fiscal Year 2005 budget request includes $20 million to continue the Water 2025 effort.

Maryanne Bach was appointed regional director for the Great Plains Region in November 1998. She began her Federal career with the legislative branch, serving eight years as a staff member on the Committee for Science, Space and Technology of the U.S. House of Representatives. She occupied several senior staff positions with program and budget oversight for the National Science Foundation, Department of Energy, the Environmental Protection Agency, the National Aeronautics and Space Administration, National Institutes of Standards and Technology, White House Office of Science and Technology Policy, National Oceanic and Atmospheric Administration and also served as liaison to the National Academy of Sciences, National Academy of Engineering and several professional/technical societies.

In 1989 Ms. Bach joined the Interior Department as deputy assistant secretary for Fish, Wildlife and Parks, and later served as director of program analysis, and special assistant to the Secretary for Policy. During her tenure at Interior, she also served a 15-month appointment as assistant director in the White House OSTP. She joined the Bureau of Reclamation in 1992, and from 1994 to 1996 served as the deputy regional director for the Great Plains Region. From 1996 to 1998 she was assistant director for Policy of Reclamation's Program Analysis Office and the agency's Drought Coordinator, stationed in Denver, Colorado.

Ms. Bach received a Bachelor of Science degree (cum laude) in biology from Providence College, Rhode Island; Master of Science in botany and plant ecology (magna cum laude) from Iowa State University; and an Honorary Doctorate in public service from Providence College in 1998. In 1992 she received the Iowa State University Distinguished Young Alumni Award. She is a member of the American Association for the Advancement of Science, Phi Sigma Tau and Phi Kappa Phi.

Wednesday, Oct. 27, 9:15 a.m.

Climate and Law: Which Way is the Wind Blowing?

Moderator: Don Kennedy
Denver Water, 1600 W. 12th Ave., Denver, CO 80254, 303-628-6528, don.kennedy@denverwater.org

Don Kennedy has been an environmental scientist with Denver Water for almost 20 years. His diverse job duties include stream improvement, land reclamation, relicensing of facilities and numerous other projects requiring compliance with governmental acts ranging from the National Environmental Policy Act to the Clean Water Act to the Endangered Species Act. Prior to working with Denver Water, Don worked for a consulting firm, the U.S. Forest Service and the U.S. Park Service. He has a bachelor's degree in forestry and a master's degree in biology with emphasis on land reclamation.

Climate Projections

Klaus Wolter
NOAA-CIRES Climate Diagnostics Center, R/CDC1 325 Broadway, Boulder, CO 80303-3328, 303-497-6340, klaus.wolter@noaa.gov

Want to understand what's really going on with the weather? Hear an overview of the factors that shape our climate, what can be said about the set-up for the 2004-05 winter and what this means for winter moisture in different parts of Colorado. There will be a brief discussion of ENSO (the El Niño/Southern Oscillation phenomenon), the importance of trends (global warming) and other climate influences.

After coming to the U.S. in 1982, Klaus Wolter studied at the University of Wisconsin in Madison where he received his Ph.D. in 1987. After a one-year stint at the National Meteorological Center in Washington, DC, he transferred to the University of Colorado in the fall of 1988, where he has been affiliated with CIRES (Cooperative Institute for Research in the Environmental Sciences) since.

His main research interests lie in empirical climate research, in particular the application of statistical methods to climate problems, such as the impact of ENSO on world-wide climate. He has developed and refined a Multivariate ENSO Index (MEI) based on tropical Pacific ship-based observations of sea level pressure, near-surface wind fields, sea - and air surface temperatures, as well as total cloudiness. The MEI is more robust than conventional indices in monitoring the ENSO phenomenon. Monthly updates and discussions of the MEI can be found at http://www.cdc.noaa.gov/people/klaus.wolter/MEI/

During the last few years Klaus has devoted more attention to the analysis and understanding of western U.S. climate, being involved in the Western Water Assessment (WWA) project at CU. Prompted by repeated requests for better regional climate forecasts, he has developed statistical tools that allow him to make seasonal climate predictions. Originally, these forecasts leaned heavily on statistical associations with ENSO, while his forecasts from late 2001 onwards were based on a variety of influences on our climate. Monthly updated discussions and forecasts are posted at http://www.cdc.noaa.gov/people/klaus.wolter/SWcasts/

Legislative Update

Barbara J. Biggs
Metro Wastewater Reclamation District, 6450 York St., Denver, CO 80229-7499, 303-286-3000, bbiggs@mwrd.dst.co.us

Don't miss this review of what happened with water-related legislation in 2004 and what we will see in the 2005 session. The things you need to know in terms you can understand.

Barbara Biggs is the governmental officer for the Metro Wastewater Reclamation District in Denver, Colorado. The Metro District provides wholesale wastewater treatment service to 1.5 million people, or roughly one-third of Colorado's population, through 56 separate local governments in the metropolitan region. Ms. Biggs has been with the Metro District for 11 years and is responsible for all aspects of the District's federal, state and local governmental and regulatory affairs. She has a bachelor's degree, cum laude, in finance and accounting from the University of Colorado and extensive experience in municipal and special district finance.

Wednesday, Oct. 27, 10:45 a.m.

Restoring a River: Happy Habitats

Moderator: Jay Skinner
Colorado Division of Wildlife, 6060 N. Broadway, Denver, CO 80216, 303-291-7260, jay.skinner@state.co.us

Effects of Urban Growth on Stream Ecosystems

Lori A. Sprague
U.S. Geological Survey, Denver Federal Center, P.O. Box 25046, MS 415, Lakewood, CO 80228, (303) 236-4882 x262, lsprague@usgs.gov

The National Water-Quality Assessment (NAWQA) Program of the U.S. Geological Survey is investigating the effects of urbanization on stream ecosystems in nine metropolitan areas across the United States, including the Front Range of Colorado. This study is addressing timely questions about the impact of increasing residential and commercial growth, such as:

- As watersheds are urbanized, what is the response in stream hydrology, water chemistry and biological communities?
- How early in the process of urbanization does degradation of stream ecosystems occur?
- How do responses to urbanization differ among the diverse environmental settings in the United States?

In the South Platte River Basin, the study began in 2001 with the identification of 278 potential monitoring sites between Laramie County in Wyoming and Arapahoe County in Colorado. Twenty-eight sites ultimately were selected to minimize natural variability (e.g., altitude, stream size, soil type and climate) so the effects of urbanization could be more closely examined. These 28 sites are located in the cities of Cheyenne, Fort Collins, Loveland, Longmont, Boulder, Wheat Ridge, Westminster, Lakewood, Denver, Greenwood Village and points in between. The sites cover a range of urban intensity, allowing the response of stream ecosystems in relatively undisturbed areas to be compared to those in moderately and highly urbanized areas.

Field sampling took place between fall 2002 and summer 2003. The sampling characterized chemical (nutrients, pesticides, organic carbon, fecal bacteria), biological (fish, algae, macroinvertebrates) and physical (stream flow, water temperature, habitat) parameters. In addition, *semipermeable membrane devices* (SPMDs), designed to mimic bioaccumulation in aquatic organisms, were deployed at the sites. The SPMDs concentrated hydrophobic organic contaminants that often are difficult to detect in streams because they are present at very low concentrations.

The results from this urbanization study will better define the interrelationships among water quality, stream hydrology and habitat, and aquatic communities along the Front Range of Colorado.

Lori is a hydrologist for the Water Resources Discipline of the U.S. Geological Survey in Denver. She currently works for the National Water-Quality Assessment Program of the USGS, which collects information on water chemistry, physical characteristics, stream habitat, and aquatic life to provide science-based insights for current and emerging water issues in surface and ground waters throughout the United States. As part of this program, she is researching several issues in the South Platte River Basin, including the quality of municipal water supplies, drought effects on water quality, and the effects of urbanization on stream ecosystems. She is also currently examining factors that have led to long-term changes in nutrient and sediment concentrations in the Missouri River Basin.

Poudre River Restoration Project

Ralph Roza
U.S. Army Corp of Engineers, 106 S. 15th St., Omaha, NE 68102-1618, 402-221-4574, ralph.r.roza@nwo02.usace.army.mil

Since Ecosystem Restoration became a priority mission area for the Corps of Engineers, the nationwide and regional demand for ecosystem restoration projects from the Corps has steadily grown. In addition to the growth in demand for single-purpose ecosystem restoration projects, new flood damage reduction projects seek to include a strong ecosystem restoration component. Also, the Corps is now emphasizing the importance of watershed-based planning and will seek to use this approach to project planning where there is local support.

This presentation will provide an overview of ecosystem related programs that are available through the Corps of Engineers, with a strong emphasis on the ongoing and planned ecosystem project efforts in Colorado by the Omaha District Corps of Engineers. The Omaha District boundaries include all of the area of the South Platte Watershed. The presentation will include information on a diverse set of various types of ecosystem restoration projects.

Ralph Roza is the chief of Planning Branch, Planning, Programs and Project Management Division, Omaha District, U.S. Army Corps of Engineers. Mr. Roza received a Bachelors of Science degree in civil engineering from the University of Nebraska in 1975. Mr. Roza is a Professional engineer in the State of Nebraska and is a member of the American Society of Civil Engineers. He has authored publications by the American Society of Civil Engineers on hydroelectric pumped storage. Mr. Roza has more than 33 years of experience with the Corps of Engineers in planning, project management and construction. In his private life, Mr. Roza has been active in the sport of curling, having coached at the national and international level. Mr. Roza was the U.S. Olympic Committee Coach of the Year for the sport of curling in 1999. His teams won three U.S. National Championships and two bronze medals in international competition.

River Channel and Aquatic Habitat Restoration in the Upper South Platte River Drainage

Rod Van Velson
Colorado Division of Wildlife, 317 W. Prospect, Fort Collins, CO 80526, 970-475-4316, rod.vanvelson@state.co.us

Since 1991, the Colorado Division of Wildlife (CDOW) has completed a variety of restoration projects in rivers and streams across South Park, located in central Colorado. All the projects were on lands owned or leased by the CDOW and city municipalities located along the Front Range. South Park contains three large reservoirs, Eleven Mile and Antero owned by the Denver Water Department and Spinney owned by the City of Aurora.

Historically the South Park river channel and aquatic habitats were degraded by poor land use practices and recently by changes in the natural stream flow regime. Both resulted in over-width river channels and loss of deep water pool habitats essential for over-wintering trout populations.

Nine restoration projects using 19 different river channel and aquatic habitat treatments, some developed specifically for South Park streams, have been completed in about seven river miles across South Park. These treatments enhanced natural river processes, reduced river bank erosion and improved aquatic and trout habitats. Pool excavation plus treatments reducing river bank erosion and decreasing river channel width were judged the most beneficial for enhancing natural river processes and improving aquatic habitats.

Most restoration projects involved installing treatments in existing river channels. However one project created a new river channel for the South Fork of the South Platte River immediately downstream from Antero Reservoir. This 3,600 ft of excavated river channel, with an average bank top width of 14 feet and containing 41 excavated pools, was lined with about 12 inches of spawning size (.5-2.5 inch) gravel. In-channel structures used 371 boulders plus 180 pieces of woody materials, consisting of logs, root wads and stumps, to create aquatic and trout habitats. Denver Water designed and installed a diversion structure and head gate to control water flows into the new channel. *(continued on p. 8)*

(continued from p. 7)

Besides improving the natural river process, the trout populations have also benefited from the restoration projects completed in South Park. For example river channel and trout habitat treatments installed in the first restoration project upstream from Spinney Reservoir in 1991 resulted in nearly doubling juvenile and adult brown trout habitats plus increased brown trout biomass from about 27 to over 100 lbs. per acre by 2003.

During restoration projects the Aurora Utilities Department and Denver Water adjusted water releases from their reservoirs to provide more favorable construction conditions.

Rod Van Velson has worked 26 years in the aquatic research section of the Colorado Division of Wildlife and has worked on river restoration projects since 1991. He also spent 12 years with the Nebraska Game and Parks Commission. Rod has bachelor's and master's degrees from Colorado State University.

Lower River Projects and Potential Future Efforts

Bill Goosmann
Colorado Division of Wildlife, 6060 Broadway, Denver, CO 80216, 303-291-7141, bill.goosmann@state.co.us

The main goal of the Colorado Division of Wildlife (CDOW) wetlands program is to protect wetlands and wetland-dependent wildlife. The program is non-regulatory and participation is voluntary. Specific activities or emphases arise from a variety of sources, including international bird treaties; federal and Colorado laws and policies; the goals of program partners such as Ducks Unlimited, The Nature Conservancy, and Partners for Fish and Wildlife; the desires of private landowners; and the requirements of funding sources. Given this variety, the definition of wetland necessarily ranges beyond the classic regulatory definition used by the Army Corps (jurisdictional wetland) to riparian and other habitats that do not meet the three-parameter delineation method, and non-traditional wetlands such as playas, "isolated waters," and similar ephemeral habitats. In each case the CDOW wetlands program also incorporates non-wetland buffer zones.

Most projects in the wetlands program are implemented through nine wetland focus area committees (FACs) located in each of the state's major watersheds. FAC members are volunteers and include natural resource agency representatives from all levels of government, non-profit groups, interested citizens and private landowners. FAC members provide local knowledge and priorities, project ideas, and project planning and oversight.

The bulk of project funding is provided by lottery proceeds from the Great Outdoors Colorado program, as well as hunting license and waterfowl stamp revenues. Additional resources arise from specific grants applied for by the program, FACs or the major program partners. Tools used by the program include direct financial involvement such as funding wetland creation and restoration projects; payments for purchase of fee title interest or conservation easements; technical assistance to landowners, such as for restoration planning and habitat management; aquatic resource inventories; support of education and outreach; and project monitoring and evaluation.

In terms of future program developments, the wetlands program will seek to increase funding from existing sources, increase the number of funding sources, increase the capacity of FACs to generate and implement projects (e.g., providing project technical support, GIS information on existing aquatic resources), expand operations beyond existing FACs, and improve pre- and post-project monitoring and evaluation to insure program performance and to document that performance in support of future funding requests.

Bill Goosmann moved to Colorado in 1979 and spent four years avoiding responsibility in Steamboat Springs. Thereafter he did twelve years hard time as a research analyst for the Colorado state legislature. Having paid his debt to society, he returned to school to further his over-education, accumulating a bachelor's degree in biology and a master's degree in riparian wetland ecology. Since then he has administered the wetland program for Colorado Department of Transportation and, as of last December, run the wetland program at the Colorado Division of Wildlife.

Wednesday, Oct. 27, Noon

An Overview of South Platte Fish and Wildlife Issues

Ralph Morgenweck
U.S. Fish and Wildlife Service, PO Box 25486, Denver Federal Center, Denver, CO 80225

Colorado and the South Platte River Basin are experiencing not only drought and challenges to water management but related difficult wildlife issues as well. While riparian systems constitute approximately 3% of the land area in Colorado, more than 80% of wildlife uses them at some point in their life. Preble's mouse, greenback cutthroat trout, piping plover, whooping crane, interior least tern, pallid sturgeon, mountain plover, black-tailed prairie dogs and many other species either reside in the state or activities in Colorado affect their continued existence. The state and, in particular, the South Platte Basin are important in developing more cooperative and anticipatory processes of dealing with these issues. These cooperative efforts will be discussed and the lessons learned will be shared.

Ralph O. Morgenweck, a native of Minnesota, began his career in 1975 in the Minnesota Department of Natural Resources. He holds Bachelor of Science and Master of Science degrees in biology from St. Cloud State University, and a Ph.D. in wildlife management from the University of Minnesota. Dr. Morgenweck is a member of several professional and scientific organizations.

In 1978 he joined the Fish and Wildlife Service. Dr. Morgenweck was appointed to head the Service's National Ecology Research Center in Fort Collins, Colorado in 1980. In May 1988, Dr. Morgenweck was named assistant director, Fish and Wildlife Enhancement, Washington, D.C.; he was named regional director, Mountain-Prairie Region, Denver, Colorado, in August 1992. Dr. Morgenweck and his family live in Littleton, Colorado.

Special Thanks

The South Platte Forum would like to thank John Fielder for his generous donation and support for the Friends of the South Platte Award. "South Platte River Sunset" can be found with John's other fine art prints at John Fielder's Colorado, his art gallery in the Cherry Creek mall. You can also view his work, learn about workshops and order books at www.johnfielder.com.

Wednesday, Oct. 27, 1:15 p.m.

"Standards-Schmandards" The Why and How of Nutrient Standards

Moderator: Reagan Waskom
Colorado State University, E119 Engineering, Fort Collins, CO 80523, 970-491–2947, reagan.waskom@colostate.edu

Reagan Waskom works for Colorado State University as the extension water resources specialist. Dr. Waskom is a member of the Department of Soil and Crop Sciences faculty and is affiliated with the Water Resources Research Institute at CSU. He has worked collaboratively with the Colorado Department of Agriculture since 1991 on water quality and nutrient issues related to the use of fertilizers and manure.

Development of Nutrient Criteria

Kathryn S. Hernandez
U.S. Environmental Protection Agency, 999 18th Street, Denver, CO 80201, 303-312-6101, hernandez.kathryn@epa.gov

This presentation will describe EPA's section 304(a) water quality criteria for nutrients which were developed with the aim of reducing and preventing eutrophication on a national scale. There will be a brief overview of several Region 8 states nutrient criteria development plans and examples of criteria that has been developed in several states. This will include a description of how those states have implemented their nutrient criteria.

Kathryn Hernandez works in the total maximum daily load (TMDL) program for the Environmental Protection Agency's Region VIII office in Denver, Colorado. She has worked for the EPA in Denver, Colorado since 1993 as an environmental scientist and has been involved in many phases of water quality sampling and assessment on a practical basis.

The TMDL program relates to the statutory responsibility of states and EPA to implement surface water quality standards. TMDLs provide the crucial link between ambient water quality standards and controls for point and nonpoint sources of pollution.

Mrs. Hernandez earned her bachelor's degree in environmental science in 1995 from Metropolitan State College, Denver and her master's degree in geology with an emphasis on geochemistry in 1998 from the University of Colorado, Boulder.

Colorado's Approach to Nutrient Standards

Paul Frohardt
Colorado Water Quality Control Commission, 4300 Cherry Creek Dr. So., Denver, CO 80246-1530, 303-692-3468, paul.frohardt@state.co.us

This presentation will describe Colorado's current nutrient standards for a limited number of water bodies and will describe the approach to future standards set forth in the Nutrient Criteria Development Plan for Colorado, which is scheduled to be updated in the summer of 2004. The presentation will then address the major issues and challenges associated with nutrient criteria development, including the need for adequate data, the link between nutrient criteria and use attainment, and the determination of appropriate "expected conditions".

Paul Frohardt has been the administrator of the Colorado Water Quality Control Commission since 1987 and is also the administrator of the Colorado Water and Wastewater Facility Operators Certification Board. He has served as acting director of the Colorado Air Pollution Control Division and as interim manager of the Rocky Flats Program Unit at the Colorado Department of Public Health and Environment.

Paul was previously a partner with the Denver law firm of Holland & Hart, specializing in environmental law and water law. He is also formerly of counsel with the Carlson, Hammond & Paddock law firm in Denver. Since 1990 Paul has taught graduate courses in Water Quality Management in Denver University's Environmental Policy and Management Program. Paul is a graduate of Harvard College and Harvard Law School. He also holds a master's degree in public policy from the Kennedy School of Government at Harvard.

Basis and Purpose for Controlling Key Nutrients in Colorado Waters

William Lewis
Center for Limnology, University of Colorado, 216 UCB, CIRES, Boulder, CO 80309-0216, 303-492-6378, william.lewis@colorado.edu

Regulation of water quality through the U.S. Clean Water Act has focused primarily on control of toxins and pathogens. It has long been known that aquatic ecosystems are severely altered and often impaired in their beneficial uses by excess nutrients derived from anthropogenic sources. Therefore, the U.S. EPA has prepared criteria for the control of key nutrients, which include phosphorus and nitrogen. In responding to these criteria by the preparation of water-quality standards, states face some difficult questions, which are the subject of this presentation, as follows: (1) To what degree can background contributions be separated from anthropogenic contributions to nutrient concentrations throughout an entire state?; (2) How much reduction in anthropogenic nutrient sources would be required to achieve beneficial results?; and (3) What methods of nutrient reduction are most feasible and cost effective?

William Lewis obtained his Ph.D. in limnology at Indiana University in Bloomington. After a brief postdoctoral appointment at the University of Georgia, he joined the faculty at the University of Colorado in Boulder. In 1985 he became director of the Center for Limnology at CU Boulder. Dr. Lewis's main interests include biogeochemical cycles in aquatic ecosystems, aquatic foodwebs and water quality. His work and that of his students has been conducted primarily in Colorado, the Orinoco basin of Venezuela and Puerto Rico. He has worked extensively with the National Academy of Sciences and the National Research Council on national issues related to water quality and aquatic life, and has been a member of the NRC's Water Science and Technology Board. He received the Renewable Natural Resources Foundation's Sustained Achievement Award in 1996 and the Naumann-Thienemann Medal from the International Society for Pure and Applied Limnology in 1998.

Wednesday, Oct. 27, 3:15 p.m.

A Date with PAM (Polyacrylamide Additives)

Moderator: Troy Bauder
Colorado State University, Dept. of Soil and Crop Sciences, Fort Collins, CO 80523-1170, 970-491-4923, tbaud@lamar.colostate.edu

Troy Bauder is the state Extension Water Quality Specialist in the Department of Soil and Crop Sciences at CSU. Troy received his bachelor's degree in agronomy and his master's degree in soil science from Colorado State University. 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.

Polyacrylamide: One of Irrigation's Most Versatile Tools

Rick Lentz
USDA-Agricultural Research Service Northwest Irrigation Soils Research Laboratory, 3793 N. 3600 E., Kimberly, ID 83341, 208-423-6531, lentz@nwisrl.usda.gov

The polyacrylamide used in agriculture and irrigation, often referred to as PAM, is a unique material that interacts with soil and water in a dramatic and complex fashion. These interactions are responsible for making PAM one of the most multifaceted tools available to resource managers today. PAM is a polymer made from two organic building blocks that are linked together into a single chain of great length. If each link in PAM's chain was the size of a walnut, a single PAM molecule would form a continuous strand nearly 50 football fields long. *(continued on p. 12)*

(continued from p. 11)

In addition to its size, PAM's solubility in water and binding action with soil and organic particles make it an efficient soil stabilizer and particle settling agent, and give it the ability to alter water infiltration characteristics of soil. These attributes can be exploited by different PAM treatments to reduce soil erosion and increase infiltration, improve runoff water quality, limit water-borne transport of weed seeds and bacteria off fields, and inhibit seepage losses from canals and ponds. This presentation will discuss research illustrating PAM's effectiveness for these uses.

Dr. Lentz is a soil scientist at the USDA-ARS Northwest Irrigation and Soils Research Laboratory in Kimberly, ID. He holds undergraduate degrees in biology and soil science from Portland State and Oregon State University; and a Ph.D. from the University of Minnesota. During the last 13 years, his research has developed and evaluated polyacrylamide applications for irrigated agriculture. His current research goals include 1) improving water quality of surface water and groundwater under irrigated agriculture; 2) developing management practices to increase water application uniformity under furrow irrigation and conserve water resources; and 3) increasing our ability to understand, describe, and predict irrigation furrow processes. http://www.nwisrl.ars.usda.gov/indexjs.shtml.

Project PAM

Kathy Holley
U.S. Bureau of Reclamation, 2764 Compass Dr., Ste. 106, Grand Junction, CO 81506, 970-248-0622, kholley@uc.usbr.gov

This presentation will be an overview of Project PAM...what we've learned about reducing canal seepage with polyacrylamide (PAM) and where we're going in the future. Project PAM is a collaborative effort by several Federal agencies, and public and private partners to understand, refine and promote the widespread use of PAM to significantly reduce irrigation canal seepage throughout the 17 Reclamation states. The Project PAM Team consists of expertise in environmental science, materials and hydraulic engineering, hydrology, toxicology, biology, canal management and field application techniques. Research efforts will emphasize measuring seepage reduction, longevity, and various application methods over long lengths of canals in various soil types.

Kathy Holley is the water conservation coordinator for the Bureau of Reclamation Western Colorado Area Office in Grand Junction, Colorado and also the Project PAM coordinator. Her background is in fisheries biology and environmental contaminants. Prior to her work with water conservation, Kathy spent nine years with the Upper Colorado River Endangered Fish Recovery Program working with contaminants and habitat restoration.

Effectiveness of PAM Treatments in Reducing Post-Fire Erosion

Daniella Rough
Colorado State University, Watershed Science Program, Fort Collins 80523, Phone 970-310-7405, drough@lamar.colostate.edu

Post-fire flooding and erosion are critical environmental concerns following high-severity wildfires. To reduce the risk of catastrophic events burned area emergency rehabilitation (BAER) treatments are often applied. Polyacrylamide (PAM) soil binding agents successfully reduce erosion from furrow irrigation. Similar agents have been promoted as a possible means of reducing post-fire erosion, but no research has evaluated their effectiveness in burned areas. The primary objective of this study was to evaluate the effectiveness of PAM treatments in reducing post-fire erosion following the 2002 Schoonover Fire in the Colorado Front Range. *(continued on p. 13)*

(continued from p. 12)

Sediment production was measured in six pairs of swales using sediment fences. One swale in each pair was randomly selected for treatment and the other was left as a control. The paired swales were divided into two groups of three according to type and timing of treatment application. In summer 2002 three swales were treated with 5.6 kg ha^{-1} of a micronized formulation of PAM (dry PAM) and three swales were treated with 11 kg ha^{-1} of the same PAM dissolved in an ammonium sulfate solution (wet PAM). The dry PAM treatment had no effect on sediment yields in summer 2002 whereas the sediment yields from the wet PAM treatment were on average 66% less than the control swales. In summer 2003 the swales treated with the dry PAM were retreated with the wet PAM solution. In contrast to 2002, neither treatment showed a significant reduction in sediment yields relative to the control swales. The PAM treatments did not significantly affect the amount of bare soil or the density of rills. The variation in results between swales suggested that excessive amounts of residual ash may reduce the effectiveness of PAM. This hypothesis was supported by a laboratory experiment, which showed that the PAM preferentially binds to ash relative to mineral soil.

These results indicate the application of PAM after a wildfire is not a reliable or effective treatment for reducing post-fire erosion. The interaction with the ash may prevent it from binding effectively with underlying mineral soil. While the wet PAM treatment did reduce sediment yields in the first year after burning, the new treatment in 2003 did not reduce sediment yields. The inconsistency of the results and potential limitations means that PAM may not be an acceptable alternative to other BAER treatments such as mulching.

Daniella Rough is a master's candidate in Watershed Science at Colorado State University. She received her bachelor's degree from the University of California, Santa Cruz, in earth sciences and worked for the San Francisco Bay Regional Water Quality Control Board before moving to Colorado to continue her education. She is now in her third year of researching the effectiveness of different post-fire rehabilitation treatments in the Bobcat, Schoonover and Hayman fires.

Thursday, Oct. 28, 8:30 a.m.

Whose Thirst is First? Future Water Supply and Development

Moderator: Carl Brouwer

Northern Colorado Water Conservancy District, 220 Water Ave., Berthoud, CO 80513, 970-622-2298, cbrouwer@ncwcd.org

Mr. Brouwer is a civil engineer with 20 years of experience in the planning and implementation of water resource supply projects. He has been with Northern Colorado Water Conservancy District since 1990. He is the project manager of the Northern Integrated Supply Project, a new water supply project intended to develop approximately 30,000 acre-ft of reliable yield for 13 participating water providers in northern Colorado. Mr. Brouwer received his bachelor's degree in civil engineering from University of Michigan and his master's degree in civil engineering from Colorado State University.

Planned Storage Projects and Section 404

Tim Carey

U.S. Army Corp of Engineers, 9307 S. Wadsworth Blvd., Littleton, CO 80128, timothy.t.carey@usace.army.mil

For most water supply projects, the U. S. Army Corps of Engineers must review and authorize or deny construction of the project under authorities contained in Section 404 of the Clean Water Act. Consequently, the Corps is aware of most planned water development projects in the South Platte Watershed. Mr. Carey will provide an overview of known water development projects, provide a status update on the Section 404 review for these projects and answer questions related to water development and Section 404.

Mr. Carey has a bachelor's degree in natural resources from Colorado State University. He began his career in 1975 with the U.S. Corps of Engineers' Kansas City District and has worked as a park ranger, park manager, outdoor recreation planner, operations manager and chief of a regulatory field office. In his current position, he serves as the chief of the Omaha District's Denver Regulatory Office and is responsible for administration of Section 404 of the Clean Water Act in northeast Colorado.

Colorado's Statewide Water Supply Initiative - Helping Ensure Colorado Will Have Adequate Water for Our Citizens and the Environment.

Rick Brown
Colorado Water Conservation Board, 1313 Sherman St., Ste. 721, Denver, CO80203, 303-866-3514, rick.brown@state.co.us

The Statewide Water Supply Initiative is a Colorado Water Conservation Board project. SWSI is a basin by basin look at current and future (forecasted to the year 2030) water supply and demands and an evaluation of how Colorado's future water needs may be addressed. The SWSI process relies heavily on local input with stakeholders from a variety of interest groups participating in Basin Technical Roundtables in Colorado's eight major river basins. This presentation will summarize the outcome of these roundtable discussions; outlining current and future municipal, industrial, and agricultural demands, and environmental and recreation needs. A short summary of some of the possible options for addressing these water demands and needs will also be provided.

Rick has been with the Colorado Water Conservation Board for five years. He was initially hired to work on Platte River issues for the Board, especially the three state cooperative agreement for Platte River Research and other efforts relating to endangered species habitats along the central Platte river in Nebraska. Rick was asked to manage the Statewide Water Supply Initiative in February 2003.

Prior to joining the Board, Rick worked for ten years in the Hazardous Materials and Waste Management Division of the Colorado Department of Public Health and Environment. His CDPHE work focused on investigation and remediation of contaminated sites under the federal CERCLA or Superfund program. Rick also has experience at the local government level with the Boulder County Health Department.

Rick is a native of Colorado with a bachelor's degree from the University of Colorado.

Facing Our Interdependent Future: Connecting Agricultural Land with Municipal Water Supply - Interruptible Leases and Drip Irrigation Systems

Douglas Kemper
City of Aurora Utilities, 15151 E. Alameda Pkwy., #3600, Aurora, CO 80012, 303-739-7370, dkemper@auroragov.org

Municipal water systems stressed by drought and the future demands of a growing population will need to continue to explore new concepts to ensure stable water supplies. Water conservation certainly plays a key role in reducing demand. And on the supply-side, short-term leases have proven to be an effective strategy to soften the impacts of severe drought. Over the past two years, Aurora has leased 20,000 acre-feet of agricultural and industrial water to help offset severe declines in our water storage levels. The farmers have benefited from a guaranteed income even as their water supplies and crop yields become more uncertain during times of drought.

Agricultural water conservation as a source of municipal water supply also deserves consideration. Aurora is investing $1.3 million through contracts with farmers in Otero County to install drip irrigation systems. The city will benefit as it diverts the saved consumptive use from the more efficient irrigation systems. The farmers benefit from on-farm improvements and, hopefully, improved crop yields. It is to the city's benefit to have these fields remain in production in order to protect its investment and thus these contracts serve to keep the land in agriculture. Facing the future, our hopes stand in reaping the benefits of a strong agricultural-municipal relationship.

Facing backwards I see the past
Our nation gained, our nation lost
Our sovereignty gone
Our lands gone
All traded for the promise of progress
What would they say. . .
What can we say? *(continued on p. 15)*

(continued from p. 14)

Facing future I see hope
Hope that we will survive
Hope that we will prosper
Hope that once again we will reap the blessings of this magical land
For without hope I cannot live
Remember the past but do not dwell there
Face the future where all our hopes stand
- Israel Kamakawiwo'ole

Doug Kemper is the manager of Strategic Resources Planning for the City of Aurora. During his 18 years with the city, Doug has worked on water supply projects in the South Platte, Arkansas, and Colorado River watersheds. His current career focus is to develop and implement strategies to ensure stable water supplies for Aurora. Activities include system modeling, risk analysis, integrated resources planning, and development of cooperative water supply agreements.

Prior to working with Aurora, Doug spent four years with Rocky Mountain Consultants. He is a graduate of University of Colorado with a master's degree in water resources engineering and is a registered Professional engineer.

Science to Policy: Bridging the Troubled Waters

Janet Bell
Jefferson County Planning and Zoning Division, 100 Jefferson County Pkwy., Golden, CO 80419, 303-271-8739, jbell@jeffco.us

Take one part fractured granite, add development pressure, top it with the worst drought since the Anasazi fled the cliff dwellings and bake in a hot oven of denial. The Turkey Creek Basin Mountain Ground Water Resource Study was started and stopped in the four years from 1997 to 2001. Working with the U.S. Geological Survey cooperative program, Jefferson County Commissioners determined to find out if science could help them know how much water was available to support existing and future development. The role of the project manager was "to raise money and bring the cookies." Who, what, where, when and how the study progressed: rocks, rapids, rainbows and roily water will be described.

Janet Bell, MPA, APA, AICP, is the Jefferson County long range planning coordinator with 20 years of experience in community and intergovernmental planning. She was the citizen participation officer for the Ohio Kentucky Indiana Regional Council of Governments for 13 years. She is president of Bell Associates, a strategic management consultancy that provides government and community relations consulting services. She was named citizen of the year by the Colorado Grange and has been appointed to two Transportation Research Board national committees. She manages the Mountain Groundwater Resource study. Other projects in the long range planning section include historic preservation, socio-demographic information, transportation analysis zone data, land use inventory, GIS mapping for county projects, Census 2000 data, economic development projects and revisions to community plans.

Parker Future Water Supply Plans

Frank Jaeger
Parker Water and Sanitation, 19801 E. Main St., Parker, CO 80138, 303-841-4627 x201, fjaeger@pwsd.org

This presentation will focus on the new paradigm that Parker Water has established in Logan County, Colorado. In partnership with the agricultural community we have invested money in the community and on operating farms to improve the efficiency of operation thereby providing water that could be put to other bifacial uses.

Frank Jaeger has served as district manager for Parker Water & Sanitation District since 1981. He is a director of the Douglas County Water Authority and president of the Parker Economic Development Council. His involvement and leadership in these agencies is indicative of his commitment to encouraging water cooperation, with water quality and water quantity as a priority in the state of Colorado.
(continued on p. 16)

(continued from p. 15)

Mr. Jaeger received the 2000 Distinguished Manager of the Year award from the Special District Association, and under his direction, Parker Water and Sanitation District was selected as the 2003 Special District of the Year by the Special District Association. He was awarded the 2003 Cornerstone Award from the Parker Economic Development Council, which honors individuals whose deeds, vision, commitment and leadership help set the course for Parker's growth and quality of life. Most recently, he was appointed by Governor Owens to a three-year term on the Colorado Ground Water Commission.

Through 23 years of service, Mr. Jaeger has been instrumental in bringing together experts in water law, hydrology and engineering to ensure an adequate water supply for Parker's current and future needs. His leadership in innovations such as the use of well injection as a storage option, augmentation of water resources through the capture of AWT treated wastewater, and irrigation return flows, is known throughout the state. The Rueter – Hess reservoir is another example of Frank Jaeger's commitment to the principles of conjunctive use and long-term water quality and availability along the Front Range.

Status of Water Supply Development in the South Metro Area

Patrick Mulhern
Mulhern MRE, Inc., 2 Inverness Dr. E., Englewood, CO 80112, 303-649-9857, pat@mulhernmre.com

The metropolitan area south of Denver has developed largely based upon the availability of non-tributary ground water from the aquifers of the Denver Basin. A recent study by the South Metro Water Supply Study Board has identified the demands for water supply in this area for the next 50 years, and has determined alternatives for water supply to meet those needs. This study was the first comprehensive study of the use and availability of the ground water to meet these demands.

The study identifies conjunctive use of surface water and ground water as a primary alternative to meet these demands. The surface water sources identified are wet year supplies on the upper South Platte and Blue River Basins. The challenges are many. This presentation will talk about the study, and the political, institutional and financial challenges of developing new water supplies along the Front Range.

Patrick F. (Pat) Mulhern, PE, is the owner and president of Mulhern MRE, Inc., a civil engineering firm specializing in water resources consulting, special district management and commercial development engineering since 1991. Mulhern MRE, Inc. manages and provides infrastructure planning and design for the Cottonwood Water and Sanitation District, the Inverness Water and Sanitation District, the Inverness Metropolitan Improvement District, the Belle Creek Metropolitan District and several other special districts in the metropolitan area. He is the study manager for the South Metro Water Supply Study Board, a cooperative group of 11 water providers in the South Metro area who are working together to develop additional sources of water supply.

Mr. Mulhern graduated from the University of Notre Dame with a bachelor's degree in civil engineering and obtained a master's degree in hydraulic engineering from Colorado State University.

Water Supplies for Well Augmentation in the Lower South Platte

Jon Altenhofen
NCWCD, 220 Water Ave., Berthoud, CO 80513, 970-622-2236, jaltenhofen@ncwcd.org

Tributary groundwater wells in the South Platte River Basin in Colorado are developing a variety of reliable water supplies for river augmentation of well depletions. The drought and the need for Water Court approved augmentation plans require good water supplies. Managed groundwater recharge has been and will continue to be a major source of augmentation in the Lower South Platte of Colorado. In addition, the change of historic irrigation water supplies such as reservoirs for augmentation use and the use of augmentation wells are other sources being relied upon to provide a reliable water portfolio for groundwater well augmentation. *(continued on p. 17)*

(continued from p. 16)

Jon Altenhofen is a supervisory water resources engineer at Northern Colorado Water Conservancy District. He has been with NCWCD since 1984. He has a bachelor's degree in civil engineering and a master's degree in water science (plant, soil, water relations) from the University of California at Davis.

He is a registered professional engineer in Colorado and California, a U.S. Patent Holder for an Evapotranspiration Instrument and the president and co-owner of the ETgage Company in Loveland, Colorado.

At NCWCD, Jon is responsible for the Augmentation/Recharge Accounting (ARA) program that assists water users with the accounting and management of their groundwater augmentation/recharge projects, plans and decrees. Jon is also the Colorado water user representative on the Water Management Committee for the Tri-State (CO, NE, WY) effort in developing a Platte Basin ESA Recovery program with the USDOI. Coordinator for SPLRG (South Platte Lower River Group, Inc.) working on developing Colorado's Tamarack Plan—Colorado's water contribution to the Tri-State effort.

Thursday, Oct. 28, Noon

The Journey To Sustainability

William Alley
U.S. Geological Survey, 5735 Kearny Villa Rd., Ste. O, San Diego, CA 92123, 858-637-6825, walley@usgs.gov

With increased worldwide attention to the theme of sustainable development and its extension to the sustainability of ground-water resources, one might ask how this new concept of sustainability relates to safe yield, and to what extent do the controversies surrounding safe yield carry over to sustainability. These evolving concepts are explored through an historical perspective and case studies.

Dr. William M. Alley received a Bachelor of Science in geological engineering from the Colorado School of Mines, a Master of Science in hydrogeology from Stanford University, and a Ph.D. in environmental engineering from the Johns Hopkins University. He has been with the U.S. Geological Survey since 1976, and is chief of the USGS Office of Ground Water. Dr. Alley has published over 80 scientific publications, including the text Regional Ground-Water Quality. He has served on national and international committees for the American Geophysical Union, UNESCO and the National Research Council.
Dr. Alley received the National Ground Water Association's John Hem Excellence in Science and Engineering Award in 2001, and the Distinguished Service Award from the Department of Interior in 2002.

Thursday, Oct. 28, 1:05 p.m.

The "State" of Water Issues

Moderator: David Little
Denver Water, 1600 W 12th Ave., Denver, CO 80254, 303-628-6533, david.little@denverwater.org

David Little has worked at Denver Water for more than 20 years. As manager of water resources, he is responsible for assuring there are sufficient water supplies for Denver Water's 1.1 million existing customers and for the additional 800,000 new customers expected in the future. Using his knowledge of Denver's water collection system, Colorado water law, environmental issues and water politics, Dave has been involved in numerous negotiations and planning efforts that have been successful, a few that have failed, and many that are still evolving.

Dave graduated from Colorado State University with a Bachelor of Science in earth resources and has completed many continuing education classes in water resource management, environmental policy, negotiation theory and practice and conflict resolution.

Wyoming Water Update

Mike Besson
Wyoming Water Development Commission, 6920 Yellowtail Rd., Cheyenne, WY 82002, 303-777-7626, lbesso@state.wy.us

Mr. Besson will discuss Wyoming's interest in participating in the proposed basin-wide Platte River Recovery Implementation Program (PRRIP). Mike will discuss why he supports the proposed recovery effort. Mr. Besson will identify reasons the State of Wyoming opted to participate in the process and outstanding issues that must be resolved for the Wyoming Legislature and Governor to endorse the proposed program. Besson will provide insight as to potential benefits that will accrue to Wyoming with the approval and implementation of the PRRIP and of the consequences Wyoming water users may experience in the event that the PRRIP is not implemented.

Mike is currently employed as the director of the Wyoming Water Development Commission and has been appointed by the Governor to represent the state on water related endangered species issues in the Platte River Basin. Mike grew up in the Big Horn Basin in north central, Wyoming and attended the University of Wyoming where he obtained bachelor's degrees in secondary education and civil engineering. Mike is a professional engineer and is registered in the states of Wyoming and Colorado.

Prior to his tenure with the Wyoming Water Development Office, Mike taught school and practiced as a consulting engineer. He enjoys the great Wyoming outdoor environment. Mike is married and has three children. His wife Betty accompanies Mike on backpacking, camping and fishing excursions throughout the state.

His work brings him closer to the outdoors and the natural resource environment. Mike considers himself quite fortunate that he was raised in Wyoming and appreciates the opportunity to serve the citizens of Wyoming as the director of the Wyoming Water Development Commission.

Nebraska Water Update

Ann Bleed
Nebraska Department of Water Resources, 301 Centennial Mall So., Box 4676, 402-471-2383, ableed@dnr.state.ne.us

The drought and integrated surface and groundwater management have been the key issues in Nebraska. Although there has been rain in the eastern portion of the state, the west, after five years, is still suffering from the drought. Irrigators and water officials are dealing with unprecedented conditions that have resulted in new problems and innovative attempts to mitigate impacts. At the same time Nebraska's sweeping new water law integrating surface and ground water management took effect July 16, 2004. The new law is more proactive than previous integrated management laws and has resulted in a flurry of joint planning efforts involving the state Department of Natural Resources and the local Natural Resources Districts. At the same time, legal actions are challenging the role of the Natural Resources Districts in managing ground water that is hydrologically connected to surface water streams.

Ann Bleed received her Ph. D. degree from the University of Wisconsin and is registered professional engineer. From 1988 – 1999 she was the state hydrologist working for the Nebraska Department of Water Resources. Since the merger of the Department of Water Resources and the Nebraska Natural Resources Commission in 1999, she has been the deputy director of the Nebraska Department of Natural Resources. Previously Ann was a professor at the University of Nebraska.

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Update on Colorado State-Wide Water Issues

Steve Sims
Colorado State Attorney General's Office, 1525 Sherman St., 5th Floor, Denver, CO 80203, 303-866-5042, steve.sims@state.co.us

I. Colorado's Position on the Platte River Recovery Implementation Program
- A. The Colorado Plan for existing and future depletions
- B. Colorado's official DEIS comments
- C. Colorado's position on the FWS biological opinion
- D. Who will pay for and implement Colorado's obligations

II. Significant Colorado Judicial decisions in 2004
- A. Trout Unlimited v. USDA (Forest Service bypass flows)
- B. High Country Citizens Alliance v. Norton & Black Canyon of the Gunnison National Park Reserved Rights Case, No. W-437 (Black Canyon quantification)
- C. Green Mountain Reservoir/Heeney landslide case
- D. Application of City of Central (Case No. 92CW168)

III. Significant Legislation in the 2004 Session of the Colorado General Assembly
- A. SB 04-222 Rio Grande wells rulemaking legislation
- B. SB 04-232 Front Range Water Conservation District
- C. SB 04-235 Creation of Republican River Water Conservancy District
- D. HB 04-1040 Basin of Origin
- E. HB 04-1256 Interruptible Water Supply Agreements
- F. HB 04-1402 Repeals Water Administration Fees

Steve Sims is senior water counsel to the Colorado Attorney General's Office. He has been with the Attorney General's Office since 1989 and has practiced in Colorado since 1979. Steve was legislative liaison for the Attorney General for water matters during the 2003 and 2004 legislative sessions, lead counsel on the 2002 Amended South Platte Groundwater Rules litigation, co-counsel on the 1996 Arkansas River Basin Ground Water Rules litigation and has argued over a dozen Colorado Supreme Court appeals including Empire Lodge v. Moyers, and Union Park I and II.

Steve Sims has a Bachelor of Arts from the University of Colorado (1975) and a Juris Doctor from the University of Puget Sound (1979). Steve lives in Greeley with his wife Yolanda and son Austin.

Poster Abstracts

Antibiotic Concentrations in Livestock Manures and Effluents and in Agricultural Reaches of the Cache la Poudre River

K.H. Carlson, J.G. Davis, S. Yang, J. Cha, S. Kim, and K.C. Doesken
Department of Soil and Crop Sciences, Colorado State University, Fort Collins, CO

Antibiotics, used in treatment of both human and veterinary diseases and for growth promotion in livestock, have become an increasing environmental concern in recent years. In this study, we monitored the Cache la Poudre River from its mountainous, pristine origins through urban and agricultural areas, and analyzed the water and the sediment for tetracyclines, sulfonamides, macrolides, and ionophores. The tetracyclines and ionophores increased in their levels of detection from the pristine to urban and finally to the agricultural areas. However, the sulfonamides had maximum concentrations in the urban areas. In order to evaluate whether livestock are a likely source of antibiotic contamination, we measured antibiotic concentrations in 25 animal waste lagoons and 23 manure stockpiles, representing beef, dairy, hog, sheep, and turkey production facilities. These data show that a wide range of antibiotics is present in most animal waste streams. Tetracycline and tylosin were the most commonly detected antibiotics. We are continuing this work through evaluation of manure management impacts on antibiotic levels in manure and effluent and through assessment of antibiotic transport from manure application sites.

CoCo RaHS (Community Collaborative Rain and Hail Study): Statewide Climate and Water Supply Monitoring Utilizing Volunteers of all Ages

Nolan Doesken and Robert Cifelli
Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523, www.cocorahs.org

CoCo RaHS, the Community Collaborative Rain and Hail Study, was initiated in 1998 as a way to enlist citizen involvement in monitoring and reporting precipitation and showing the incredible local variations in moisture that typify our semi-arid climate. Since 1998 and with the help of several local and sponsors, CoCo RaHS has grown both in area and in participation. In 2004, the program went statewide and also expanded rapidly to include Wyoming and Nebraska. With over 1000 active volunteers collecting accurate measurements of rainfall, hail, snowfall and snow water content, we are able to map details of precipitation patterns that could not be accomplished from traditional data sources. For example, the March 2003 snowstorm was captured by several hundred volunteers in the South Platte Basin providing the best picture ever of snowfall patterns associated with extreme Front Range snowstorms. Rainfall associated with localized flash floods in 2004 were also well documented. CoCo RaHS continues to grow and expand, and more volunteers, with interest in weather and water, are needed.

The 2004 Water Year -- Drought or Not?

Nolan Doesken and Roger Pielke, Sr.
Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523

The 2004 water year brought the first major winter snow accumulation to southwestern Colorado in several years. However, Colorado's northern and central mountains and Front Range once again had much below average winter precipitation and an extremely warm and dry March. Drought concerns expanded rapidly but were quieted a bit by a very wet April and some cool, and story weather in June. A preliminary summary of 2004 precipitation, snowpack, reservoir storage and streamflow will be presented, and an evaluation of current drought conditions will be offered.

Walking through the Water Year: A Colorado Water Education Initiative

Nolan Doesken
Department of Atmospheric Science, Colorado State University, Fort Collins, CO 80523

Recent drought has focused attention on the need for a well-educated water-appreciative public. With a good knowledge of our climate, water and water law, we will be best equipped to make choices and meet challenges in a way that protect the resources that matter most for our future. "Walking Through the Water Year" is a water education idea proposed by the Colorado Climate Center. We are hoping to build a water education coalition that will work together for one special year where we all follow the water cycle day by day and week by week through one complete water year. Along the way, using the incredible information resources, media support and water expertise that exists in Colorado, we hope to lead the citizens of Colorado to a greater appreciation of where our water comes from, where it goes, how it gets there, and how our water management and planning decisions affect us. Are you interested? Sign on to the "Water Year Team".

A Review of the SDF Semi-Analytical Stream Depletion Model in Bounded Alluvial Aquifers

Calvin Miller and Deanna Durnford
Dept. of Civil Engineering, Colorado State University, Fort Collins, CO 80523

A widely-used semi-analytical model (the “SDF method”) describing stream depletions and accretions induced from groundwater pumping and augmented groundwater recharge is currently being reviewed for accuracy when applied in bounded alluvial aquifers. In the late 1960’s and early 1970’s, the USGS performed electric-analog modeling in the Arkansas River valley and numerical modeling in the South Platte River valley to account for stream depletion behavior under stream-aquifer conditions that do not match the ideal assumptions of analytical stream depletion models. The USGS modeling effort examined non-ideal effects caused by tributary streams, the spatially-variable aquifer transmissivity, the meandering river boundary, and the irregular alluvial aquifer boundary. These effects and the associated stream-aquifer responses were integrated into a single descriptor—a unit of time—called the stream depletion factor (SDF) which the USGS provided on maps delineated into areas of equal SDF within the river valleys. Using the modeled SDF values in analytical stream depletion calculations greatly improved estimates of stream-aquifer interaction, especially within timeframes close to the SDF value of a given location. The method was an efficient and useful improvement for stream depletion estimates and was a simplification necessitated by the limited computing resources of that era. The USGS noted that the method was an approximation having a level of error assumed to be tolerable. Over the years, however, during which use of the SDF method has become routine in Colorado, practitioners may have forgotten that the method does not precisely account for aquifer boundary effects at times much less or much greater than the SDF time. As an alternative, fully-analytical methods can precisely account for the alluvial aquifer boundary at all times (e.g., the Glover method combined with the method of images), but, on the other hand, they do not account for the other non-ideal factors that were integrated into SDF maps through modeling. Both methods have advantages and limitations that should be considered in water rights planning and administration. Each method may be preferable for certain scenarios, depending on the specifics of a given site. This presentation will illustrate these considerations and expected differences between the two methods. Expanded stream aquifer response curves for bounded aquifers along with error analysis and field examples will be provided.

Have YOUR poster on display at the next South Platte Forum

If you have a poster you would like to present at the 2005 South Platte Forum, Oct. 26-27, 2004, email a one-page abstract to Jennifer Brown, jennifer@jjbrown.com, by Aug. 1, 2005.
Include your name, organization, address, phone number and email address.

Large-Scale Subsurface Dams in Alluvial Aquifers: Potential for New Water Storage in Colorado?

Calvin Miller and Deanna Durnford
Dept. of Civil Engineering, Colorado State University, Fort Collins, CO 80523

Alluvial aquifers represent a significant water source and potential reservoir for the semi-arid western United States. The use of this water faces limitations, however, since depletions to surface water bodies induced by groundwater pumping are often restricted by environmental concerns or water rights. Also, the timing and yield of groundwater recharge and augmentation projects may be constrained by the rapid return of recharged waters to the alluvial stream, especially in narrow or high-permeability aquifers. Subsurface dams have the potential to address these issues either by creating isolated subsurface reservoirs that are no longer in connection with alluvial streams or by simply slowing the hydraulic response between alluvial streams and nearby groundwater pumping and recharge activities. By providing control of groundwater migration, subsurface dams can also address concerns and uncertainties about the success of recovering water placed in aquifer storage. This added control, along with eliminating the high evaporation rates associated with surface reservoirs in the region, could provide water storage that bridges multiple year droughts more effectively than surface reservoirs. Also, since the subsurface reservoir would have a very small footprint on the ground surface, the time and effort required to study, permit, and construct such a reservoir may be significantly less than a conventional surface reservoir. A site in the South Platte River alluvial aquifer is being used to consider the practicability of using subsurface dams for these purposes. Preliminary evaluations indicate that a large-scale subsurface dam could create an isolated subsurface reservoir that is both large in scale (e.g., 30,000 acre-feet) and economically feasible under regional water prices. Numerical model simulations are being conducted to examine the operation of such a reservoir, to further examine the economic feasibility of such a reservoir, and to also test the economic and technical feasibility of using smaller-scale subsurface dams to slow the return flows of recharged water.

Comprehensive Pond Site Assessment Model (CPSAM):

Selection of Pond Sites for Streamflow Augmentation Recharge and Waterfowl Habitat

Cat Shrier
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Seasonally flooded wetland ponds have been recognized as providing multiple beneficial functions, including groundwater recharge, groundwater discharge to augment streamflows, and habitat for a diverse array of wildlife species, including waterfowl (Adamus et al. 1991). In the lower South Platte River Basin of Colorado, managed groundwater recharge ponds have been developed for conjunctive management of stream-aquifer systems for streamflow augmentation during low-flow periods to off-set depletions caused by well withdrawals from alluvial aquifers, in accordance with Colorado's *prior appropriation* water law. Several habitat partnership programs have begun working with landowners and water user organizations in this region to include managed groundwater recharge ponds in wetland restoration efforts, and to design the ponds to provide seasonal wetland habitat, primarily for waterfowl.

By selecting appropriate pond locations and appropriately designing and operating the recharge ponds, well users can mitigate the stream depletion impacts of their pumping on more senior water rights under a *prior appropriation* legal doctrine. Pond locations can also be selected and evaluated for their potential to benefit waterfowl at the site, and for the development of regional wetland complexes. The cost of the pond site development is also tied to the pond's location due to such factors as the proximity and gradient to water sources and soil excavation costs.

The selection and evaluation of pond sites in this region for streamflow augmentation benefits, pond development costs, and waterfowl habitat benefits has historically been conducted by local experts. Scientific studies and non-refereed publications are available on some portions of pond site selection for recharge potential (e.g. Bouwer 2002) or waterfowl benefits (e.g. Cross 1988, Ringelman 1991). There has been, however, no formal, systematic approach to the selection of pond sites for streamflow augmentation, nor for waterfowl habitat benefits in this region. There has also been no pond site evaluation method to support coordination between the water managers and the wildlife managers in the selection of pond sites to provide multiple and mutual benefits. *(continued on p. 23)*

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The objective of this research was the capture and replication of the site assessment decisions of water managers and habitat managers on the evaluation of recharge pond sites for streamflow augmentation, pond development costs, and waterfowl habitat restoration benefits, in an automated and transparent decision support tool. This objective was met through the development of a methodology and prototype model combining the use of knowledge-based systems (KBS), geographic information systems (GIS), and multi-criteria decision analysis (MCDA).

A nine-step methodology was used for the development of an Excel-based prototype model called the Comprehensive Pond Site Assessment Model (CPSAM) that is linked to GIS coverages for data acquisition and spatial analysis. The target region for CPSAM is the Lower South Platte River of Colorado, specifically within Sedgwick County. CPSAM was designed to maximize the ability to evaluate potential recharge sites using 1) available knowledge from both local experts and published literature sources and 2) available databases and GIS tools assembled and updated to provide data necessary for site evaluation in an appropriate format, with minimal input requirements from KBS users. CPSAM was developed in a modular approach consisting of separate components, i.e. physical attributes of sites to be developed for streamflow augmentation credits; pond development costs; and waterfowl habitat benefits. These components are referred to as the Recharge Pond Assessment Tool (RPAT), Cost Assessment Tool (CAT), and Waterfowl Habitat Assessment Tool (WHAT), respectively. CPSAM provides complete explanations to the user of the multiple criteria and subcriteria analysis results and the rules and raw data behind the results of those analyses as applied to the specific alternatives being analyzed. CPSAM also includes adaptable rule/criterion parameters that can be easily changed by the user for instantaneous updates to the model outputs to reflect new understanding of site assessment criteria by the user, or to reflect new situations (e.g. assessment for different waterfowl species or changes in cost estimation parameters).

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Cumulative Effects of Aggregate Mining Along the South Platte River

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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 U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, and the U.S. Fish and Wildlife Service (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 (Figure 1) (study corridor).

The study analyzes certain environmental resources and indicators that were jointly identified by the CRPA and the federal agencies. The resources and indicators include:

- Geomorphology (river channel geometry and location);
- Surface and groundwater hydrology, including water quantity, quality, and flow regime;
- Type and size of vegetation communities;
- Type and extent of wetlands; and
- Type and extent of wildlife habitat.

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The socioeconomics of aggregate mining in the State, as well as the six county Denver metropolitan areas, were also analyzed and extrapolated to the study corridor.

Among the major findings of this study are the following:

- The geomorphology of the river corridor indicated no significant impact as shown by the physical evidence from older, reclaimed areas as well as setback areas adjacent to existing operations.
- Significant changes to natural vegetation communities occurred with conversion of native vegetation to agriculture and grazing land long before the advent of aggregate mining.
- The quality and variety of wetland types was most affected by the historic practices of agricultural diversion and flood retention prior to the onset of aggregate mining.
- Representative common wildlife species have not been negatively affected by aggregate production and the post-mining landscape resulting from aggregate production usually provides an open water type of wildlife habitat.

The research performed in this investigation demonstrates that aggregate mining and reclamation do not have a discernable (significant) cumulative effect on the study corridor. Despite the inherent topography changes from aggregate extraction in the alluvial margin of the river, neither the quality of the habitat and vegetation nor the quantity of water flow is degraded. Reclamation has been shown to create areas of high value wildlife habitat as well as diverse wetlands.

Estimating the Water Conservation Potential of Subsidies for Irrigation Technology Transition

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In light of the growing competition for limited water supplies, a subsidy approach to encourage on-farm irrigation technology transition is often advocated as a means of making additional water available for higher-valued urban and environmental uses and, at the same time, preventing losses in agricultural production and income. Some analysts have on conceptual grounds disputed the conservation potential of improved irrigation technologies. Their critique rest on the distinction between withdrawal (the amount of water diverted from a source), delivery (the amount of water delivered to the place of use), and consumption (the amount actually depleted), and in the observation that only if consumptive use is reduced will any basin-wide real conservation be achieved. But so far policy-makers have not been provided with detailed empirical estimates on the impacts of irrigation technology subsidies in terms of water deliveries, consumptive use, resource use and agricultural income, as well as on the cost-effectiveness of different subsidy programs.

Based on a mathematical programming model incorporating water-crop production functions from a crop simulation model applied to an irrigation water delivery organization near Greeley in the South Platte Basin, we analyze hypothetical subsidy policies with regard to their impacts on water use as well as on land and labor use and farm net income. The irrigation organization has senior irrigation rights for river flow, and rights to reservoir water which is mostly used in the late-season. Some irrigators also own shares in the Colorado-Big Thompson transmountain water diversion project. In addition, ground water is pumped from the unconfined shallow alluvial aquifer along the South Platte. Farmers rely on surface irrigation systems, with open ditch with siphon tubes distributing water on more than half of the irrigated area. The main crops are corn grain and alfalfa, followed by edible dry beans, corn silage, and sugar beet.

In the context of the irrigation water delivery organization, assuming an average-weather year, optimally timed irrigations, and a range of on-farm adjustment possibilities in a long run framework, our results confirm empirically what previously has been conceptually discussed: that in river basins such as the South Platte Basin, where irrigation return flows have value to downstream water users, subsidies would be a relatively ineffective policy instrument for bringing about water conservation. In fact, when yield levels can be profitably increased by applying additional numbers of irrigations, consumptive use may rise—even without an accompanying expansion in irrigated area. Overall, our results suggest that a subsidy approach can be viewed as an expensive form of transferring income to farmers, an approach that is at best ineffective in providing real water conservation.