**CONFERENCE PROCEEDINGS**

**Wednesday, November 28, 2007**

5:00-7:00 p.m.  
Registration

7:00-9:00 p.m.  
**Opening Reception and Award Presentations**  
Special guest, via video, US Senator E. Benjamin Nelson, NE

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**Thursday, November 29, 2007**

**SESSION ONE: WHAT IS KNOWN**

8:45 a.m.  
**Welcome**  
Cindy Kreifels, *The Groundwater Foundation, Lincoln, NE*

9:00 a.m.  
**Bridging the Science and Policy Gap - Strategies for Success**  
John Berge, US Senator E. Benjamin Nelson’s Office, Scottsbluff, NE

9:30 a.m.  
**Threats from Chemical and Microbiological Sources, Protection Success Stories and Remaining Challenges**  
(View PowerPoint)  
William Alley, *US Geological Survey, San Diego, CA*

10:00 a.m.  
**Threats from Shrinking Supplies, Conservation Success Stories and Remaining Challenges**  
(View PowerPoint)  
Michael Jess, *University of Nebraska — Conservation and Survey Division, Lincoln, NE*

10:30 a.m.  
**Networking Break and Exhibits**

10:45 a.m.  
**Myth vs. Reality: An Analysis of Western Water Use**  
(View PowerPoint)  

11:15 a.m.  
**The Value of Aquifer-Based Management and Integrating Local, State, and Federal Groundwater Programs**  
(View PowerPoint)  
Mike Wireman and Greg Oberley, *US EPA Region 8, Denver CO*

12:15 p.m.  
**Networking Luncheon**

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**SESSION TWO: WHAT IS PRACTICED**

1:30 p.m.  
**Protecting Ground and Surface Water Together: What Does Integrated Management Really Mean?**  
(View PowerPoint)  
Moderator: Rick Karlin, Awwa Research Foundation, Denver, CO  
Panel: Patrick Tyrrell, *State Engineer’s Office, Cheyenne, WY*  
Michael Jess, *University of Nebraska — Conservation and Survey Division, Lincoln, NE*

2:00 p.m.  
**Integrated Management: Successful Case Studies**  
(View PowerPoint)  
Moderator: Jay Beaumont, Eustance & Horowitz P.C., Circleville, NY  
Panel: Brett Gracely, *Colorado Springs Utilities, CO*  
Mitch Bishop, *Southern Nevada Water Authority, Las Vegas, NV*  
Christine Owen, *Tampa Bay Water, Clearwater, FL*

2:45 p.m.  
**Groundwater Guardian Green Sites: Current and Future Best Practices**  
(View PowerPoint)  
Moderator: Bob Swanson, US Geological Survey, Nebraska Water Science Center, Lincoln, NE  
Panel: Mark Langner, *Farmlinks Research Center, Sylacauga, AL*  
Steve Merkel, *Landscapes Unlimited, Lincoln, NE*  
Marge Cook, *Desert Hot Springs Guardian Team, CA*

3:30 p.m.  
**Networking Break and Exhibits**
4:15 p.m.  Groundwater Guardian and Groundwater Guardian Green Sites Designation Ceremony  
(View Designation Presentation)  (View Photo Slide Show)

5:30 p.m.  Silent Auction

6:30 - 8:00 p.m.  Celebration Banquet

Friday, November 30, 2007
SESSION THREE:  BRIDGING THE GAP BETWEEN WHAT IS KNOWN AND WHAT IS PRACTICED

8:30 a.m.  Bridging the Gap: Water Rights and Water Law Model Programs  (View Handout)
Justice Gregory Hobbs, Jr., Colorado Supreme Court, Denver, CO

9:00 a.m.  Determining and Communicating the Value of Water: Bridge to the Future  (View PowerPoint)
Robert Renner, Awwa Research Foundation, Denver, CO

9:30 a.m.  Enhanced Groundwater Monitoring: First Step in Bridging the Gap  (View PowerPoint)
Christine Reimer, National Ground Water Association, Westerville, OH

10:00 a.m.  Groundwater Management on the National Forests and Grasslands  (View PowerPoint)
Chris Carlson, USDA Forest Service, Washington, DC

10:30 a.m.  Networking Break and Exhibits

10:45 a.m.  Groundwater Protection on Federal Lands: Current Science and Future Directions  (View PowerPoint)
Moderator: Pat Mangan, US Bureau of Reclamation, Denver, CO  
Panel: Chris Carlson, USDA Forest Service, Washington, DC  
Michael Higgins, US Fish and Wildlife Service, Annapolis, MD  
Craig Goodwin, Bureau of Land Management, Denver, CO  
Gary Rosenlieb, National Park Service, Fort Collins, CO

11:30 a.m.  Sustainable Infrastructure and Asset Management: Maximizing Local Resources  (View PowerPoint)
Moderator: Frank Blaha, AwwaRF, Denver, CO
Panel: Mary Price, Denver Water, Denver, CO  
Elaine Lai, US EPA Region 8, Denver CO  
Catherine Chertudi, City of Boise Public Works, Boise, ID

12:15 p.m.  What Are Tribes, States and Communities Doing to Bridge the Gap?  (View PowerPoint)
Moderator: Tim McLelland, Hamilton to New Baltimore Groundwater Consortium, Fairfield, OH
Panel: Gary Collins, Mni Sose Intertribal Water Rights Coalition, Rapid City, SD  
Art Goodtimes, County Commissioner, San Miguel County, Telluride, CO  
Kevin Frederick, Wyoming Department of Environmental Quality, Cheyenne, WY

1:00 p.m.  Luncheon: The Role of Water Education in Bridging the Gap
Jeannine Tompkins, Colorado Foundation for Water Education, Denver, CO

2:15 p.m.  Water Tour
Bureau of Reclamation Hydraulics Laboratory and USGS National Ice Core Laboratory

5:00 p.m.  Adjourn
E. Benjamin Nelson  
**Government Service Award**  
**Dr. William M. Alley** - US Geological Survey, San Diego, CA  
Dr. Alley serves as Chief of the USGS Office of Ground Water. He oversees the USGS Ground Water Resources and Water Use Programs as well as USGS support of the Yucca Mountain project.  
Dr. Alley recognizes the benefits of public involvement in management of the nation’s water resources and as such has authored and co-authored a series of USGS Circulars. One of the most influential Circulars he co-authored is “Ground Water and Surface Water—A Single Resource.” He has also served as the groundwater coordinator for the pilot National Water Quality Assessment (NAWQA) Program; and coordinated the Regional Aquifer System Analysis (RASA) Program.

Maurice Kremer Groundwater Achievement Award  
**Jim Cook**, Lincoln, NE  
Jim Cook was instrumental in writing Nebraska’s water laws and drafting important groundwater legislation over the past 25 years. Jim also played a key role in the development and implementation of the Platte River Cooperative Agreement.  
Jim served as chief legal counsel for the Department of Natural Resources until late 2003. He helped guide the formation and evolution of Nebraska’s innovative natural resources districts and authored much of Nebraska’s groundwater legislation. He also served as a member of the Nebraska team that negotiated a settlement of the dispute with Kansas and Colorado over the Republican River Compact.

The Groundwater Foundation Champion Award  
**Water Systems Council**, Washington, DC  
As the initial recipient of this award, the Water Systems Council (WSC), a Groundwater Guardian (GG) National Partner for eight years, has provided generous annual support for GG which has proved crucial to its continuation as a major Groundwater Foundation program. In addition, the WSC has partnered with the Groundwater Foundation in helping to develop and implement youth water festivals and wellcare workshops throughout the U.S.  
WSC services also include providing wellcare materials and other private well information to Foundation members, Groundwater Guardian community teams, and others at no charge. The partnership with the WSC has significantly expanded the reach and impact of The Groundwater Foundation mission on a national level.

About The Groundwater Foundation National Awards Program  
The Groundwater Foundation National Award winners are selected by a committee consisting of Foundation Directors, Technical Advisors, and/or previous award recipients. Now accepting nominations for 2008, please visit www.groundwater.org for details.
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  • The Groundwater Foundation, Lincoln, NE

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  • Awwa Research Foundation, Denver, CO
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  • US Geological Survey, Colorado Water Science Center, Lakewood, CO
  • US Geological Survey Nebraska Water Science Center, Lincoln, NE
  • US Geological Survey, Reston, VA
  • W. K. Kellogg Foundation, Battle Creek, MI

Conference Exhibitors
The Groundwater Foundation, Lincoln, NE
Awwa Research Foundation, Denver, CO
Olsson Associates, Lincoln, NE
US EPA Region 8, Denver, CO
US Geological Survey, Denver, CO

Silent Auction Donors
Jay Beaumont, Eustance and Horowitz, P.C., Circleville, NY
Mitch Bishop, Southern Nevada Water Authority, Las Vegas, NV
Michelle Bucklin, Cargill Corn Milling North America, Blair, NE
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Jackie Ponder, Miller Brewing Company, Trenton, OH
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Ted Seacrest, Edmonton, Alberta, Canada
Andy Willhoit, StormWater Outreach, Chico, CA

2007 Conference Executive Committee
Jerry Biberstine, Rural Water Association, Denver, CO • Catherine Chertudi, City of Boise, Boise, ID • Rick Karlin, Awwa Research Foundation, Denver, CO • Kristi Mallow, Coors Brewing Company, Golden, CO • Pat Mangan, Bureau of Reclamation, Denver, CO • Greg Oberley, US EPA Region 8, Denver, CO • Steve Vandas, US Geological Survey, Denver, CO • Mike Wireman, US EPA Region 8, Denver, CO
Threats from Chemical and Microbiological Sources: Protection Success Stories and Remaining Challenges

William M. Alley

2007 GW Foundation National Conference
Outline

• Regional water quality
• The third dimension
• Interdisciplinary science
• Natural cleansing
• SW/GW interactions
• Water quality and conjunctive use
• Effects of individual actions
(1) Regional water quality

52 NAWQA Study Areas
VOC concentrations in ambient ground water

Detected, above 1 ppb

Detected, below 1 ppb

Not detected

Zogorski and others (2006)
Most frequently detected VOC’s in ambient ground water

Chloroform
PCE
MTBE
TCE
Toluene

DETECTION FREQUENCY, IN PERCENT

Zogorski and others (2006)
Microbial Water Quality by Rock Type

Embrey and Runkle (2006)
(2) The Third Dimension

Not to Scale

Aquifer

Water Table

Confining Unit

public-supply well

domestic well

months

cyenturies & millennia

years

Source: S. Eberts, USGS
Standard geophysical tools are long and rigid

Accessing production wells under pumping conditions with standard geophysical tools is difficult and expensive
Depth-dependent water-quality sample collection and velocity logging

Trailer with reels for sample collection and dye injection

Flexible hoses allow entry to wells having limited access

USGS
Joshua Tree Production Well #16 (1N/7E-21H1)
(3) Interdisciplinary Science: Expanding our View

Characterizing fluid movement and chemical transport in fractured rock

- Fracture Mapping
- Borehole Geophysics
- Hydrologic Testing
- Geochemistry
- Surface Geophysics
- Geologic Mapping
- Tomographic Imaging
- Microbial Ecology and Microbial Transport
- Ground-Water Flow and Transport Modeling
Integrated Monitoring and Modeling

Monitoring (Water Levels, Water Quality, Streamflow, Water Use)

- Update Conceptual Model
- Simulation Model
- Environmental Tracer Data
- Geologic and Hydrologic Studies
- Adjust monitoring network

Alley, 2006
(4) Natural Cleansing

http://toxics.usgs.gov/
NAWQA ACT Studies: Denitrification

Green and others, 2007
(5) SW/GW Interactions
Fiber Optic Sensing Technology

• Measurements over kms
• Meter-scale resolution
• 0.1 °C resolution
• Cycle times of minutes
Shenandoah River, VA

Thermal Anomaly

CLOCK TIME, ON AUGUST 9-10, 2006

Courtesy of Virginia WSC
(6) Water Quality and Conjunctive Use

Fram and others (2002)
Tritium

LA River
San Gabriel
Santa Ana
Santiago Ck
Detected
Not detected, < 1pCi/L

USGS NAWQA
CA SWRCB

Belitz and others (2003)
VOCs

LA River
San Gabriel
Santa Ana
Santiago Ck
Below LRL only
Not detected

USGS NAWQA
CA SWRCB

Belitz and others (2003)
(7) Effects of Individual Actions: (It’s not just the farms and factories)
Pesticide Detections

Percentage of Samples with Pesticide Detections

Gilliom and others (2006)
Common Pesticides in Streams

Agricultural

- Atrazine
- Metolachlor
- Cyanazine
- Simazine
- Prometon
- Tebuthiuron
- Diazinon
- Chlorpyrifos
- Carbaryl

Percentage of Samples with Detections

Urban

Gilliom and others (2006)
“What made the deepest impression upon you?” inquired a friend one day of Lincoln, “when you stood in the presence of the Falls of Niagara, the greatest of natural wonders?”

“The thing that struck me most forcibly when I saw the Falls,” Lincoln responded with characteristic deliberation, “was where in the world did all that water come from?”
Threats from Shrinking Supplies, Conservation Success Stories and Remaining Challenges

Groundwater Foundation National Conference
November 28-30, 2007
Lakewood, Colorado
Demands exceed supplies

U.S. Drought Monitor

November 20, 2007
Valid 7 a.m. EST

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

http://drought.unl.edu/dm

Released Wednesday, November 21, 2007
Author: Richard Heim/Liz Love-Brotak, NOAA/NESDIS/NCDC
Demands exceed supplies

Population growth
• From 1950 to 2000, population of Florida, California, Nevada, Utah, Colorado & Arizona grew more than 200%
• Since mid-1960s, U.S. population expansion primarily fueled by immigration

Urbanization displaces 1,000 acres/week
• Since January 2007, majority of world’s population lives in cities
• Las Vegas, Denver, Albuquerque, Los Angeles, Phoenix, San Diego, Atlanta, Memphis, Charlotte, Chicago, Dallas, District of Columbia metro . . .

Agricultural production
• Crops for food and energy

Changed societal values - non-consumptive demands
• Environmental preservation & instream uses
• Bay-Delta of the Sacramento & San Joaquin Rivers
• Missouri River
Interstate Water Allocation
Compacts
Success stories

Coming to grips with sustainability

• Settlement of Pecos River dispute in Texas v New Mexico (1988)
• Settlement of Neb v Wyo (2001) – North Platte River
• Settlement of Kan v Neb & Colo (2003) – Republican River

Habitat Recovery/restoration

• Water right acquisitions in Oregon (especially), Idaho, Washington & Montana (1987)
• Platte River Recovery Implementation Program (1997)
Remaining challenges

Connecting the dots - - - Is the science credible? Where’s the ethics?

Inter-connected ground & surface water supplies
“Don’t look at me; it’s all due to the drought.”
“The impacts can’t actually be measured, and anyway, it’s only a little bit.”
“We need to pump the well now; besides, impacts may never be noticed.”
“Who’s going to pay for all of this (mitigation)?”

Do Americans have political will-power?
“Not nontributary” deep aquifer water use regulations in Denver basin
Phoenix AMA safe yield projected deficit of 251,000 AF by 2025

Global warming - - - the “wild card”
Are former parameters and paradigms still reliable?
Challenges confronting water managers in Nebraska

Implementing provisions of LB 962

Compliance with settlement in *Kan v Neb & Colo*

Habitat preservation in the Platte, Niobrara & Missouri rivers

Emerging market-place for water right transactions
Sustainability Challenges for Nebraska

Ground Water

Groundwater-level Changes in Nebraska - Predevelopment to Spring 2007
Sustainability Challenges for Nebraska

Surface Water

**Frenchman River**
Since 1965 un-regulated ground water pumping caused annual flows to decline by 60%

**Lodgepole Creek**
Since 1965 un-regulated ground water pumping caused annual flows to nearly vanish

**Pumpkinseed Creek**
Since 1960 un-regulated ground water pumping caused annual flows to decline by 90%

**Platte River**
Riparian habitat needed by certain bird & fish species continues to decline - - - Interior Least Terns, Piping Plovers, Whooping Cranes, Pallid Sturgeon, others (?)
Contact Information

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Myth vs. Reality: An Analysis of Western Water Use

Presented by Kathleen M. Stanley
November 29, 2007
• Anasazi abandoned Chaco Canyon dwellings in the midst of a 50 year long drought.
• It’s easy to draw parallels from Chaco to life in the Southwest today – both = thriving civilizations, people are completely dependent on scarce water resources and there’s a threat of a devastating drought.
• Today, the Southwest is in a drought that started in 1999 and that could be longer and more severe than the one that forced the Anasazi to abandon their homes.
National Water Use Statistics

USGS estimates that about **408 BILLION** gallons per day are withdrawn for all uses in the US (2000)

Total withdrawals remain about **80% surface water and 20% groundwater**

**PWS withdrawals** = more than **43 billion gallons per day** (11% of total withdrawals)

% of groundwater use for **PWS** = approx. **40 percent**
Self-supplied domestic (household wells) = 43.5 million people or 15% of population

Self-supplied domestic (household wells) water withdrawals account for less than 1% of all withdrawals

Some other uses…….

- Livestock = less than 1%
- Aquaculture = less than 1%
- Mining = less than 1%
- Industrial = 5%
Two Largest Uses...

About 48% of all freshwater and saline-water withdrawals are for thermoelectric power = about 52% of fresh surface water withdrawals and about 96% of saline-water withdrawals.

Irrigated agriculture is the largest use of freshwater in the US.

Agriculture is a major user of groundwater and surface water in the US and accounts for 80% of the Nation’s consumptive water use and over 90% in many Western states.

42% of total irrigation use = groundwater withdrawals.
The land surface in Central California dropped 30 feet in elevation from 1925 to 1977 and is still falling, reported the *Fresno Bee*. Worldwide, subsidence such as this resulting from extensive groundwater pumping is “the largest human alteration of the Earth’s surface,” the USGS said, according to the *Bee*.

A USGS scientist described two kinds of subsidence affecting the CA landscape – one is regional caused by deep groundwater pumping, the second is local, non-uniform subsidence caused by the weight of irrigation water added to the surface.
CHEYENNE, Wyo. (AP) - A judge has ruled that state courts lack the authority to order Gov. Dave Freudenthal to approve regulations to limit water discharged by coal-bed methane wells.

In April, the Governor rejected rules developed by the state Environmental Quality Council. The Powder River Basin Resource Council filed suit in response.

The judge said the Governor's Office is not a state agency in the rule-making context.
In Wyoming’s Powder River Basin, some groundwater wells have been pumping for two years or more while no gas has been produced.

The Wyoming Oil & Gas Conservation Commission has said that “more than 14% of active CBM wells in the Powder River Basin in December (2006) were producing only water and more than 39,000 acre-feet of water have been produced from wells that have not produced any gas.”

In the interest of efficiency & environmental concerns, some companies have started to inventory these wells to see where water savings can be made.
More farmers and other water users in northeastern CO could see their wells shut down if new rules to bring the state into compliance with an interstate water compact on the Republican River are approved.

Drought conditions in both CO and NE have caused those states to use more water from the river than they are allowed under an agreement with KS, which says it will soon act to force compliance. (October 2007)
In The News.....Arizona Water Use & Population Growth

“Arizona is notoriously independent, and especially rural Arizona is notoriously independent, but at this point we have recognized with growth and private property rights that we hold dear that we need to regulate and protect our natural resources,” said Rep. Lucy Mason, R-Prescott.

Arizona is the nation's fastest growing state... smaller cities and towns are facing strains from that population growth. In parts of eastern and northern Arizona, residents have to truck in water.
Arizona Water Use Statistics (USGS 2000)

- Irrigation: 80.3%
- Public Supply: 13.7%
- Power: 2.2%
- Domestic Private: 0.8%
- Industrial: 0.6%
California Water Use Statistics (USGS 2000)

- Irrigation (76.4%)
- Public Supply (18.4%)
- Domestic Private (1.7%)
- Industrial (1.2%)
- Livestock (1.2%)
- Aquaculture (1%)
- Mining (0.1%)
Colorado Water Use Statistics (USGS 2000)

- Irrigation: 93.1%
- Domestic Private: 2.9%
- Public Supply: 2.3%
- Industrial: 1%
- Power: 0.7%
Nevada Water Use Statistics (USGS 2000)

Irrigation (74.8%)

Power (1.6%)

Public Supply (19.9%)

Domestic Private (3%)

Industrial (0.7%)
New Mexico Water Use Statistics (USGS 2000)

- Irrigation (79.7%)
- Public Supply (17%)
- Domestic Private (2%)
- Industrial (0.6%)
- Power (0.7%)
Utah Water Use Statistics (USGS 2000)

- Public Supply (36.2%)
- Irrigation (46.6%)
- Industrial (3.4%)
- Aquaculture (11.6%)
- Mining (0.9%)
- Power (1.3%)
Wyoming Water Use Statistics (USGS 2000)

- Irrigation (76.4%)
- Public Supply (10.6%)
- Domestic Private (1.2%)
- Mining (10.9%)
- Power (0.2%)
- Industrial (0.8%)
Kansas Water Use Statistics (USGS 2000)

Irrigation (90.5%)

Livestock (2.3%)
Aquaculture (0.1%)
Mining (0.4%)
Power (0.4%)
Domestic Private (0.6%)
Industrial (1.2%)
Nebraska Water Use Statistics (USGS 2000)

- Irrigation (94.4%)
- Public Supply (3.4%)
- Domestic Private (0.6%)
- Industrial (0.5%)
- Livestock (1%)
- Mining (0.1%)
- Power (0.1%)
Montana Water Use Statistics (USGS 2000)

- Irrigation (44.1%)
- Public Supply (29.8%)
- Domestic Private (9.2%)
- Industrial (17%)

Note: Mining use statistics are not reported for Montana
Policy Implications… Montana HB 138

• Montana Supreme Court ruled in April 2006 that rivers and streams in much of the state depend on groundwater for part of their flows

• HB 138 introduced by W. McNutt in legislature December 21, 2006

• Main requirement was for a hydrologic study for proposed wells in closed basins (did not apply to surface water use by municipalities, livestock or non-consumptive hydropower); an augmentation plan was required if study showed that well would deplete water that may otherwise supply a senior surface-water rights holder… requires senior water rights holders to demonstrate harm…

• Tabled in committee (February 24, 2007)
Closed basins in Montana

- A “closed basin” means no more surface water rights can be issued
- Teton River Basin
- Upper Clark Fork River Basin
- Jefferson River Basin
- Madison River Basin
- Upper Missouri River Basin
- Bitterroot River Basin
Thank you!

Kathleen M. Stanley
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Aquifer-Based Ground-Water Management

Mike Wireman and Greg Oberley
US EPA Region 8

2007 Groundwater Foundation National Conference
Denver, CO
“The country cannot sustain even the current levels of ground-water use, never mind the projected increases in ground-water consumption in the next two decades. Our enormous expansion of ground-water pumping since the 1940’s….has caused a number of serious environmental problems.” (Such as rivers drying up, wells going dry, subsidence, loss of wetlands, springs, lakes)

From “Water Follies” by Robert Glennon, 2002, Island Press—page 32
GROUND-WATER USE

- **GW use World-wide**
  - Accounts for 98% of fresh water in the world
  - 25% (1.5 billion) of world population depend on ground-water

- **GW USE in the US (2000) (USGS)**
  - USA- 83.3 bgd (14 % increase from 1985)
  - 140 million people (50%) in USA drink GW
  - PWS use increased 400 % between 1950 & 2000
  - GW use for irrigation increased from 24 % of total irrigation use in 1950 to 42 % in 2000
Current Approach to GW Management

State governments

- Withdrawal & use of ground-water administered by different agency than regulation / protection of ground-water quality
- Within “DEQs” and Public Health Departments ground-water management related to protection of quality is commonly split among numerous programs (based on CWA, SDWA, RCRA etc.)
Current Approach to GW Management

State governments

- Drinking water programs focus on quality at the tap (SDWA)
- Source water protection is split between SW and GW (SDWA)
- CERCLA / RCRA programs focus on cleanups
- Non-point source programs focus on agriculture chemicals in ground-water (CWA, TSCA)
- Storm water programs interested in infiltration of storm water from surface runoff to the sub-surface (CWA)

Wetlands (CWA Sec 404)
Current Approach to GW Management

Federal Government

- Authority derived from 16 different federal laws
- Federal role primarily related to cleanup authorities under CERCLA / RCRA / drinking water protection
- Not very active in ground-water management
- No national framework for monitoring or standards
- Poor trans-boundary cooperation where aquifers span State boundaries
PROBLEMS RELATED TO CURRENT GW MANAGEMENT

- Management of GW is not aquifer based
- GW management is fragmented at Federal/State level
- Poor coordination between water supply and water quality management programs
- Inadequate recognition of GW/SW connections in the various programs
- Rules/regulations not aimed at preventing aquifer mining
- Declines in resources and emphasis on GW protection, especially monitoring programs
WHAT CAN BE DONE?

- Step up federal leadership (GWPC - Call to Action and the National Science and Technology Council Committee on Environment and Natural Resources – September 2007)

- Need to refocus, strengthen and support ground-water protection / management work at State / Tribal level

- Encourage cooperative management and monitoring of ground-water between Federal, State / Tribal and local governments

- Implement an aquifer-based approach to ground-water management (Region 8 Focus)
Aquifers and aquifer systems are natural units of management for ground-water just as a stream, lake or watershed are natural units of management for surface water.
Aquifer-Based GW Management

Aquifers have mappable boundaries that are delineated based on:

- Geologic features
  - formation boundaries
- Hydrologic features
  - flow system divides
- Water quality
  - quality related to aquifer mineralogy
Aquifer-Based GW Management

- Aquifers have hydrologic / hydraulic properties that are routinely assessed using standardized methods
- Mappable Aquifer-Zones are based on sub-divisions of aquifers with differing hydrologic conditions
  - Recharge / discharge areas
  - Confined vs unconfined
  - Gaining / losing reaches of streams
Aquifer-Based GW Management

- Data / information needs
  - A map of the aquifer or aquifer system which depicts the aerial extent and describes the lithology and hydrologic characteristics
  - Delineation of recharge and discharge areas
  - Sound understanding of the hydrology of the aquifer (confined vs. unconfined, hydraulic properties, interaction w/ surface waters, ecological importance)
  - Real time tracking of water levels and water quality
  - Information on location and annual yield of ground-water supply wells
  - Data on chemistry of the ground water in different parts of the aquifer, including areas of known contamination
Aquifer-Based GW Management

• USGS & State have mapped and assessed hundreds of aquifers and aquifer systems in the US

• USGS Circular 1279 – Estimated Withdrawals from Principal Aquifers in the United States
Principal Aquifers in the United States (USGS)
Aquifer-Based GW Management Goals

- Allowable annual withdrawals based on sustaining the use of the aquifer for future beneficial uses including ecological needs

- Plan for large increase in GW use required to produce energy from new sources (ethanol, nuclear)

- Differential management of aquifer-zones
Aquifer-Based GW Management Implementation

- Re-focus and strengthen Federal/State /Tribal GW protection & management programs
  - Leadership
  - Incorporate into a national Strategy/policy

- Federal agencies (EPA, USGS) – Support GW protection /management programs at the State /local levels

- Full cost pricing applied to ground-water development and use

- Effective integration of ground-water quality and ground-water quantity / supply in decision making
Aquifer-Based GW Management Implementation

Science R&D

“…develop a coordinated, multi-year plan to improve research to understand the processes that control water availability and quality” (OST Sept 2007)

✓ Monitoring “…and to collect and make available the data needed to ensure an adequate water supply for the Nation’s future.” (OST Sept 2007)

ACWI -SOGW
Aquifer-Based GW Management Implementation

Science R&D

- Need to improve quantitative assessment of aquifer / stream water balance – aquifer recharge, discharge

- Need to improve understandings of ground-water flow systems within aquifers

  - Flow paths (preferential flow vs. radial flow)
  - Residence time in aquifer, travel time from recharge to discharge, piston flow vs. mixed flow
THANK YOU!

✓ **Urgency to renew our focus on the resource!**

✓ **Yes, ground-water is in the Clean Water Act!**
Protecting Ground and Surface Water Together: What Does Integrated Management Really Mean?

Moderator
Rick Karlin
Awwa Research Foundation
Denver, Colorado
Patrick T. Tyrrell, P.E.

- Wyoming State Engineer
- Wyoming’s Commissioner to the Upper Colorado River, Bear River, and the Yellowstone River Compact Commissions
- Represents Wyoming on the:
  - North Platte Decree Committee
  - Colorado River Basin Salinity Control Forum
  - Western States Water Council
J. Michael Jess, P.E.

- Senior Lecturer, University of Nebraska
- Served as Acting Director of the Nebraska Water Center until 2003
- Past Director of Nebraska’s Department of Water Resources (now the Department of Natural Resources)
- Has also served as:
  - Nebraska’s Commissioner for a U.S. Supreme Court decree and four interstate compacts charged with apportioning river flows among Nebraska and adjoining states.
  - Chairman of the Nebraska Boundary Commission
In one minute, define “integrated management.”
Why should integrated management be considered a viable management option?
What are the political and economic obstacles that come with implementing integrated water management and how can they be overcome?
Integrated Management: Successful Case Studies

Moderator
Jay Beaumont
Eustance & Horowitz, P.C.
Circleville, New York
Brett W. Gracely, P.E.

- Water Resource Planning Supervisor in the Water Services Division for Colorado Springs Utilities
- 17 years experience in water resources and environmental engineering
- Member of:
  - American Geophysical Union
  - American Water Resources Association
  - American Society of Civil Engineers
Mitch Bishop

- Coordinates activities of the Advisory Committee for Groundwater Management for the Southern Nevada Water Authority’s Groundwater Management Program
  - Helps to protect and manage groundwater resources
  - Educates well users about the aquifer, conservation and rules governing wells in Southern Nevada
Christine Owen

- Water Quality Assurance Officer for Tampa Bay Water
- Past Water Quality Supervisor for the City of Tampa Water Department

Serves on:
- US EPA Science Advisory Board – Drinking Water Committee
- US EPA National Advising SubCommittee on Environmental Policy and Technology
- American Water Works Research Foundation Research Advising Council for High Quality Water
- AWWA Microbial/DBP Technical Advising Workgroup
What has been the biggest challenge in implementing integrated management in your community?
What has been the most surprising benefit that has emerged as a result of implementing your program?
Given the experiences you just described, what is the single most important “take-home” message about integrated management?
Groundwater Guardian
Green Sites: Current and Future Best Practices

Moderator
Bob Swanson
U.S. Geological Survey
Lincoln, Nebraska
Mark Langner

- Director of Agronomy and Applied Research at FarmLinks Golf Club
- Certified Golf Course Superintendent
- Past President of the Alabama Golf Course Superintendents Association
Steve Merkel

- Director of Agronomy for Landscapes Golf Group in Lincoln, Nebraska
  - Manage and provide support for Golf Course Superintendents at 12 facilities across the U.S.
  - Manage capital expenses, safety program, and maintenance equipment fleets
- Certified Golf Course Superintendent
Marge Cook

- Executive Director for the Desert Hot Springs Groundwater Guardian Team, Desert Hot Springs High School Groundwater Guardian Campus Team, and Desert Hot Springs Middle School Groundwater Guardian Campus Team

- Member of:
  - Desert Hot Springs Chamber of Commerce Board of Directors
  - Mission Springs Foundation Board of Directors
  - The Groundwater Foundation Technical Advisory Committee
Groundwater Guardian
Green Sites

Helps educate, recognize, and encourage the managers of highly managed green spaces to implement, measure, and document groundwater-friendly practices.
Groundwater Guardian Green Sites

Serves to expand and enhance the existing community-based Groundwater Guardian program by presenting a land-use best practices component to Groundwater Guardian teams and other interested partners.
Groundwater Guardian
Green Sites

The program will calculate, document, and recognize the environmental and water quality benefit of groundwater-friendly practices on highly managed green spaces.

- Golf Courses
- Ball Fields
- Educational Campuses
- Residential, Recreation, Office Parks
Groundwater Guardian Green Sites

Program Benefits

- Documents the environmental benefit of groundwater-friendly practices
- Demonstrates the connection between public involvement and groundwater benefits.
- Encourages the use of groundwater-friendly practices at a variety of locations.
- Protects groundwater in the community.
Marge – Based on your perspective and experience, describe how you see the educational element of the Groundwater Guardian Green Sites program being beneficial to the site and to the larger community.
Mark – Based on your perspective and experiences in turf management research, describe how you see the Groundwater Guardian Green Sites program contributing to environmental protection.
Steve – From a public relations perspective, describe how a golf course will benefit from Groundwater Guardian Green Sites designation.
Any last thoughts you would like to share about Groundwater Guardian Green Sites.
Groundwater Guardian
Green Sites

For more information or to participate in the program, visit
www.groundwater.org/gg/greensites.html
to download the pilot program application or
call The Groundwater Foundation at
1-800-858-4844.
2007 Groundwater Guardian National Designation Ceremony

Celebrating 14 years of Groundwater Guardian
I love my Groundwater Guardian team because...

If I could recommend an activity for all Groundwater Guardian Communities to try, it would be...because...

When you get started in Groundwater Guardian, no one ever tells you...

If we had to do it all over again, my Groundwater Guardian team would have...

The most fun I’ve ever had at a Groundwater Guardian event/activity was...because...

My team’s most successful activity this year was...because...
Special Recognition of 10-Year Groundwater Guardians
10-Year Communities

Indianapolis-Marion County, Indiana
Wright-Patterson Air Force Base, Ohio
10-Year Affiliates

Mecklenburg County Groundwater and Wastewater Program, North Carolina
Groundwater Guardian
Green Site Program
2007 Pilot Sites

Bayside Golf Course – Brule, Nebraska
Arbor Links Golf Course – Nebraska City, Nebraska
Players Club at Deer Creek – Omaha, Nebraska
Firethorn Golf Club – Lincoln, Nebraska
Heritage Hills Golf Course – McCook, Nebraska
Eastern Nebraska 4-H Center – Gretna, Nebraska
Hickory Hills Golf Club – Grove City, Ohio
2007 Groundwater Guardian National Designation Ceremony

Celebrating 14 years of Groundwater Guardian
Groundwater Guardian 2007
Groundwater Guardians make all of us feel proud.
Boise City, Idaho
Dayton Multi Jurisdictional Well Field Protection Program, Ohio
Covington County, Alabama
Llagas Valley, California
North Plains Groundwater Conservation District, Texas
Springfield, Oregon
Orange County, New York
Spring Creek Prairie Audubon Center, Nebraska
Marshfield Area, Wisconsin
Las Vegas Valley, Nevada
Milladore Area, Wisconsin
Kalamazoo, Michigan
Santa Clara Valley Water District, California
Indianapolis-Marion County, Indiana
DUMP NO WASTE
PROTECT YOUR GROUNDWATER

North Plains Groundwater Conservation District, Texas
Orange County Water District, California
Greater Lansing Area, Michigan
Chippewa Falls, Wisconsin
Mission Springs Water District, California
Marshfield Area, Wisconsin
Dayton Multi Jurisdictional Well Field Protection Program, Ohio
Milladore Area, Wisconsin
Wright Patterson Air Force Base, Ohio
Marshfield Area, Wisconsin
Cargill Blair, Nebraska
Chippewa Falls, Wisconsin
The Groundwater Foundation

Accepting the Cooperative Conservation Award from the Department of Interior, nominated by USGS for Groundwater Guardian
All water within Colorado is a public resource, subject to the creation of use rights according to the applicable constitutional and statutory provisions. There are four classifications of water in Colorado: (1) waters of natural streams, which include surface water and groundwater that is tributary to a natural stream, (2) designated groundwater, (3) nontributary groundwater outside of designated groundwater basins, and (4) nontributary and not-nontributary Denver Basin groundwater of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers.

Before any well may be drilled for use of any classification of groundwater anywhere in Colorado, the State Engineer must issue a construction permit. Often, people think that issuance of a state engineer well construction permit is the same as the state of Colorado granting a water use right. As the statutes of the General Assembly and cases of the Colorado Supreme Court demonstrate, however, a well construction permit does not amount to establishment of a water right. Like a ditch, a well is a diversion device. To be administered, the water right must be obtained and recognized as the applicable law provides.

**Tributary Groundwater**

The first classification of water includes groundwater that is tributary to a natural stream. This groundwater is subject to allocation and administration according to Colorado’s constitutional prior appropriation doctrine, as implemented by the 1969 Water Right Determination and Administration Act. Water courts for the seven water divisions in Colorado adjudicate conditional and absolute use rights, changes of water rights, and augmentation plans for tributary groundwater, as with
surface water. Appeals from decisions of the seven water courts proceed directly to the Colorado Supreme Court.

Colorado water law contains a presumption that groundwater is tributary unless shown to be otherwise. Under Colorado Supreme Court case law, groundwater is tributary if, in its natural state, it could reach a surface stream within one hundred years.

State administration differs depending on the classification of the groundwater. In 1965, the Colorado General Assembly enacted two separate statutes delineating the fundamental differences between the administration of tributary groundwater and groundwater that has little or no effect on surface streams.

For water of the natural stream and tributary groundwater, actual beneficial use of the water creates the water right. However, to be administered, the water right for a ditch or a well must have a water court decree that sets forth its priority date, location of diversion, rate of diversion, and type of beneficial use. The State Engineer, Division Engineers for the seven water divisions, and local Water Commissioners enforce the water rights for the diversion ditches and wells in order of the adjudicated priority dates of the various water rights in the water division.

In times of short supply, water rights are curtailed in reverse order of priority, junior to senior, in accordance with the decrees of the water court. Out-of-priority diversions are allowed only if a water-court adjudicated augmentation plan, or a State Engineer approved substitute supply plan, is in effect in compliance with statutory requirements to replace depletions to the water supply that would injure decreed water rights. Injury occurs when water that would otherwise be available to fill a water right operating in priority has been intercepted by someone whose decreed appropriation is junior in priority or someone who is diverting without a decree.

Three out of four major river basins of Colorado are over-appropriated, the Platte, the Arkansas, and the Rio Grande. This means that there is essentially no un-appropriated water remaining for appropriation by ditches or wells. Regulation of surface and tributary groundwater diversions in these over-appropriated basins is necessary to protect vested water rights according to their decreed priorities.
Three Other Classifications of Groundwater

The General Assembly has created three other classifications of groundwater under the 1965 Ground Water Management Act: designated groundwater, nontributary groundwater, and Denver Basin bedrock groundwater. These classifications are for groundwater the legislature has presumed has little or no connection to a natural stream.

Designated Groundwater

The Colorado Ground Water Commission allocates and administers the use of designated groundwater utilizing a modified prior appropriation permit system for the beneficial use of groundwater that has little or no connection to a surface stream (except for designated groundwater in the four Denver Basin aquifers, which is subject to allocation by the Ground Water Commission by permit for beneficial use to overlying landowners at a 1/100ths percent per year pumping rate, as with the rest of the Denver Basin, see below). The purpose of this management program is to permit economic development while maintaining reasonable pumping levels, so that the designated basin groundwater will not be mined excessively over the rate of recharge.

The Ground Water Commission has designated eight groundwater basins in Colorado, all of which are located on the high plains of Colorado east of the Continental Divide: Northern High Plains, Southern High Plains, Camp Creek, Upper Crow Creek, Lost Creek, Kiowa Bijou, Upper Black Squirrel Creek, and Upper Big Sandy designated basins. The latter four of these include portions of the Denver Basin.

Under the modified prior appropriation regime for designated groundwater, curtailment based upon an injury allegation is subject to the discretion of the Ground Water Commission and the local Ground Water Management Districts. Appeals from actions of the Ground Water Commission and Ground Water Management Districts go to local Colorado district court groundwater judges, not to the water court judges whose jurisdiction is under the 1969 Act. Appeals from the
decisions of the groundwater judges go directly to the Colorado Supreme Court.

The Ground Water Commission has promulgated rules applicable to the use of designated groundwater.

**Colorado Nontributary and Denver Basin Groundwater**

The Colorado General Assembly has provided that the use of nontributary groundwater outside of the designated basins, and the use of groundwater in the four Denver Basin bedrock aquifers, may be made by overlying landowners or those who have the consent of the overlying landowners. This groundwater may be extracted at the rate of 1/100ths percent per year. In contrast to designated groundwater, nontributary water outside of the designated basins and Denver Basin groundwater may be mined regardless of any consideration of recharge.

The overlying landowner, or person acting with the consent of the overlying landowner, may obtain such a use right by drilling a well or obtaining water court adjudication for the amount of water underlying the land (an amendment to the 1969 Act provided water court judges with this jurisdiction for non-tributary and Denver Basin groundwater that is outside of a designated groundwater basin).

The four Denver Basin bedrock aquifers are the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers.

Use of nontributary and Denver Basin groundwater is not subject to curtailment on an injury basis. The State Engineer has promulgated rules for the use of nontributary and Denver Basin groundwater.

**Timeline of Colorado Groundwater Law**

The following timeline sets forth, in summary form, major events in the establishment of Colorado groundwater law.

1876  Article XVI, Sections 5 and 6 of the Colorado Constitution declare that the un-appropriated water of every “natural stream” is the property of the public dedicated to the beneficial use of the people of the state by priority of appropriation.
1903  Colorado General Assembly provides that any water right derived from any “natural stream” is subject to court adjudication, 1903 Colo. Sess. Laws, Ch. 130, 297-98.

1914  Colorado Supreme Court confirms that the constitutional term “natural stream” subjects to the rule of prior appropriation all sources of stream supply, including percolating ground water, that is tributary to a surface stream, German Ditch & Reservoir Co., 56 Colo. 252, 270-71 (1914).

1919  Colorado General Assembly provides that all claims to prior appropriation water rights shall be filed within two years; if not, their priorities shall be postponed to those water rights that are adjudicated by the courts, 1919 Colo. Sess. Laws, Ch. 147, 487-96.

1951  Colorado Supreme Court holds that Colorado law includes a presumption that all groundwater is tributary to and subject to appropriation and administration as part of the waters of a surface stream, unless a person proves by clear and satisfactory evidence that the ground water is not tributary, Safranek v. Town of Limon, 123 Colo. 330, 333 (1951).

1957  Colorado General Assembly provides that: (1) all users of ground water must file a statement of use with the state engineer, (2) new wells shall not be drilled without a permit from the state engineer, (3) a well permit “shall not have the effect of granting or conferring a ground water right upon the user,” (4) the priority date of a “ground water appropriation shall not be postponed to a time later than its true date of appropriation by failure to adjudicate the right in a surface water adjudication,” and (5) the newly-established Ground Water Commission shall identify critical ground water areas that “have approached, reached or exceeded the normal annual rate of replenishment,” 1957 Colo. Sess. Laws, Ch. 289, 863-73.
Colorado General Assembly adopts the Ground Water Management Act that: (1) authorizes the Colorado Ground Water Commission to create designated basins for groundwater that has little or no connection to a surface stream, (2) provides for the Ground Water Commission to allocate and regulate designated groundwater through a permit system on a modified prior appropriation basis for economic development through the maintenance of reasonable pumping levels, (3) authorizes the creation of local groundwater management districts for regulation of designated groundwater, (4) requires all new wells, wherever they may be located in the state, to obtain a construction permit from the state engineer, and (5) provides that a state engineer well construction permit “shall not have the effect of granting nor conferring a ground water right upon the user,” 1965 Colo. Sess. Laws, Ch. 319, 1246-68.

Colorado General Assembly, by a separate act from the Ground Water Management Act, requires State Engineer to administer tributary groundwater in accordance with the doctrine of prior appropriation that is applicable to the distribution of surface water, and adopt rules and issue orders necessary to enforce this responsibility, 1965 Colo. Sess. Laws, Ch. 318, 1244-45.

Colorado Supreme Court states that “implicit” in the Colorado Constitution’s prior appropriation provisions are the propositions that: (1) “along with vested rights, there shall be maximum utilization of the water of this state” and (2) administration of water in the second century of prior appropriation law involves how maximum utilization of surface water and tributary groundwater can be integrated into the law of vested rights, Fellhauer v. People, 447 P.2d 989, 995 (Colo. 1968).

Colorado General Assembly adopts the Water Right Determination and Administration Act of 1969 which, among other provisions, states that (1) tributary groundwater and surface water shall be administered according to the doctrine of prior appropriation, in order to maximize beneficial use, (2)
vested surface water and tributary groundwater rights shall be protected in order of their decreed priorities, (3) wells that have not obtained adjudication of their priorities have a period of two years in which to file for their original appropriation date and, if not, their priorities shall be postponed to other priorities that have been adjudicated by the courts, and (4) augmentation plans may be decreed to allow out-of-priority diversions that are not subject to state engineer curtailment, if sufficient replacement water is provided to alleviate material injury to adjudicated water rights, 1969 Colo. Sess. Laws, Ch. 373, 1200-1224.

1973 Colorado General Assembly provides that non-tributary ground water outside of designated ground water basins shall be subject to state engineer well construction permits and rules that provide for overlying landowners, or those acting with the consent of overlying landowners, to use this type of groundwater which underlies their lands on the basis of a “minimum useful life of one hundred years,” 1973 Colo. Sess. Laws, Ch. 441, 1520.

1974 Colorado Supreme Court holds that the “tributary character” of water that “takes over a century to reach the stream” is “de minimus” and is “not part of a surface stream” as contemplated by the Colorado Constitution’s prior appropriation provisions, Kuiper v. Lundvall, 187 Colo. 40, 44 (1974).

1977 Colorado General Assembly repeals legislation it had enacted in 1974, 1974 Colo. Sess. Laws, Ch. 111, 440-42. that had allowed the State Engineer to approve temporary augmentation plans while the water court was adjudicating applications for augmentation plans, 1977 Colo. Sess. Laws, Ch. 483, 1702-04.

1983 Colorado Supreme Court holds that: (1) designated groundwater and nontributary ground water are not subject to the prior appropriation provisions of the Colorado Constitution, and the General Assembly may use its plenary authority to decide how these public waters shall be allocated and
administered, and (2) the 1969 Act applies only to surface water and tributary groundwater, *State v. Southwestern Colorado Water Conservation District*, 671 P.2d 1294 (1983). The General Assembly responds promptly with legislation that (1) recognizes and enforces prior water court decrees adjudicating nontributary groundwater outside of designated basins and (2) allows the water courts to adjudicate to overlying landowners the right to extract nontributary groundwater outside of designated basins under their lands, 1983 Colo. Sess. Laws, Ch. 516, 2079-80.

**1985** Colorado General Assembly provides that nontributary and not-nontributary groundwater in the Denver Basin bedrock aquifers of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills formations shall be allocated to overlying landowners, or those acting with the consent of the overlying landowners, to be extracted at a rate of no more than 1/100ths percent per year, 1985 Colo. Sess. Laws, Ch. 285, 1160-69.

**1988** General Assembly clarifies that the Ground Water Commission, when issuing permits for the beneficial use of designated groundwater in the four Denver Basin aquifers, shall allocate this water on the same basis as provided in the 1985 act for non-designated portions of the Denver Basin, namely “upon the basis of ownership of overlying land” and “an aquifer life of one hundred years,” 1988 Colo. Sess. Laws, Ch. 258, 1238.

**2000** Colorado Supreme Court holds that all water within Colorado constitute a public resource consisting of: (1) waters of the natural stream, which includes surface water and groundwater that is tributary to the natural steam, (2) designated groundwater, (3) nontributary groundwater outside of designated groundwater basins, and (4) nontributary and not-nontributary Denver Basin groundwater of the Dawson, Denver, Arapahoe, and Laramie-Fox Hills aquifers, *Upper Black Squirrel Creek Ground Water Mgmt. Dist. v. Goss*, 993 P.2d 1177, 1182 (Colo. 2000).
2001  Colorado Supreme Court holds that through the 1969 Act (1) the General Assembly created a new statutory authorization for water uses that, when decreed, are not subject to curtailment by priority administration, (2) this statutory authorization is for out-of-priority diversions for beneficial use that operate under the terms of decreed augmentation plans, (3) plans for augmentation allow diversions of water out-of-priority while ensuring the protection of senior water rights through a replacement water supply that offsets injurious out-of-priority depletions, and (4) injurious depletions not adequately replaced shall result in curtailment of the out-of-priority diversions. Empire Lodge Homeowners’ Association v. Moyer, 39 P.3d 1139, 1150 (Colo. 2001).

2002  Colorado General Assembly (1) authorizes State Engineer to approve substitute supply plans for out-of-priority tributary groundwater diversions under limited circumstances while augmentation plan applications are pending in the water court, and (2) approves the Arkansas river basin amended rules governing the diversion and use of tributary groundwater in that basin, 2002 Colo. Sess. Laws, Ch. 151, 459-64.

2003  Colorado Supreme Court holds that proposed State Engineer 2002 South Platte Basin rules allowing out of priority diversions under replacement plans, in the absence of an augmentation plan application pending in water court, were contrary to statute and in excess of his authority, Simpson v. Bijou Irrigation Co., 69 P.3d 50, 67 (Colo. 2003).

2004  Colorado General Assembly allows South Platte tributary groundwater wells to operate out-of-priority under State Engineer approved substitute supply plans, with provisos that (1) augmentation plan applications must be filed in Division No. 1 Water Court by December 31, 2005, and (2) wells not included in an adjudicated augmentation plan or State Engineer approved substitute supply plan shall be “continuously curtailed” from operating out of priority, 2004 Colo. Sess. Laws, Ch. 316, 1205.
Topics

- Who is AwwaRF?
- The Value of Water
- Communicating the Value of Water
Mission: Advance the science of water to improve the quality of life

- Centralized research program for drinking water utilities
  - Sponsor research
  - Develop knowledge
  - Promote collaboration
- Agenda is planned and guided by drinking water utilities
- Research covers a broad range of topics including source water, treatment, infrastructure, and management for drinking water utilities
Sources of Funding

- Voluntary Subscriptions from Water Supply Community
- Partnerships / In-kind contributions
- Congress
  - Bud Shuster: 1-9-87 “Clean water is not an expenditure of Federal Funds; clean water is an investment in the future of our country”
Current Topics of High Interest

- Climate Change
- Emerging Contaminants & Treatment Technologies
- Distribution System Water Quality
- Asset Management
- Water Reuse/Desalination
- Energy Management
Water

- Water is essential to life
  - 75 percent of world’s surface
  - 90 percent of human body

- Water is essential to civilization
  - Food
  - Environment
  - Economic and social welfare
Value of Water

- Value = worth of the service measured by willingness to pay
- Willingness to pay defines demand curve
- Supply curve represents costs based on supply
- Less water, higher the price
Benjamin Franklin - 1746

“When the well is dry, we know the worth of the water”
Trends Affecting the Value of Water

- Population
- Climate Change
- Technology
- Energy
- Infrastructure
Population Growth

Demographic Changes: Population Has Grown Fastest in the West, Particularly in the “Public Land States”

Percent Change in Resident Population for the 48 States and the District of Columbia: 1990 to 2000

- Darker areas denote faster growth rates.
- Nevada (66%) and Arizona (40%) lead the nation.
- Intermountain states average about 30%.

U.S. Population Projections

2000 – 282,125,000
2030 – 363,584,000

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Climate Change Impacts

- Changes in average annual snow pack runoff
- Shorter snow season, less volume
- Earlier peak flow, so water stored in past as snow is lost unless water system storage capacity is increased
- Glacial recession
  - summer flow ▲ near-term, but ▼ long-term
Climate Change Impacts on Water Utilities

- Quantity uncertainties
  - Increasing unpredictability of precipitation
  - More difficult to capture
  - Increased evaporation from reservoirs

- Quality degradation
  - Increased erosion
  - Flooding
  - Salt-water intrusion

- Demand
  - Increased due to higher temperatures
Climate Change Awareness

- Climate change science and research is incomplete
- Climate change is a national issue but its effect is regional
- Climate change is having a dramatic and immediate impact on water utilities
Total Water Management: Water Use Trends by Category, 1950-2000

Public water use is increasing

Impairment is widespread

Source: USGS, March 2004

Given current trends in development patterns, we will be unable to meet the goals of the Clean Water Act (CWA) and the Safe Drinking Water Act (SDWA) with our traditional water programs alone.
Total Water Management: Alternative Water Sources

Expansion of alternative supply use:

- Desalting
- Recycling
- Conjunctive Use
- Conservation

- Use of “marginal” supplies (cost and quality) growing
- Membrane costs dropping & energy efficiency improving
- Real & perceived quality issues
- Water/Growth: chicken or egg?
- 1950 seawater desalting US$4/kL; now ~US$0.65/kL
- Residuals disposal issues grow
Multiple drivers pushing new treatment technologies

- Alternative source water
  - Impaired/degraded sources
- Increased demand
- New/future SDWA regulations
- Emerging contaminants
Energy

- Increased technology requires energy
- Energy cost and supply reliability will become major issues for utilities
- Petroleum based energy will give way to other forms within 20-40 years
Energy Management

- Energy-Water Nexus
- Energy Use By Utilities 35% of Operating Budget
- 20 percent of energy use in CA for water
Water Reliability is Paramount in the Future of the Value of Water

The challenges of replacing and repairing infrastructure will strain many systems.

- Doubling to tripling of rates over next 20 yrs.
- Rising rates will require “cost-containment”
Why Communicate Value

- Maintain and enhance quality of life
- Build community confidence in water utility
- Support wise use of water
- Obtain financial resources to ensure sustainability of water utility
Where Should the Water Community Focus Communication Efforts?

- With the public
  - Effective and credible
- With elected officials
  - To secure funds
- With and through the media
  - To deliver value of water to public
Communication Strategy

- Develop a branding strategy that builds public trust and communicates the utility value proposition to the customer.
- Devise an effective communication program using specific guidelines, processes and communications tools.
Conclusion

- The Value of Water Needs to be Communicated to All Americans to Ensure Enough Safe Affordable Drinking Water Today and in the Future

- Water Research is a Bridge to Provide Accurate Data that will Support Powerful Communications
Thank You

Robert C. Renner
Executive Director
AwwaRF
www.AwwaRF.org
Enhanced Ground Water Monitoring: First Step in Bridging the Gap

Groundwater Foundation Meeting
November 30, 2007

Christine Reimer
SOGW Executive Secretary
National Ground Water Ass’n
Outline

• Background on NGWA
• Genesis of the Subcommittee on Ground Water (SOGW)
• Current SOGW and Work Group Rosters
• Update on Activities
• Next Steps
• Feedback/participation
NGWA Vision

• To be the leading community of ground water professionals that promotes the responsible development, use, and management of ground water.
Membership

- Contractors: 28%
- Mfrs: 4%
- Scientists & Eng: 65%
- Suppliers: 3%
Mission

Dedicated to advancing the expertise of all ground water professionals and to furthering ground water awareness and protection through education and outreach.
History of SOGW

• Ground-Water Quality Networks
• Ground-Water Level Networks
• January 2006: Suggestion made to ACWI to form a ground water subgroup
• May 2006: National Water Quality Monitoring Conference Session
• August 2006: Ad Hoc Steering Committee (SC) formed to develop a formal proposal to ACWI
• September 2006: SC began work on draft Terms of Reference (TOR)
• SOGW approved at January 2007 ACWI meeting
ACWI SUBGROUPS

- National Water Quality Monitoring Council
  - Methods and Data Comparability Board
    - Work Groups
  - New Subcommittee on Ground Water
    - Work Groups
- National Liaison Committee for NAWQA
  - * Subcommittee on Spatial Water Data
    - Work Groups
- Subcommittee on Hydrology
  - Work Groups
- Subcommittee on Sedimentation
  - Sustainable Water Resources Roundtable
    - Work Groups

* Also reports to Federal Geographic Data Committee
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<th>Organization</th>
<th>Representative(s)</th>
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<tr>
<td>American Society of Civil Engineers</td>
<td>Schreiber, Robert P. (Non-Federal Co-Chair)</td>
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<tr>
<td>Association of American State Geologists</td>
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<td>Association of State and Interstate Water Pollution Control Administrators</td>
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<td>Ground Water Protection Council</td>
<td>Paque, Michael</td>
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<td>Interstate Council on Water Policy</td>
<td>Badr, Bud; Evans, Peter</td>
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<tr>
<td>National Ground Water Association</td>
<td>Jansen, John; Reimer, Christine (Exec Sec)</td>
</tr>
<tr>
<td>State of Texas</td>
<td>Betz, Cary</td>
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<tr>
<td>US Geological Survey</td>
<td>Cunningham, William L. (Federal Co-Chair)</td>
</tr>
<tr>
<td>USEPA Headquarters and Region</td>
<td>Job, Charles; Wireman, Michael</td>
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<td>Schweinfurth, Rob</td>
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<td>USDA Forest Service</td>
<td>Carlson, Christopher P.</td>
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Subcommittee and Work Group Membership*

Federal  13
State/local  25
Academia  4
Private sector  19
Total  61

*As of 09/12/07
SOGW Purpose

The overall goal of the SOGW is to develop and encourage implementation of a nationwide, long-term ground-water quantity and quality monitoring framework that would provide information necessary for the planning, management, and development of ground water supplies to meet current and future water needs, and ecosystem requirements.
SOGW Scope

This national framework for ground water monitoring and collaboration will be developed to assist in assessments of the quantity of U.S. ground water reserves, as constrained by ground water quality. The SOGW will also consider ground water quality monitoring in order to help determine water quality related constraints on supply and use, and for helping assess potential ecological impacts caused by changes in ground water quantity and quality.....
Work Groups

Subcommittee on Ground Water (13)
Bob Schreiber, ACWI – ASCE
Bill Cunningham, USGS

Executive Secretary
Chris Reimer, NGWA

GW Monitoring Inventory Work Group (14)
Bill Cunningham, USGS
Mike Wireman, USEPA
Emery Cleaves, AASG

GW Data Standards and Data Management Work Group (13)
Chuck Job, USEPA
Scott Andres, DE Geological Survey

GW Field Practices Work Group (10)
Rod Sheets, USGS
Mike Nickolaus, GWPC

GW Monitoring Design Work Group (21)
Bob Schreiber, ACWI- ASCE
Kevin Frederick
WY DEQ

Quantity
Quality

Quantity
Quality

Quality

Quantity

Quality

Quantity
Inventory Work Group

1. Develop picture of current status of ground water monitoring
2. Research underway at state and federal levels
3. Data analysis underway
Field Practices Work Group

1. Develop recommendations regarding data collection techniques, documentation and standardization, and well instrumentation
2. Help ensure data comparability
3. Draft report near completion
Data Standards & Management Work Group

1. Develop recommendations for archiving and accessing ground water data

2. Conducting attribute comparison, identifying data standards, and developing several case studies.

3. Working on initial draft report
Ground Water Monitoring Design Work Group

1. Develop draft national framework for ground water monitoring and collaboration

2. Identifying questions; researching designs; and defining important discriminators, e.g. major aquifers, ambient or non-stressed wells, etc.

3. Working on initial draft report
Other Progress and Milestones

http://acwi.gov/sogw/
SOGW Major Milestones Ahead:

• February 2008 – Update to ACWI
• May 2008 – Presentation of draft report at National Water Monitoring Conference
• Summer/Fall 2008 – Request ACWI approval of draft recommendations
• Implementation??
Ways to Get Involved:

• Work Groups
• FYI list
• May 2008 conference

http://acwi.gov/sogw/
creimer@ngwa.org
Feedback

• Types of questions you face
• Main data needs
• Data accessibility
• Current status
• Words of advice
Thank you
Ground Water Management on the National Forests and Grasslands
Recognizing and Managing a Largely Overlooked Resource

Christopher Carlson
National Ground Water Program Leader
USDA Forest Service
Washington, DC

Groundwater Foundation National Conference
November 2007
“Water will be the defining national conservation issue of this century.”

- Rick Cables, Rocky Mountain Regional Forester
2005 Speech Marking Forest Service Centennial
Focus Areas for the Forest Service under Chief Gail Kimball:

1) Climate Change
2) Water
3) Reconnecting people, especially kids, with nature
Outline

• What are the FS roles and authorities with respect to groundwater?
• Why should the public care about FS groundwater management?
• What is the FS groundwater program?
• Questions?
The Hydrologic Cycle

Atmospheric Water

Transpiration

Precipitation

Evaporation

Transpiration

Soil and Biologic Water

Surface Water

Ground Water
Global Water Distribution

~5% of global water is fresh
~68% of that fresh water exists as ground water
National Forest System lands consist of 193 million acres of forests & grasslands located in 42 states and Puerto Rico.
Forest Service as Water Steward

NFS lands are located in the source areas for many important rivers and local and regional aquifer systems. NFS lands are the largest source of municipal water in the US; serving over 66 million people in 3,400 communities in 33 states.
Percentage of State Populations Using Ground Water for Drinking Water

- Idaho 96%
- Florida 93%
- Mississippi 92%

- New Mexico 90%
- Nebraska 87%
- South Dakota 70%
- Wisconsin 70%
- Washington 62%
- Wyoming 57%
- Arkansas 53%
- Montana 52%
- North Carolina 50%

1995 data
NFS lands contain more than 38,000 abandoned or inactive mines and several hundred non-mining CERCLA cleanup sites.
FS operates over 17,000 pit/vault toilets and over 3,400 septic systems.
Forest Service and Water Policy

From the Organic Administration Act of 1897 through the Multiple Use-Sustained Yield and National Forest Management Acts of the 1960s and 1970s, Congress has directed in nearly every relevant piece of legislation that the National Forests and Grasslands be managed at least in part for water, watersheds, or stream flows.
Purpose for Establishment or Acquisition of National Forest System Lands

- **Organic Administration Act of 1897** – public domain land set aside to secure *favorable conditions of water flow* and a continuous supply of timber.
- **Weeks Law of 1911** – land purchase for *navigable stream protection* or timber production.
- **Clarke-McNary Act of 1924** – land acquisition for *stream-flow protection* and timber production.
- **Bankhead-Jones Farm Tenant Act of 1937** – acquisition of damaged or non-productive agricultural lands, in part, to *mitigate floods, conserve surface and subsurface moisture, and protect watersheds*.
Ground Water Program Authorities

- Property Clause of US Constitution
  - Multiple Use and Sustained Yield Act
  - Forest and Rangeland Renewable Resources Planning Act
  - Federal Land Policy and Management Act
- Commerce Clause of US Constitution
  - Clean Water and Safe Drinking Water Acts
  - RCRA, CERCLA
Forest Service and Ground Water

• Active management of ground water resources is **fundamental** to appropriate management of watersheds as directed by Congress.

• If the FS does not become proactive with respect to ground water resource management, consequences are significant to its mission and the availability of water in broad areas of the country.

**Key caveat:** FS trustee management of NFS (ground) water resources does NOT involve water allocation.
Why Care About Ground Water? - Ecosystems
Ground Water Dependent Ecosystems

Communities of plants, animals, and other organisms whose extent and life processes are dependent on access to or discharge of ground water.

- Springs and wetlands
- Ground water fed streams/lakes and associated riparian areas
- Shallow water table areas
- Cave and karst systems
Ground Water Supports Ecosystems

Aquatic Biology

Springs, Fens, Stream Baseflow

Terrestrial Biology

Geology

Ground Water Flow System

Forestry Service Department of Agriculture
Ground Water-Dependent Streams

Fraction of Streamflow Attributed to Ground Water
Understanding GW Dependency

Vital Attributes
• Flow (Flux)
• Level (Pressure or Head)
• Quality

Functions
• Nutrient Supply
• Stabilizing Conditions
• Refugia
• Baseflow
Why Care About Ground Water?
- Land and Water Uses
Under Forest/Grassland Development
Metropolitan Water District of Southern CA
Arrowhead Tunnels

L = 4.1 miles

L = 5.8 miles
Why Care About Ground Water?
- Contamination
Ground Water Contamination

Common Sources of Ground Water Contamination

- Fertilizers, Pesticides, Road Salt
- River Leakage
- Leaky Well Casing
- Surface water runoff
- Storm Drain or Injection Well
- Oil, Solvent, Lead
- Septic Leachate
- Landfill Leachate
- Protective Soil Cap
- Excavations, Mining
Why Care About Ground Water?
- Energy Development
Coal Mining

Surface (Open Pit)

Underground
Oil & Gas Development
Power River Basin CBM Leases
Forest Service Ground Water Resource Management Program

- Ground water program initiated in 2005
  - a more comprehensive view of water resources and agency responsibilities
  - increasing water development pressures on NFS lands
  - growing need for in-house technical capacity
- Organized around management of ground water-dependent ecosystems
- Conceptualized as a cooperative resource management effort with States
- Development of internal policy ongoing
- Internal training course
- Project-level technical assistance
Key Ground Water Program Goals

• Promote cooperative management with States and others
• Develop FS technical expertise and strengthen the program in each region
• Foster interdisciplinary cooperation among and across FS staffs at each organizational level
• Improve understanding of role of ground water in NFS land and resource management
• Integrate ground water resources into everyday activities/decision making
Policy Directives

- FSM 2560 – Ground Water Resource Management
  - Draft targeted for publication for comment
- FSM 2880 – Geologic Resources, Hazards and Services
Technical Guide

http://www.fs.fed.us/publications/
FS Ground Water Policy

• Cooperate with appropriate State agencies
• Assume ground and surface water are connected, unless demonstrated otherwise
• Inventory and monitor ground water and dependent ecosystems, incorporating knowledge into land management planning
• Permit new ground water withdrawals on NFS lands for off-NFS uses only when other alternative water sources are not reasonably available
FS Ground Water Policy

• Meter most large water supply and injection wells and report quantities
• Integrate ground water into project/permit evaluation and decision making
• Evaluate cumulative effects of activities on ground water and ground water-dependent resources in planning and permitting
• Ensure monitoring and evaluation of effects on ground water resources as a result of authorized activities
Groundwater Protection on Federal Lands: Current Status and Future Directions

Moderator
Pat Mangan
U.S. Bureau of Reclamation
Denver, Colorado
Chris Carlson

- National Ground Water Program Leader for the USDA Forest Service
  - Developing national policy
  - Fostering awareness of the resource across the agency
  - Providing technical assistance and training on ground water issues to the agency nationwide

- Hydrogeologist for the Wisconsin Department of Natural Resources

- Research Scientist for the Department of Soil Science at the University of Wisconsin – Madison and at the Indiana Geological Survey

- Instructor at the Indiana University Geologic Field Station in southwestern Montana
Michael Higgins

- Aquatic Ecologist for the Headquarters Office of the National Wildlife Refuge System, U.S. Fish and Wildlife Service
- Water Resources Coordinator for the National Wildlife Refuge System
- Former USDA Water Science Fellow
Craig Goodwin

- Senior Water Quality Specialist for the Bureau of Land Management
  - Provides water quality technical guidance, policy analysis, and training
- Participated in and led projects ranging from the evaluation of the occurrence and characteristics of groundwater in Wyoming’s Bighorn Basin for EPA’s UIC program to planning watershed and water quality restoration in metropolitan Atlanta, Georgia.
- Formerly with the Natural Resources Conservation Service in Lincoln, NE.
Gary Rosenlieb

- Hydrologist
- Chief, Water Operations Branch of the National Park Service’s Water Resources Division and Natural Resources Program Center
  - Provides technical and programmatic support in the areas of surface and groundwater hydrology, floodplain management, surface and groundwater quality management, and water resources data and information management.
- Water Quality Program Leader for the National Park Service
- Formerly worked for the Bureau of Land Management’s Wyoming State office.
How does your agency approach management of groundwater resources on its lands?
How does your agency approach addressing impacts from activities that cross the public land boundary?
What are the biggest water availability and quality related challenges/opportunities facing public lands in the next 10 years?
Sustainable Infrastructure and Asset Management: Maximizing Local Resources

Moderator
Frank Blaha
Awwa Research Foundation
Denver, Colorado
Mary C. Price

- Planner working in General Planning for Denver Water
  - Focus on conservation and customer demand.
  - Worked for Denver Water for 10 years.
Elaine Lai

- Sustainable Water Infrastructure Coordinator and Decentralized Wastewater Coordinator and Wastewater Permit Writer for US EPA Region 8.

- Working with partners in the drinking water and planning communities to change the way water infrastructure is viewed, managed, and planned in order to ensure the continued availability and delivery of drinking water and wastewater services into the future.
Catherine Chertudi

- Environmental Programs Manager for the Boise City Public Works – Environmental Division
  - Supervises a work group dealing with a broad range of environmental issues including solid waste and recycling, groundwater protection, air quality, and hazardous waste management and remediation.
- The Groundwater Foundation Board Member
- Idaho Water Education Foundation Board member
- Founder of the Idaho Water Awareness Week program
Elaine – Briefly describe EPA’s new program which will encourage utilities to begin recognizing aquifers and watersheds as fundamental components of their asset portfolio.
Mary – We hear a lot about failing infrastructure, what in your opinion will be the impacts if communities do not take action now and what methods do you recommend to increase awareness of the need to sustain infrastructure?
Catherine – What are the potential benefits to a community that includes water and sustainable infrastructure in its asset management strategy?
What Are Tribes, States, and Communities Doing to Bridge the Gap?

Moderator

Tim McLelland
Hamilton to New Baltimore Groundwater Consortium
Fairfield, Ohio
Gary Collins

- Tribal Liaison for the Northern Arapaho Tribe within the State of Wyoming’s Governors Planning Office as a policy advisor.
- Shoshone and Arapaho Tribes Tribal Water Engineer administering the Tribal Water Code.
- Chairman of the Arapaho Tribe when the “Big Horn Water Rights Case” was brought before the U.S. Supreme Court.
- Vice President of the MNI SOSE InterTribal Water Rights Coalition
- Founding Member of the Indigenous Water Network
Art Goodtimes

- **San Miguel County Commissioner (third term)**
  - Only Green Party commissioner currently elected to office in the inner basin West
- **Poet and Journalist**
- **Founder of the San Juan Fens Partnership**
- **Advocate of intergovernmental cooperation**
- **Serves on the National Association of Counties Public Lands Steering Committee**
- **Twice appointed to the Bureau of Land Management’s Southwestern Colorado Resource Advisory Council.**
Kevin Frederick, P.G.

- Manages the Groundwater Section for the Wyoming Department of Environmental Quality’s Water Quality Division
  - Wellhead Protection and Source Water Assessment
  - Aquifer Sensitivity Mapping
  - Aquifer Prioritization
  - Ambient Groundwater Monitoring
  - Underground Injection Control Program
  - Groundwater Pollution Control Program
  - Federal Facilities Corrective Action Program

- Ground Water Protection Council Board Member
- Wyoming’s Well Driller Licensing Board Member
From your perspective and experience, when it comes to bridging the gap between what is known and what is practiced, what is the most practical approach?
When it comes to the practice side of the equation, it many times boils down to changing human behavior – what, if anything, can we do to facilitate this change?
Describe ways that you have seen your representative sector successfully bridge the gap between what is known and what is practiced.