RECLAMATION
Managing Water in the West
Oct.-Dec. 2006

S&T Highlights

Improving Infrastructure Reliability

Coatings evaluation.—The Bureau of Reclamation (Reclamation) is facing significant problems with coatings. These problems are primarily due to the degradation of the original coatings and uncertainty about the service life of new coatings. To compound this issue, many of the original coatings used by Reclamation are no longer available due to new safety and environmental regulations.

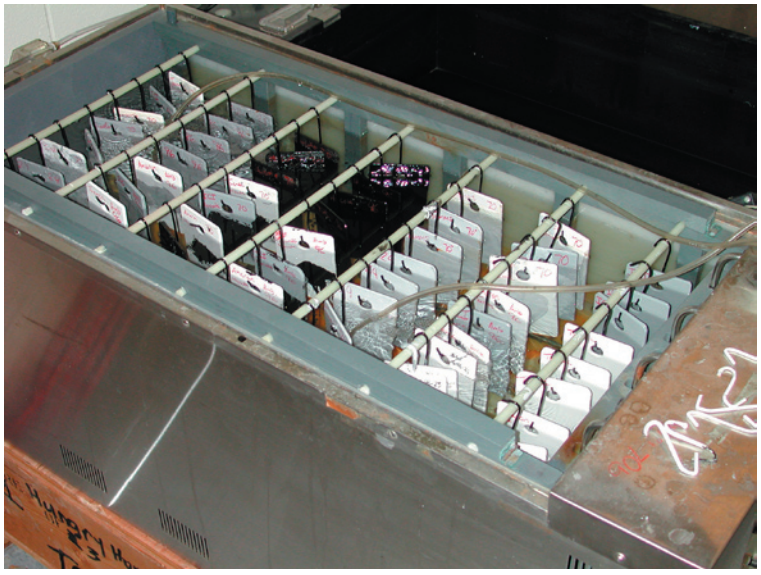
To determine how well new coatings will work for Reclamation, the **Technical Service Center (TSC)** has re-established the Coatings Lab. The lab will conduct research and evaluation of new coatings to determine their service life. The lab's goal is to find coatings that have a service life of at least 30 years.

Coatings technology has vastly changed in the past 20 to 30 years. Well over 100 coatings companies offer over 1,000 products, only some of which may be suitable for the conditions that Reclamation structures are subjected to. Anecdotal and test data indicate that many of these coatings do not perform well when in use at Reclamation structures. Finding high quality suitable coatings is a necessity to keep maintenance costs low. The research conducted in the Coatings Lab will help determine which coatings will best serve the needs of Reclamation. (Allen Skaja, 303-445-2396)

Surface preparation.

U.S. Department of the Interior
Bureau of Reclamation
Science and Technology

Spray application.



Immersion testing.

Improving Decision Support

*Development of a coupled hydrologic and economic trading model to evaluate water trading and water markets in the **Boise Valley***.—Researchers from the **Pacific Northwest (PN) Regional Office** and the University of Idaho presented a paper titled *Economic/Hydrologic Externalities and Spatial Water Allocation Modeling* November 18 and 19 at the Idaho Water Resources Research Institute Annual Symposium in **Boise, Idaho**. The presentation was a product of an interdisciplinary hydrologic and economic modeling investigation that the **Snake River Area Office** is conducting in collaboration with the Idaho Department of Water Resources as part of the Boise Valley Water Use Planning Study. (Robert Schmidt, 208-378-5081)

The Western Water Institutional Solutions Project.—The **Upper Colorado (UC) Regional Office** has been cooperating with the TSC, the PN Regional Office, the University of Utah, and Oregon State University since fiscal year 2005 on a research effort called the Western Water Institutional Solutions Project (WWIS).

The WWIS uses media and legal sources to code conflictive and cooperative events to provide a profile of events over time and correlate these with risk factors for water conflict. The coded events, along with issue type codings, become part of an "events database." Analysis of this database can (1) present a conflict/cooperative profile for an area, (2) pick up emerging water trends, (3) assist in the development of a portrait of existing social, economic, and political relationships, (4) over time, give users a summary of critical, "turning point" events, and (5) help build up a library of lessons learned.

In the summer of 2006, the UC Region Leadership Team recommended that the WWIS research team conduct focus groups in the UC Region's area offices to learn what causes water conflict and what resources water managers could use to change potential conflict into collaboration. Accordingly, focus groups were conducted at the **Grand Junction, Albuquerque, and Provo Area Offices** of the UC Region during the autumn of 2006.

What is the nature of water conflict? One area office representative explained that a finite amount of water is co-joined with a need to use the resource differently than it has been used in the past. More and more demands are being placed upon water resources. At the same time, there are institutional, contractual, and legal reasons why water cannot be allocated as it has been in the past. These reallocations cannot be made quickly. Many water interests want the reallocation process to move swiftly, but it is impossible to simply take water from one use or user and give it to another. These conditions, taken together, can give rise to conflict.

What are the primary causes of water conflict? Broadly speaking, change, especially sudden change, was cited as a primary cause of conflict. For one

thing, the mix of water users has changed. The American West faces many new constituencies for water. Among these are recreational users, environmental conservation groups, rapidly growing cities and suburbs, and Native Americans. In addition, budgetary changes, new legislation, interstate lawsuits, and new policy directions can provide new settings for conflict as some constituencies gain while others potentially lose.

The limitations of science were cited as fostering conflict. In particular, water managers, of course, need scientists to give them information as to the capacity of the natural system to adjust and adapt to changes in the amount of water that is available. For instance, what exact flows at what times of year does an endangered fish truly require? Would an additional 5 cubic feet per second of water flow help an endangered fish, for example? Unfortunately, scientists may either have differing opinions about the amount of water a fish requires, or simply may not know.

Other factors cited as contributing conflict included (1) public perceptions that an agency is inflexibly enforcing laws or policies, (2) the failure of some stakeholders to acknowledge the legitimate needs of other stakeholders or to see themselves as a part of a larger community of stakeholders, (3) unclear, unenforced, or unenforceable laws or policies, and (4) rewarding conflict with money, especially when funds are taken from proactive or planning efforts and transferred to crisis situations.

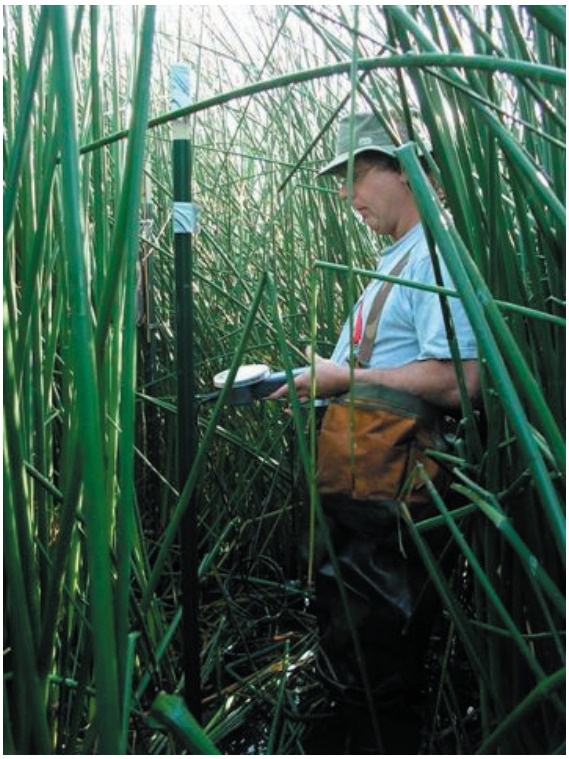
What resources do managers require to better handle water conflict? Area management personnel concluded that these resources fall into two categories, (1) those currently available and (2) those requiring research and development. They developed lists of several resources in each category.

The WWIS team believes that its database, containing more than 5,000 record events created for the UC Region, can (1) help managers to understand the social, economic, and political relationships in their jurisdictions, (2) serve as a jumping off point for developing in-depth case studies, (3) show how and when institutions responded effectively, and (4) build up a library of lessons learned. In addition, new automated coding technologies show promise for allowing real-time events monitoring. The WWIS team is putting together an workshop funded by the Science and Technology program scheduled for September of 2007 to bring water managers and experts together to discuss best practices for detecting and managing water conflict.

To receive a full summary of the focus group findings or the 2006 WWIS annual report, contact Dennis Kubly at 801-524-3715, Amy Cutler at 801-524-3654, or Douglas Clark at 303-445-2271.

Improving Water Delivery Reliability

Study on how to increase the life of water treatment wetlands completed.—Biomass from plants in treatment wetlands tends to build up until treatment functions are compromised. Decomposition (from both microbes and invertebrates) of plant material was studied in a wetland in **San Jacinto, California** to see how material could be processed more rapidly. Data suggested that wetland design and management were critical for ensuring the presence of aquatic invertebrates that increase the rate of decomposition. Designs that encourage invertebrate processing of plant material should keep treatment plants online longer and decrease maintenance costs. This should aid in uninterrupted water supplies to irrigators who use this wetland water. (S. Mark Nelson, 303-445-2225; Joan Thullen, 303-445-2212)



Wetland sampling.

Improving Water Supply Technologies

Modeling and field experimentation to determine the effects of terracing and small reservoirs on water supplies in the ***Republican River Basin*** *above* ***Hardy, Nebraska***.—Field data collection and testing of water balance models is under way in a study to quantify the effects of land terracing and small reservoirs on water supply. Data collection sites have been established at five land terrace and 32 reservoir sites in the Republican River Basin in **Nebraska, Kansas**, and

Colorado. Data such as precipitation, reference evapotranspiration, water levels, and soil moisture content at various soil depths is being collected at these sites to help researchers better understand the water balance of these two types of water conservation structures that have been constructed across the basin.

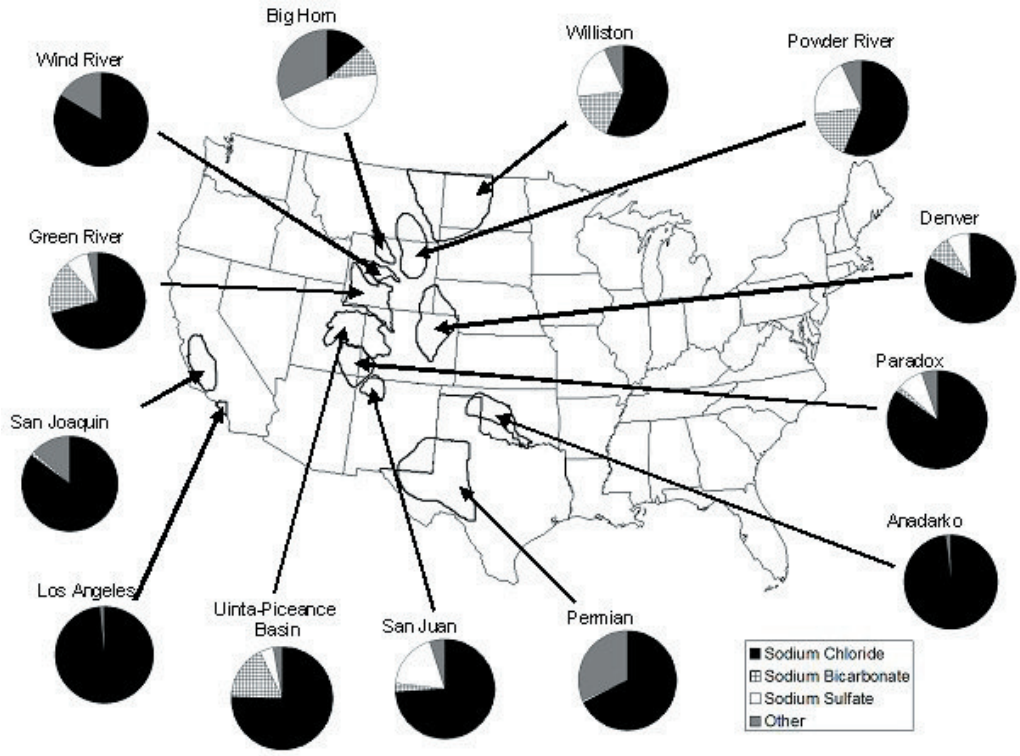
Water balance models are being tested in the **Medicine Creek Basin in Nebraska** and the **Prairie Dog Creek Basin in Kansas**. The data and knowledge gained from the field research is being used to modify, calibrate and verify the water balance simulation models. Simulation model modification and improvement will continue as additional field data and model testing continues through this year. The project also includes a geographic information system database to aggregate and process input data for the simulation models and to process results to enhance understanding of the effects of terraces and small reservoirs on the water supply. Mapping of terraced lands in the basin was recently completed. The 5-year study is expected to be competed in 2009.

Reclamation manages the water supply at eight reservoirs in the Republican River Basin that supply irrigation water to about 137,360 acres as well as supplying municipal water, fish and wildlife benefit, and flood control. This research will improve the understanding of how land terracing and small reservoirs affect the water supply so Reclamation can properly manage and allocate the water supply and develop more useful and reliable river and reservoir operating plans. The States of Colorado, Kansas, and Nebraska are partners in the study. The knowledge gained during this study will also position the States to better manage their water supplies, which are allocated among the three States under the Republican River Compact. (Scott Guenther, 406-247-7736)

An EnviroSMART probe installed in a terrace channel used to measure volumetric water content at six depths up to 6 feet. The picture at the left shows the probe installation into the access tube, and the picture at the right shows the completed installation.

Oil- and gas-produced waters.—An analysis of the geographical distribution, occurrence, and composition of oil- and gas-produced waters was conducted from October to December 2006. TSC staff have prepared a paper on this work and submitted it to *Separation and Purification Technology*, a peer-reviewed journal. Sodium chloride is the dominant salt in the majority of the produced water samples analyzed. The concentration of salts in the water can vary from 1,000 mg/L to over 400,000 mg/L, and the organic content of the water can also range from 40 mg/L to 1,800 mg/L. The Western States generate approximately 300 million gallons per day of produced water.

This work serves as a starting point for determining what types of treatment are appropriate for different types of produced water. Treatment technologies need to be tailored to the types and concentrations of constituents present in the water and the desired end use for the water. Additionally, the chemical composition and quantity of produced water available provides an idea of which areas of the Western U.S. have the greatest potential for beneficial use of produced water. (Katherine Benko, 303-445-2013)



Location of the major oil- and gas-producing basins in the Western U.S. and the salt composition of the water within each basin.

Enhancement of HydroGeoSphere.—To address important issues concerning water supply, water quality and ecosystem health, integrated modeling tools are needed for accurate analysis of hydrological and ecological processes in a watershed. HydroGeoSphere is a fully coupled numerical computer model for conjunctive analysis of the processes with regard to optimal management of water resources and long term protection of complex ecosystems.

The development of HydroGeoSphere has been a joint effort involving Reclamation, the University of Waterloo, Laval University, and HydroGeoLogic, Inc. In its current form, it accounts for water flow and solute migration in two-dimensional surface water, one-dimensional irrigation systems, wells and tile drains, and three-dimensional variably saturated subsurface water.

To facilitate application of the model to multiscale watershed problems, subtiming and subgridding approaches were incorporated into the model during fiscal year 2006, under S&T Program funding. In fiscal year 2007, the subtiming and subgridding approaches are being evaluated against field data collected from a drainage water reuse system and vicinity (small scale), Red Rock Ranch on the west side of California's **San Joaquin River Basin**, and a subbasin located in the San Joaquin River Basin (large scale). Personnel from the Mid-Pacific (MP) Regional Office have completed evaluation and analyses of water flow and water quality data collected by the California Department of Water Resources and the MP Regional Office. The MP personnel are applying geographic information system (GIS) tools to finalize construction of the geological conceptual model in preparation for development of input data files for the model at Red Rock Ranch and in the subbasin. (George Matanga, 916-978-5084)