

# Colorado DSS Provides a Statewide Water Management Tool

Ray Alvarado – Colorado Water Conservation Board and Lavanya Gullapalli – Brown and Caldwell

State agencies, water providers, and water users are constantly evaluating strategies for managing water resources in response to increases in population and demand, droughts, endangered species issues, and funding cuts. A comprehensive decision support system, known as the Colorado DSS (CDSS), is being developed under the direction of the Colorado Water Conservation Board (CWCB) and the state's Division of Water Resources (DWR). DSSs are being completed for the seven river basins in Colorado, with some DSSs covering more than one river basin, so ultimately CDSS will cover the entire state. DSSs have been completed for the Rio Grande and Colorado River basins. A DSS for the South Platte basin currently is being developed, and ones for the Arkansas and Republican rivers are scheduled. These will provide state agencies, water users, and managers a better means for organizing, accessing, and evaluating a wide range of information and alternative strategies for managing water resources. Funding for these DSS efforts comes from CWCB's construction fund as an annual appropriation; no general funds are used. The expenditures for the Colorado and Rio Grande DSSs total approximately \$12 million over a 10-year period.

## Phased-Development Approach Maximizes Benefit

The CDSS is being developed in a phased approach by basin, providing opportunities to build upon the tools and lessons learned from each DSS as it is completed. For each basin DSS, datasets must be established for climate, consumptive use, irrigated parcels, groundwater levels, and water rights and priorities. Creating datasets involves gathering existing information, evaluating data against quality controls, identifying data gaps, and collecting additional information as

needed. Currently, the South Platte DSS is being developed based on the experience gained and databases, tools, and models already completed for the Colorado River and Rio Grande DSSs.

However, the South Platte River basin is more complex from hydrologic, hydrogeologic, and institutional perspectives, warranting development of new datasets and enhancements, as well as some new analytic tools and models. The South Platte DSS is expected to be completed in 2008.

## All Data Available on Website

The CDSS website was designed to facilitate access to the data, which are organized both by basin and information type. All published data, including raw data, maps, and technical memoranda, as well as products, models, and user interfaces are available electronically.

The **CDSS Map Viewer** allows users to zoom to any part of the state and view any combination of detailed map or data layers. Layers include cities,

counties, townships, highways, rivers, reservoirs, land use, diversions, wells, precipitation, temperature, stream-gauging stations, and instream minimum flow.

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The **View Data** feature allows users to query a variety of data, including groundwater, water rights, calls, sampling stations, and structures data.

All models and related final datasets and technical memoranda are available for download:

- HydroBase, the state's relational database, contains streamflow, diversion, water rights, and other data.
- The Data Management Interface links HydroBase to other applications.
- Current GIS (Geographic Information System) data layers are available as ESRI shapefiles.
- Colorado's Consumptive Use Model provides estimates and reports of crop and non-crop consumptive use within the state.



South Platte DSS team member Nils Babel (Riverside Technology Inc.) and irrigator Steve Smith (water manager, North Poudre Irrigation Company) work on irrigated parcel maps.

- Groundwater modeling features of CDSS are being developed and software, data sets, and documentation will be updated as progress occurs.
- The state's Stream Simulation Model is a monthly and daily water allocation and accounting model capable of making comparative analyses of various historic and future water management policies in a river basin. It is designed to be applicable to any river basin.

### Benefits to Users

The effort invested in CDSS by each of the DSS development teams, comprised of state agency staff members, consultants, and various stakeholders, has proved worthwhile. Users now include water commissioners, ditch/irrigation companies, government agencies, universities, local water conservancy districts, and municipalities. CDSS tools are being used by state employees and consultants for many water resources projects, including the Coordinated Facilities Operations Study in the Colorado River Basin and the Statewide Water Supply Initiative. Users have confidence in its validity: they accept analyses and results from the CDSS because its models already are widely accepted in the state. They cite the availability of comprehensive water resources data in one location as the primary benefit of the CDSS.

In creating a comprehensive groundwater database, the South Platte DSS team built on the Rio Grande DSS database, and searched additional existing data for information on aquifer properties, configuration, and changes in groundwater levels over time. The team compiled reports published by the Colorado Department of Natural Resources, U.S. Geological Survey, universities, and local water conservancy districts. These and other data more than tripled the amount of information available on the region's aquifers.

The South Platte DSS team also has developed irrigated parcel boundaries and irrigation ditch service areas containing

*see CDSS, page 33*

## DSS in Colorado River Negotiations

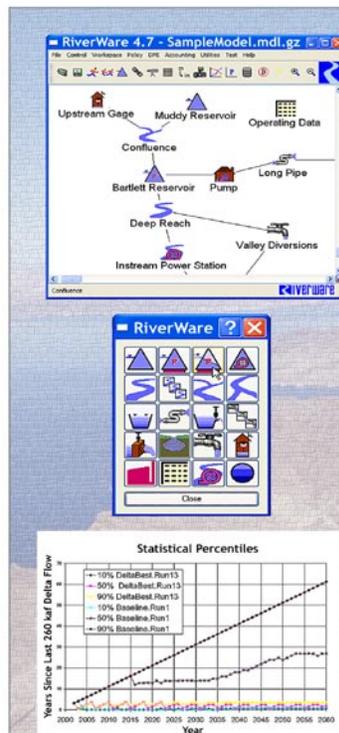
The recent consensus recommendation by the Colorado River Basin states to the Secretary of Interior for managing the river under drought conditions was big news. RiverWare, a decision support model developed by CADSWES at the University of Colorado at Boulder, played a key role in keeping the negotiations moving on the technical front by allowing negotiators to test the implications of various management strategies on a simulation model of the river, built by the Bureau of Reclamation. RiverWare is a multi-objective river and reservoir system modeling tool that can be applied to any basin to simulate hydrologic processes along with operational policies for planning or scheduling operations. Operating policies are expressed as prioritized logical rules by the modeler; the ruleset is part of the input data, along with numerical data such as inflows and demand schedules. Multiple hydrologic traces can be run, providing probabilistic results.

Runs of the shortage negotiation model started with current reservoir conditions and simulated the effects of alternative operating strategies on future water supplies to the states under multiple possible hydrologic scenarios. The modeled operating policies consisted of the current policies that incorporate the many compacts, laws, treaties, and court decrees known as the "Law of the River," along with proposed coordinated operations of Lake Powell and Lake Mead during droughts. The basin states' recommended management strategy ([www.usbr.gov/lc/region/programs/strategies/scopingreport/](http://www.usbr.gov/lc/region/programs/strategies/scopingreport/)) will become one of the alternatives included in the upcoming Environmental Impact Statement for shortage guidelines and operations during low reservoir conditions.

*RiverWare is available through the CU Office of Technology Transfer at [www.riverware.org](http://www.riverware.org).*



Multi-objective River and Reservoir System Modeling Tool



- > Fast Operational Analysis: Scheduling, forecasting, planning
- > Simulation and Optimization
- > Risk-based comparison of operating alternatives
- > Water rights /accounting /banking
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[www.riverware.org](http://www.riverware.org)

Associations represented by signatures on the document include the American Planning Association, American Water Works Association, Association of Metropolitan Water Agencies, Association of State Drinking Water Administrators, Association of State and Interstate Water Pollution Control Administrators, Clean Water Fund, Environmental Finance Centers, The Groundwater Foundation, Ground Water Protection Council, National Association of Counties, National Rural Water Association, River Network, and Trust for Public Lands.

The agreement can be viewed at [www.epa.gov/safewater/protect/pdfs/visionstatement\\_swp.pdf](http://www.epa.gov/safewater/protect/pdfs/visionstatement_swp.pdf).

## NGWA-IA Collaboration Announced

The National Ground Water Association (NGWA) and the Irrigation

Association (IA) have signed an agreement to support efforts to address mutual areas of interest such as scientific, technical, and policy issues related to groundwater and wells. According to the agreement, increased cooperation between the two organizations could occur in the form of joint research, conferences, education and training, policy statements, technical documents, or business development.

“Decisions about water are often based on emotions,” said IA Executive Director Tom Kimmell. “It is in the interest of the Irrigation Association, our members, and the National Ground Water Association to encourage policy decisions based on science. This agreement allows our organizations to work together to support research and fact-based public policy where groundwater and irrigation are concerned.”

Visit [www.ngwa.org](http://www.ngwa.org) and [www.irrigation.org](http://www.irrigation.org).

CDSS, continued from page 21

crop types and sources of irrigation water from 2001, and a GIS tool for viewing groundwater data and irrigated parcels. The South Platte DSS team and employees of the ditch companies labored over mark-ups of parcel maps to make them as accurate as possible. Experience from previous DSSs and the availability of new technologies, such as ESRI products, allowed this process to be more cost-effective and comprehensive.

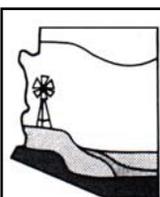
## Stakeholders Using CDSS

The models and data available through the Rio Grande DSS allowed for the fast resolution of litigation involved in the sale of property in the San Luis Valley. Because the consumptive use and irrigated parcel data were readily available, costs were reduced from hundreds of thousands of dollars to tens of thousands, and the time frame was reduced from years to months. Ultimately, the land was sold to The Nature Conservancy and the sale led to the expansion of the Great Sand Dunes National Park and Preserve.

The Northern Colorado Water Conservancy District used the 2001 irrigated parcel boundaries and crop types developed by the South Platte DSS team to help set up a system to annually monitor crops and irrigated lands. The Central and Lower South Platte water conservancy districts are using the irrigated parcels to assist in carrying out augmentation plans, modeling, and visualizing the irrigation in their areas.

The development of each DSS involved input from different levels of review committees, including stakeholders. Currently, the South Platte DSS has a core advisory committee that reviews overall progress and direction, as well as multiple technical peer review committees. Newsletters for each basin, containing updates on progress and products, are routinely mailed during the development of the basin DSS to keep stakeholders involved, informed, and interested.

Access the CDSS at [cdss.state.co.us](http://cdss.state.co.us). Contact Ray Alvarado at [ray.alvarado@state.co.us](mailto:ray.alvarado@state.co.us).



## Arizona Hydrological Society's 2006 Annual Symposium

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## Isotope Analysis

$^2\text{H}$   $^{13}\text{C}$   $^{14}\text{C}$   $^{15}\text{N}$   $^{18}\text{O}$   $^{34}\text{S}$

$^{15}\text{N}$  of  $\text{NO}_3$ ,  $^2\text{H}$  +  $^{18}\text{O}$  in Groundwater  
 $^2\text{H}$ ,  $^{13}\text{C}$ ,  $^{14}\text{C}$ , of crude, Petroleum Fuels & Gases

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805.544.4696 [isotope@zymaxusa.com](mailto:isotope@zymaxusa.com)