American Water Resources Association
2009 SUMMER SPECIALTY CONFERENCE
Adaptive Management of Water Resources II
June 29 – July 1, 2009
Snowbird, UT

Tuesday, June 30
3:30 PM – 5:00 PM
SESSION 27: Models Supporting Adaptive Management 2

1. Multi-Objective Water System Operations Optimization to Address Supply Uncertainty - Bill Fernandez, CDM, Walnut Creek, CA (co-authors: Kirk Westphal, Alek Cannan)

Operations managers of complex water systems in California have an ongoing need for analytical tools to assist in their short- to mid-term operations planning and to address future supply uncertainty. CDM, in collaboration with the Santa Clara Valley Water District, has developed a water supply operations optimization model that will supplement the District's long-term simulation models by providing analysis on short-term decisions related to reservoir operations, groundwater storage, and imported water contracts in the context of climate uncertainty. The Santa Clara Valley Water District (District) is the primary water resources agency for Santa Clara County -- providing treated water deliveries to its client municipalities as well as acting as the county's flood protection agency and as the steward for its watersheds and groundwater basins. The District also manages imported supplies from the State Water Project and Central Valley Project. The optimization tool developed for the District employs a linear programming solver to develop monthly operating plans indicating the volumes of water to store in surface or ground reservoirs, volumes of imported water supplies, and delivery volumes that are 'optimized' to obtain minimum cost, maximum reliability, or some combination of the two (reliability is measured by contract water delivered and/or reservoir storage target volumes). The optimization model helps operations managers to better understand the tradeoffs among the multiple objectives and the variables that constrain system performance. The optimization model's "batch" mode repeats the two-year optimization sequentially for every pair of years in the historic hydrologic record. This allows the District to examine the 'optimal' system operation under hydrologic uncertainty. The result is a set of cumulative distribution plots of important system variables that show the frequency with which a specified variable was determined by the model to be the 'best' value. This leads to better understanding of the mix and timing of District water supplies and helps to quantify the range over which good decisions can be made subject to a variable climate. The model was developed in Excel using Frontline System's Premium Solver Platform add-in and thus provides a familiar and adaptable programming environment to the District staff.

2. Hydrostratigraphy and Aquifer Characteristics of South Las Posas Basin, Ventura County, California - Kenda Neil, CSU Northridge, Northridge, CA (co-author: M. Ali Tabidian)

Groundwater is the primary source of water for Ventura County, California. Whereas approximately 66% and 23% of the county's water supplies are derived from local groundwater reservoirs and imported water, respectively, the remaining supply is from local surface water resources. In order to avert rising water supply costs and demands and lessen dependency on inter-basin water transfers, a better characterization and management of local basins such as the South Las Posas Basin (SLPB) groundwater resource in Moorpark, Ventura County, is warranted. The basin encompasses an area of approximately 10,560 acres and by volume is ninth of the top ten groundwater basins in Ventura County. Although SLPB has an estimated 1,600,000 acre-feet of storage capacity, the local population relies heavily on imported water. It is of paramount importance to plan the utilization and conduct the management of the aforementioned groundwater resources. In addition, with increasing population and environmental concerns, additional constraints are being placed upon imported water resources. The purpose of this research was to characterize the basin aquifers by developing the hydrogeologic framework and delineating the water-bearing (hydrostratigraphic) units. A hydrologic budget was developed to better estimate basin storage values. A comprehensive subsurface analysis of the aquifers was also conducted, providing an overview of the area's geology, hydrology, hydrogeology, and water quality. For better water resource management and planning, all available hydrologic data were assembled in a geo-referenced format. RockWorks™ was used to integrate geologic, and hydrogeologic data into a 3D hydrostratigraphy model of the basin. Information obtained from this research can be utilized by local and regional water agencies to improve current water resource management and provide a means to assess new water resources as additional or emergency supplies during prolonged periods of drought.

3. Resource Based Modeling - An Easily Understood Adaptive Managment Tool - Paul Flack, Colorado State Parks, Denver, CO

An interdisciplinary adaptive managment policy model has been developed by the University of Colorado to optimize water uses and provide decision-makers with an easy to understand framework to develop effective public use strategies. The adaptive management tool is called "Resource Based Modeling" and it can be used for a variety of water resource issues, including reservoir operations, ground water management, flood control regulations, wetland restoration, and local water allocation systems. The model incorporates the needs of all stakeholders in a given project setting by combining community-based policies with economic/marketing considerations and then matching those outcomes with political goals and objectives. The model allows for a visual, easily understood analysis of the strenghts and weaknesses of a current public policy and identifies areas of improvement. By doing so, decision-makers are able to achieve maximum efficiency of the resource. Specifically, the modeling effort demonstrates not only the relationship between the stakeholders, but it also identifies the relationship of individual stakeholders to the resource itself. This provides the opportunity for the sustainability of the resource while the various desired uses of the resource can be simultaneously achieved. The first of many practical field tests for Resource Based Models was begun in 2006 using an interdisciplinary approach to streamline and optimize recreational water use in South Africa. The model was developed for the South African government and its results were used to develop local and national water management strategies, integrating recreational water needs with pre-existing agriculture and municipal uses. Subsequently, the model has been applied to ground water projects, reservoir management strategies, and, most recently, the model's abilities have been expanded beyond water resources and into other natural resource fields such as forestry and fishery management. The basic elements of Resource Based Modeling are the model's strenghts in public-policy making. Databases are readily developed, results are presented in an easily understood format, inputs to the model can be changed and/or modified (adaptive), and future recommendations are identified in a straightforward manner. Therefore, both water resource managers and decision-makers alike can benefit from the model analysis.

4. Data-Driven Lake and Reservoir Monitoring Using Real-Time 3-D Hydrodynamic and Water-Quality Simulations - Reed Green, U.S. Geological Survey, Little Rock, AR

Recent advances in sensor technology and data telemetry allow a range of surface meteorological and vertical water-column data to be collected simultaneously, in real time, for lakes and reservoirs. With recent advancements in computer technology, three-dimensional lake and reservoir models can be run in much shorter time frames, allowing for real-time simulations of hydrodynamics and water quality. Together, these advances allow for the development of quasi-real-time decision-support systems for water-quality management of individual lakes and reservoir systems. Using real-time instrumentation, the models can "learn" from the data and continuously check their predictive capabilities. Real-time model simulations will provide necessary information for "data-driven" monitoring schemes designed to examine current physical, chemical, and biological conditions that impair the water quality of a lake or reservoir, like algal blooms. For example, real-time model simulations and resultant animations of algal patch development (functional groups like nitrogen-fixing cyanobacteria or even species like

Microcystis aeruginosa), which may be responsible for taste and odor or toxin problems in drinking water, will provide up-to-date information that can be used by monitoring teams to cost-effectively target data-collection to specific locations in the lake or reservoir and collect data throughout the growth phase and subsequent crash of the algal population. Until recently, recognition of an algal bloom in a lake or reservoir did not happen until after the bloom peaked or crashed, and then too late to collect information about the conditions that propagated the bloom. Understanding the processes that lead to an algal bloom and water-quality impairment will aid in the design of in-lake or landscape engineering or management solutions to reduce or eliminate future impairments. Example applications of the recent technology (using idealized conditions) include two reservoir systems and one lake: Beaver Lake, an impounded mountain valley reservoir in the Ozarks of northwestern Arkansas, Lake Houston, an impounded flood-plain reservoir near the Gulf Coast of Texas, and the south arm of the Great Salt Lake.