WATER REPLENISHMENT DISTRICT OF SOUTHERN CALIFORNIA

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GROUNDWATER MODELS - A PREDICTIVE AND ANALYTICAL TOOL FOR THE CENTRAL AND WEST COAST BASINS

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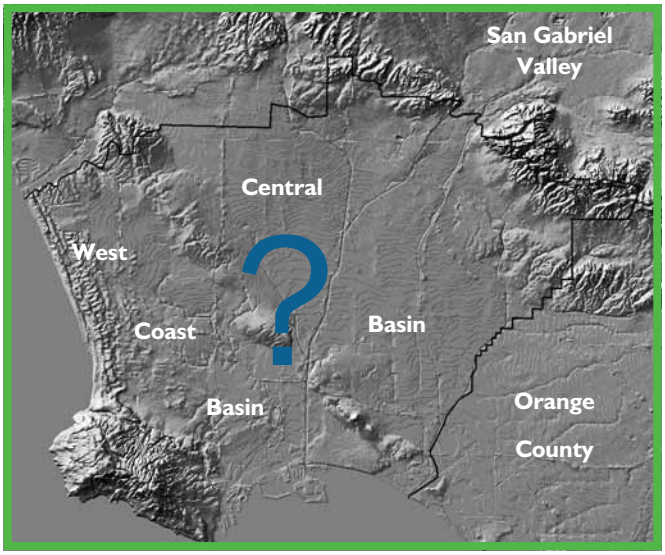
Can the Basins Be Operated Differently?

There have been a lot of discussions lately about optimizing the management of the Central and West Coast Groundwater Basins. Questions such as: Can operations in the West Coast Basin change to reduce the seawater barrier costs? What is happening to the saline plume? How much storage space exists in the basins for conjunctive use projects and what will be the impacts of these projects? Can more water be pumped out of the Montebello Forebay to encourage greater stormwater capture? Can the pumping carryover be increased to 60%? Where is the injected recycled water after recharge? What will the basins look like over the next 25 years if nothing changes?



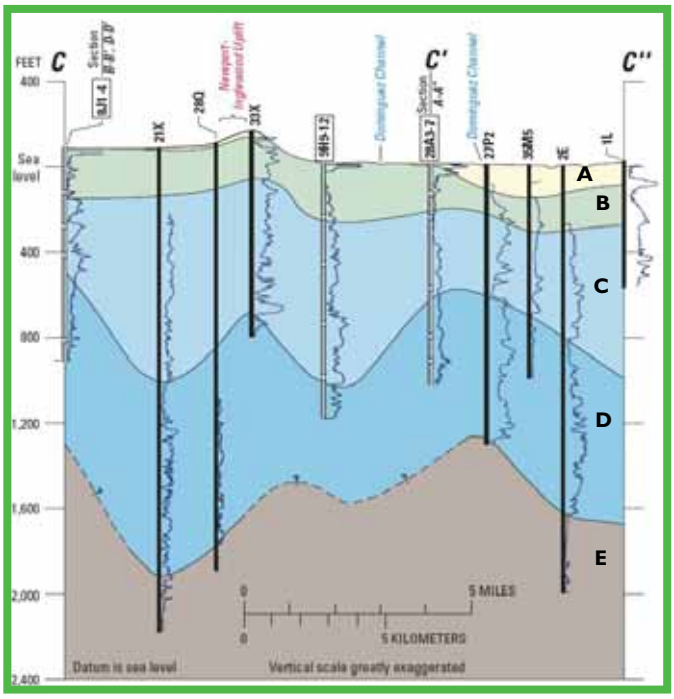
Management Questions for the Central & West Coast Basins

These are good questions that have a lot of details and complicated variables associated with them. So how are all of these complexities addressed? One tool that the WRD uses to help solve these problems is groundwater modeling. But what is a model? The purpose of this Technical Bulletin is to explain groundwater models and how they can be used as a predictive and analytical tool for basin management..

What are Groundwater Models?

A model is a representation of something real. It can be a child's model of a toy airplane, an architectural model of a new building, a diagram of the human body, or a computer simulation of a physical process. The groundwater model fits into this last category. It simulates the movement of groundwater using a set of mathematical equations to reproduce the complexities of the underground flow systems. Once built, it can be used to make predictions on future basin conditions under different management schemes.

To construct the model, the hydrogeology of the groundwater basins must be well understood so that the model can accurately reflect it. The input data are obtained from existing information and from the collection of new information by drilling monitoring wells, performing geophysical surveys, and collecting soil and water samples. Aquifer parameters such as their depths, hydraulic conductivities, and storage coefficient values are collected. The recharge from rainfall and at the spreading grounds is determined. Information on pumping and injection wells are collected. Geologic maps, cross sections, and water balances are created to document the hydrogeologic understanding. The computer model is then built to match the known system as close as possible. Calibration of the model is an important step to prove that the model adequately simulates the real system.

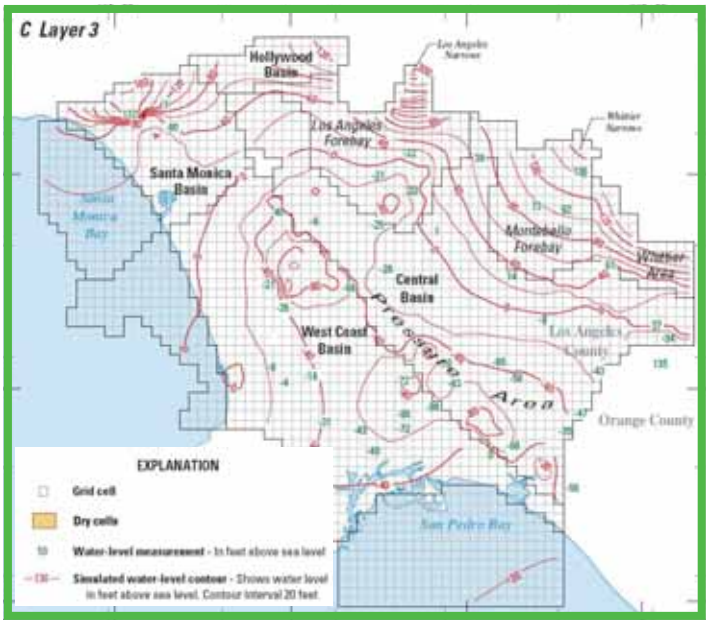


Typical Cross Section through the Central and West Coast Basins (after Reichard, et al, 2003) used to construct the model. Wells and geophysical e-logs shown. A= Recent Formation, B = Lakewood Fm, C=Upper San Pedro Fm, D = Lower San Pedro Fm, E = Pico Fm.

U.S. Geological Survey / WRD Model

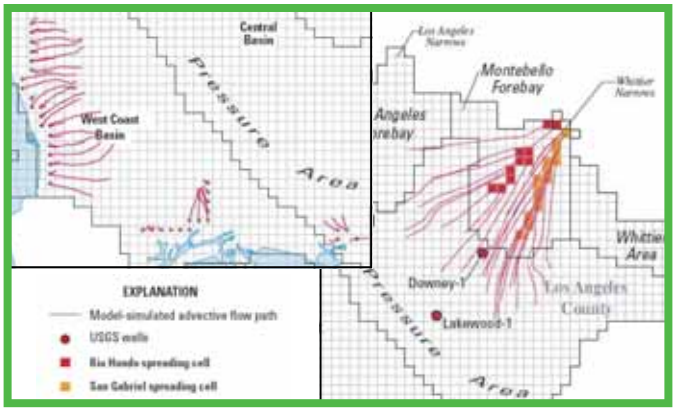
The USGS has developed a model of the Central and West Coast Basins in a cooperative effort with WRD (Reichard, et al, 2003). The model simulates groundwater movement by dividing the area into 18,760 individual model grid cells (1/2 mile x 1/2 mile each) in four vertical layers to represent the major aquifer systems. The model grid is shown below.

The model simulates groundwater conditions over a 30-year period from water year 1970/71 through 1999/2000. The model was subjected to extensive calibration to meet rigorous USGS protocol to produce a reliable groundwater simulator. The groundwater elevation contours generated by the model are shown below. The USGS report can be obtained from: http://water.usgs.gov/pubs/wri/wrir034065/wrir034065.pdf



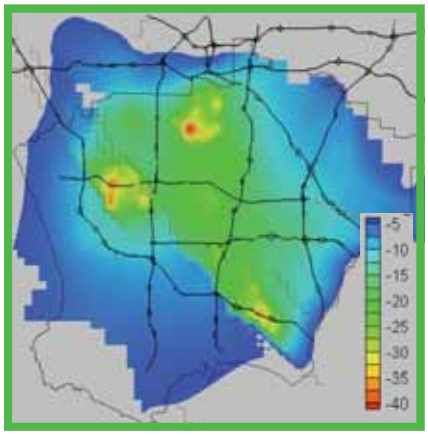
Once constructed and properly calibrated, the model can be used as a predictive and analytical tool. WRD and the USGS have been performing various "what if" scenarios to help answer some of the questions raised in the beginning of this Technical Bulletin to provide optimal basin management.

For example, the USGS has used the model to predict the movement of recycled water from the spreading grounds and the barrier wells using a process called "particle tracking". Results of the tracking simulations are shown below.



In addition, WRD is evaluating the potential impacts if the pumping carryover is increased from 20% to 60%. Model runs have been performed to predict water level fluctuations that may occur during reduced pumping conditions (carryover or banking period) followed by the increased pumping conditions (extraction of the carryover). Results are shown below.

Other Models



In addition to the USGS model, other models have been developed to focus on special study areas, such as the seawater barriers and the Montebello Forebay. All of the models can be used to predict how the basins will function under different operating conditions, leading to improved basin management and the establishment of a scientific basis for sound decision making. For more information on modeling, please contact the WRD.

Sources of Information for this Technical Bulletin:

Reichard, E.G., Land, M., Crawford, S.M., Johnson, T., Everett, R.R., Kulshan, T.V., Ponti, D.J., Halford, K.J., Johnson, T.A., Paybins, K.S., and Nishikawa, T., 2003, *Geohydrology, Geochemistry, and Ground-Water Simulation-Optimization of the Central and West Coast Basins, Los Angeles County*, USGS Water Resources Investigations Report #03-4065.

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