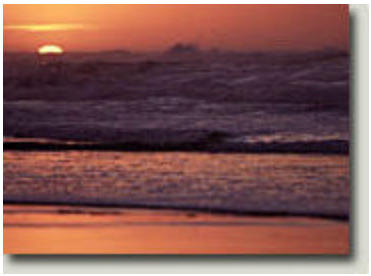

2005 Annual Meeting Poster Session Titles

Sponsored by Watercourse Engineering

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2005 Annual Meeting
Poster Session Titles

Tuesday, March 1, 2005

Poster 1: Probabilistic Analysis of Multi-Region Conjunctive Use Water Supply and Evaluation of Long-Term Regional Water Plans, Debbie Hathaway (SSPA)

To balance limited water supplies with increasing and competing water demands, water planners in Western States must consider a complex set of interacting conditions. These include the high variability of surface water flows; obligations under interstate stream compacts or other allocation agreements; in-stream flow requirements; and, often significant, but lagged, impacts of groundwater use on stream flow. The future projection of water availability is further complicated by the fact that climatic conditions governing water yield in recent periods may embody undesired bias and may not represent a suitable baseline condition for water planning. This study develops a methodology for probabilistic evaluation of a multi-region water supply that incorporates variability, groundwater depletions and allocation constraints; and, evaluates the climatic baseline condition. The methodology is used to characterize the conjunctive use water supply in the Middle Rio Grande Basin of New Mexico and is applied to the evaluation of long-term regional water plans developed by three planning regions within the basin.

Water inflows and depletions to the region are quantified to reflect climatic variability. Appropriate historic conditions to use in the analysis were determined based on analysis of available tree-ring reconstructions of regional precipitation and climate, and on analysis of regional response to ENSO and Pacific Decadal Oscillation forcing. Based on this analysis, the period from 1950-2002 was chosen as representative of long-term (>1000 year) average regional climatic conditions. The years 1950-1977 and 2000-2002 were used to represent extended region drought conditions. For each water budget term exhibiting climate dependency, the range and nature of this variability was described based on historic data for the desired baseline condition. Water demands are specified for the existing and for alternative-based development conditions. Groundwater depletions were linked to the stream system using a regional-scale groundwater model developed by the U. S. Geological Survey. Through this approach, hydrologic processes occurring in the aquifer that have effects on the river, for example, precipitation, recharge, and groundwater pumping, were integrated into the water supply analysis.

A probabilistic water budget model was developed to evaluate the range of possible outcomes that result from the range of possible inflows and selected demands. The model was used to evaluate regional water plans proposed by each of three water planning regions lying within the study boundaries. Hydrologic impacts of the water plans given 40-year projections of water demand were incorporated into the model. Available surplus/deficit water within the region was assessed within a probabilistic framework, given interstate compact obligations under alternate climatic assumptions, including a baseline and a drought condition. Model results are presented as a distribution of possible outcomes, such as the range of water surplus or deficit available or required by the region.

Poster 2: High-Resolution Groundwater Models for the Assessment of Riparian Restoration Options and River Conveyance Efficiency, Debbie Hathaway (SSPA)

A suite of groundwater models have been developed for the shallow riparian groundwater environment along the Rio Grande in New Mexico to support analysis of restoration options and river management strategies. The first year of this multiple year project was completed in January 2005, with the development of three fine-mesh, three-dimensional groundwater models spanning approximately 60 river miles. The model grid consists of cells of 250 feet x 125 feet with four model layers. The three shallow riparian zone groundwater models (riparian models) represent physical processes relevant to assessing shallow groundwater conditions, exchanges between surface water and shallow groundwater within the floodplain of the Rio Grande, and interaction between shallow and deep groundwater systems. Using input from existing regional surface-water and groundwater models, the models developed in this study can be used to analyze transient interactions between flow conditions in the river (and riverside drains) and the shallow groundwater under various hydrologic conditions. Modeled interactions include seepage from the river, interception of shallow groundwater by drains, recharge to shallow groundwater from flooded overbank areas, and water depletions due to open water evaporation and riparian evapotranspiration. Riparian evapotranspiration rates are variable, depending on the existing mapped vegetation classifications in the riparian zone. The riparian models improve our ability to assess shallow groundwater conditions important to water supply reliability in specific river reaches and to evaluate habitat restoration goals. The models have been used to evaluate the relationship of shallow riparian groundwater conditions to variations in (a) regional groundwater conditions, (b) flood magnitude and duration, (c) vegetation type and coverage and (d) alternate channel conditions. The riparian model simulations conducted in this first project year illustrate the dynamic nature of riparian zone behavior, with inter-relationships among environmental components including groundwater, surface water and vegetation. These dynamics have implications for both water management and restoration activities.

Poster 3: Financial Optimization of Environmental Water Account Purchases with Uncertainty, Sarah Hollinshead and Jay Lund (UC Davis)

Because the Environmental Water Account (EWA) "solves" the conflict between water exports and endangered fish in the San Francisco Bay-Delta, many stakeholder groups are invested in its performance. In this charged setting it is important to consider how to achieve the greatest possible success with limited resources. This model seeks to identify least-cost strategies for purchasing water and water options for the Environmental Water Account. It uses three-stage linear optimization to minimize the expected cost of EWA water purchases that are applied to compensate for fish-related export cuts, considering hydrologic, operational, and biological uncertainty. Applications can focus on adjusting the quantity, location, timing, or type of purchases. They can also investigate how strategies change as the user varies the hydrologic, operational, biological, and/or cost inputs. Decisions that are repeatedly optimal over a wide range of conditions may warrant further consideration in the context of planning for a long-term EWA.

Poster 4: Preliminary Assessment of Sea Level Rise Impacts on Delta Salinity
Jamie Anderson and Aaron Miller (CA DWR)

Historical data indicate that sea level at Golden Gate has been rising about 0.04-0.08 inches per year. Projected increases in air temperature due to climate change could increase the rate of sea level rise due to thermal expansion of the ocean and melting of the polar ice caps. Potential impacts of sea level rise on Delta salinity are being investigating using numerical hydrodynamic and water quality models. Multi-dimensional models (RMA-2 and RMA-11) are being used for short-term studies, and a one-dimensional model (DSM2) is being used for longer-term studies.

The RMA models were used to simulate salt transport from Golden Gate into the Delta for base (~historical) and one-foot sea level rise conditions for 1992. Results from that study were used to generate a relationship between base and one foot sea level rise conditions at Martinez. The newly developed Martinez salinity relationship was used to generate boundary conditions for longer-term studies using DSM2. Sixteen year planning studies (water year 1976-1991) were run using DSM2 for base and one foot sea level rise conditions considering current land use practices (2001 level of development) and projected future land use practices (2020 level of development). Simulated changes in Delta EC for one-foot sea level rise conditions are presented with an emphasis on urban intakes and D1641 water quality standard compliance locations.

Poster 5: Reclamation, MP-Region Science and Technology Forum,
Claire Jacquemin and George Matanga (USBR)

The Division of Planning (MP-700), Mid-Pacific Region, is proposing the formation of an MP Science and Technology Forum (STF). The forum will be based on our professional interest in application of sound science in solution of interrelated problems related to water supply reliability, water quality, and ecosystem health. The STF's objectives include, but are not limited to, bringing multidisciplinary professionals and managers together through regular meetings to discuss the application of effective and sound science in the solution of various problems affecting the MP-Region, as well as identifying goals and objectives to improve the problems affecting the Region; fostering multidisciplinary collaboration in developing proposals for funds to perform scientific and technological research and development targeted at solving current issues of concern; facilitating the development and utilization of scientific and technological expertise through collaboration among the MP- Region professionals and with other agencies, organizations and stakeholders; providing a platform for scientists, engineers, and managers, to improve their understanding of current or anticipated programs, projects, and issues; keeping Forum members apprised of (a) Reclamation's S&TP objectives, (b) the criteria by which S&TP proposals will be evaluated for funding, and (c) other potential funding alternatives.

Poster 6: Klamath River Thermal Refugia Study: Flow and Temperature Characterization,
Stacy Tanaka and Mike Deas (Watercourse Engineering)

Thermal refuges are areas of cooler temperature water that occur where colder water tributaries or groundwater seepage flows into the main stem of the river. The size and depth of these thermal refugia depend upon many different conditions and characteristics, including flow and temperature in the tributary and mainstem, channel geometry, basin topography, local geology, riparian coverage, and atmospheric conditions. Thermal refugia are used by cold-water dependent fishes, such as coho and Chinook salmon and steelhead, to survive during the hottest parts of the day when temperatures in the mainstem of the river are excessive. Coho salmon are of particular importance in Klamath River, where they are listed as a threatened species. In response to the National Marine Fisheries Service's biological opinion a multi-year study to investigate the effects of various Iron Gate Dam flow regimes on the size of thermal refugia was initiated. The confluence at Beaver Creek (about thirty miles downstream of Iron Gate Dam) was subjected to intensive temperature monitoring and fish counts. Four flow regimes were captured during the study period. It was found that as the flow increased the cold water was pushed closer to the shore and that traces of cold water were found further downstream. Fish counts were conducted at the site for 6 days during the daylight hours. The number of fish counted in the refugial area increased as the day progressed and water temperatures increased for days when water temperatures in the mainstem exceeded 24°C.

Poster 7: Data Analysis with Fourier Transforms, George Nichol (SWRCB)

Fourier Transformation is a data analysis process. This poster shows in schematic form how the Fourier Transform process works to separate time-series data into the individual signals that produced the data. Attempting to understand Fourier Transforms solely by reading mathematics books is difficult. One probably remembers from college how individual sinusoidal–type waves could be added to arrive at the resulting total wave. This total wave is what we see in the data we collect, and unfortunately at this point we can no longer see the individual waves any more. But can we work backwards and break the total wave (i.e. the collected data) back into the individual waves that caused it? Can it be done? Yes, by using Fourier Transforms and band-pass filtering. By knowing the individual sinusoidal waves we are in a better position to understand and work on the system being measured. The Fourier Transform process has application in chemistry, medicine, biology, geology, astronomy, oceanography, and communications, to name a few applications. It is fast evolving as a powerful technology that will help shape science in the twenty-first century. An example for the Sacramento-San Joaquin Delta is presented, where water velocity and salinity were examined in the lower Sacramento River. The sinusoidal-type data collected were a net result of the flood and ebb of the tide, the reduction in river flows from summer to fall, the changes in tidal stage due to the Spring and Neap tides, atmospheric pressure, wind speeds, and other conditions. Fourier Transforms and band-pass filtering were used to remove the high frequency data (i.e. the daily tidal cycle) from the data sets. This was done separately for both surface and bottom water, so conditions could be studied separately for surface and bottom. The results show the net (i.e. tidal action taken out) magnitude and timing of saline water as it moves inland along the channel bottom of the lower Sacramento River during low Delta outflow years, even as the surface water is moving seaward. The original and transformed data from this project can be used during the calibration and verification of two-dimension (longitudinal-vertical) mathematical models for hydrodynamics and salinity.

Poster 8: Klamath River Flow and Water Quality Modeling Framework,
Mike Deas (Watercourse Engineering)

To support flow and water quality studies associated with the PacifiCorp hydropower FERC relicensing project on the mainstem Klamath River, Watercourse Engineering, Inc. constructed a mathematical modeling framework. The Klamath River study area encompasses the river system from Klamath Falls (river mile (RM) 253) to the Klamath River estuary (RM 6), including four mainstem reservoirs: Keno, J.C. Boyle, Copco, and Iron Gate reservoirs. To assess project impacts, as well as potential mitigation measures, sub-daily model results were required throughout the calendar year. To assess river reaches, including hydropower peaking operations, the RMA models RMA-2 (hydrodynamics) and RMA-11 (water quality were applied. The reservoirs were assessed using the U.S. Army Corps of Engineers model CE-QUAL-W2. The river models were applied in one-dimension, representing longitudinal gradients. The reservoir model was applied in two-dimensions, representing vertical and longitudinal variations. RMA-11 was modified to ensure state variables would be consistent among the different models. Modeled constituents include river depth and reservoir stage, velocity, temperature, dissolved oxygen, biochemical oxygen demand, epiphyton and phytoplankton, organic matter, ammonia, nitrate, and orthophosphate. Simulation results are produced at one-hour intervals. Typical river model output includes time series at selected points or longitudinal profiles of river conditions for a particular time. Reservoir model output includes time series of discharge conditions, vertical and longitudinal profiles for a particular time.

Poster 9: San Joaquin Data Atlas, Russ Brown and Russ Grimes (Jones and Stokes)

The successful analysis and modeling of water quality in the San Joaquin River (SJR) and the Stockton Deep Water Ship Channel (DWSC) requires a large amount of reliable data. Many types of data are available for the SJR and DWSC from a variety of government agencies that routinely measure river flow, temperature, salinity, and other water quality parameters with monitoring devices and samples for laboratory analysis. Different agencies have collected data during various time periods, at different stations and with different parameters. This data is stored in several different public and private databases, operated by several different agencies. This makes it difficult for stakeholders, agencies, or interested persons to access the full range of available data. Each type of data must be individually downloaded, processed, compiled, and compared. These data retrieval tasks make the compilation, analysis and modeling of the SJR and DWSC water quality a time-consuming and tedious exercise.

The SJR Water Quality Data Atlas was created to provide a rapid and consistent method to access all available data on the SJR and DWSC flow and water quality conditions for the 20-year period of 1984 to 2003. The SJR Water Quality Data Atlas includes flow and water quality data from the SJR Stevinson gage downstream to the DWSC portion of the SJR. Tributary flow and water quality data are included for the Merced, Tuolumne, and Stanislaus Rivers, as well as Salt Slough and Mud Slough. Some basic tidal stage, salinity, and water quality data from the Delta are included for reference. Annual Excel spreadsheet files contain all daily data; comparison files have graphs with simple analyses that allow selected data from several stations to be visually evaluated for any specified year.

Poster 10: Butte Basin IGSM2 Model, Brian J. Heywood (CDM)

Following the late 1980s through early 1990s drought period, the Butte Basin Water Users Association (BBWUA) funded the initial development of the Butte Basin Groundwater Model to support water management activities. BBWUA subsequently entered into an agreement with the Butte County Department of Water and Resource Conservation (Butte County) whereby model maintenance and update would be completed by Butte County. During the period of model development, the conceptual model of the Butte Basin hydrogeology represented the basin as generally undifferentiated sediment. As a result, the original model represented the basin stratigraphy as 3 horizontal or "pancake" layers.

More recently, the DWR Northern District Groundwater Section has completed studies that provide a significantly improved interpretation and of the basin's many stratigraphic units. Butte County understood that updating the model to more accurately represent the basin stratigraphy was necessary to improve the model's functionality as a water management tool. Butte County also wanted to improve the pre and post-processing capabilities of the original model. The County contracted Camp Dresser & McKee, Inc. (CDM) to update the original model.

For the new model, the underlying hydrogeology was completely updated based on DWR Northern District's most recent data and interpretation. Additionally, the County required a modeling code capable of simulating a wide range of water management activities, including the ability to represent water use conditions and associated water supply deliveries. After reviewing the existing model code and other available tools, Butte County selected IGSM2 as the new code for the Butte Basin Groundwater Model.

With funding from the United States Bureau of Reclamation and Butte County, CDM has successfully completed the update, and initial calibration of the Butte Basin IGSM2 model. The Butte Basin IGSM2 model was developed to be consistent with the latest data and interpretation

of hydrogeology of northern Sacramento Valley groundwater basin. In addition to applying the latest version of the IGSM2 code, CDM created a number of dynamic links to visualization and geographic information tools. The ability to quickly, and effectively, display complex model inputs and results to stakeholders in Butte County is important, and adds both credibility and utility to the model.

Poster 11: Surface Water Ambient Monitoring Program (SWAMP), George Nichol (SWRCB)

The SWAMP program is integrating existing water quality monitoring activities of the SWRCB and the Regional Water Quality Control Boards, and is coordinating these activities with the monitoring programs of others. The SWAMP program will collect data statewide under well-defined QA/QC procedures, to ensure data comparability throughout the State and scientifically defendable data. Such data will be helpful in the calibration and validation of mathematical models. Data to be collected include chemical, toxicity, and biological data. The SWAMP program will incorporate the data from the following programs: Grants; TMDLs; NPDES Point Sources and Stormwater; Agricultural Waivers; Aquatic Pesticides; and Volunteer Monitoring. The poster shows the inter-relationship between the SWAMP program and other data collection efforts throughout the State. The SWAMP program will enter its data into the California Environmental Data Exchange Network (CEDEN).

Poster 12: Beware of Limitations of Jacob Methods for Aquifer Test Analyses,
Gordon Thrupp (SSPA) and Jessica Oster (UC Davis)

Many California counties require proof of adequate water supply before residential or commercial development is allowed where municipal water supply is unavailable. Some counties have guidelines for implementation and analysis of pumping or aquifer tests. Most analysis methods are analytical models of aquifer response to groundwater pumping. Too often, however, fundamental assumptions and limitations of the aquifer pumping models are overlooked when analyzing pumping test results.

Misuse of the simplified Jacob analysis method is a common cause of technically flawed interpretation of aquifer testing data. The Jacob method is an approximation of the Theis solution, and while valid for certain conditions, use beyond its limitations can produce in erroneous results. The Theis and Jacob solutions are subject to an identical set of limitations and assumptions. However, the Theis solution applies at all times and distances from the pumping well, while the Jacob method is only applicable to the zone in which steady-state conditions prevail (e.g. Heath, 1989).

An example is presented where inappropriate use of the Jacob method supported apparent availability of sustainable groundwater resources in bedrock for a proposed development. Steady-state flow conditions were not achieved during the test, so the Theis method would have been a better choice. For the same pumping rate and aquifer properties, the Theis method indicates orders of magnitude greater drawdown distances reported to have “negligible drawdown” based on the Jacob method. In addition, the impact was assessed for pumping duration of only one day, but the proposed development would need water for many months. During the last 6 hours of the 24-hour pumping period, the water level in the pumping well dropped at a rate of 12 feet per day. Also, in 24 hours only 65 % recovery occurred in the pumping well following the 24-hour pumping period. Even without any analysis, these data raise serious doubt that the well can sustain the test pumping rate.

Aquifer tests can be key components in land use planning policy decisions. Proper aquifer testing methodology and analysis are important in assessing sustainable groundwater production potential, particularly for development in small coastal-margin aquifers or bedrock settings that depend on groundwater resources.