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To: Members of CALFED DNCT Modeling & Accounting Workgroup

From: Russ T. Brown, CALFED Consultant Team

Subject: Development of an Interactive Simulation Tool to Demonstrate and Evaluate the Proposed Implementation of the CALFED Environmental Water Account

The DNCT meeting on January 19, 1999 suggested that a work group be formed to develop a simulation tool that could be used to demonstrate and evaluate the CALFED Environmental Water Account (EWA). The goal of this work group effort will be to provide an interactive tool that can simulate the current operations of the Central Valley water management facilities and the general effects of these operations on the fish populations in the Delta and tributary streams. This tool must be easy to understand and use (i.e. spreadsheet or Internet accessible program).

The basic structure of the tool should follow the actual planning and operations sequence. For example, the hydrologic conditions and reservoir operations rules currently simulated in DWRSIM (or CALSIM) would provide the basis for monthly targets for reservoir and Delta operations. Reservoir storage together with hydrologic forecasts based on snow surveys are used in the winter (e.g. March 1) to estimate annual delivery targets for the year. However, the actual operations are then governed by daily hydrologic events and fish abundance (i.e. location and density) information. Flood control releases and export pumping restrictions to reduce entrainment of fish may cause daily adjustments within the monthly planning targets. The EWA operations must be simulated to augment the environmental water management already provided by instream flow requirements (i.e. AFRP actions, VAMP), and Delta water quality objectives (i.e. E/I ratio, X2, salinity standards).

There may be relatively little flexibility in reservoir operations and Delta management during many periods of the year. An interactive tool is needed to simulate the effects of various alternative EWA operations within the constraints of the actual capacities of the existing water management facilities and the water supply targets. For example, attempting to export a total of 6 MAF with the current pumping limits (i.e. 10,000 cfs combined pumping for 20 TAF/day) would require 300 days of full pumping. The available San Luis Reservoir storage of 2 MAF is not large enough to provide the full delivery of summer irrigation demands without relatively high export pumping.

A simulation tool for the EWA is needed to determine how Delta exports might be shifted from periods with relatively high fish entrainment (i.e. reduced during the VAMP

period) to periods when fish entrainment impacts would be less. Export shifting will generally require water storage, either in San Luis Reservoir or in upstream reservoirs. How much water can be exported and stored before vulnerable fish populations increase in the winter and spring? Is there enough storage space in San Luis or other aqueduct storage facilities for the EWA water? Fixed rules for minimum flows, Delta outflows, or maximum pumping may be adjusted in exchange for additional EWA upstream storage or EWA export storage credits. Where can the EWA water be stored upstream until it is released to allow increased pumping to balance the reduced pumping during VAMP? The effects of water transfers must be simulated as specified adjustments in reservoir and Delta operations. The simulation tool will allow these possible operations of the EWA to be evaluated and demonstrated.

Because the simulation tool is needed relatively soon (e.g. within two months) to test out EWA operations during 1999, a spreadsheet model (i.e. Lotus or Excel) is recommended. This will also allow many DNCT and other interested persons to share the tool and compare results of their ideas. The work group can select the spreadsheet and specify its capabilities. The simulation tool should include the following features.

- The simulation tool should bridge the gap between multi-year planning studies and operations scheduling for a single year. This will require the combination of monthly planning results, monthly historical conditions, and daily historical hydrology and operations data. The simulation tool will interface with a full collection of historical and projected operations information (i.e. database). For example, DWRSIM results can be organized as monthly time-series for each reservoir inflow, storage, release, diversion, and river flow location (i.e. columns of data). The historical conditions can be arranged in the same way for easy comparison. The daily information can be similarly arranged in annual files (e.g. DAYFLOW daily Delta water budgets).

- The simulation tool should only use the information that is actually available to water and environmental managers. Reservoir operations decisions cannot use actual future runoff information, they must be based on forecasts and hydrologic probabilities. Fish density information is scarce, but habitat conditions can be more easily estimated (i.e. temperature in rivers or salinity in the Delta). EWA management decisions to modify fish habitat conditions (i.e. flows and salinity) or reduce entrainment effects must be based on general life-stage knowledge and limited real-time sampling from a few locations for a few years (e.g. salvage records, screw-traps, Chipps Island trawling). These habitat and fish abundance information should be organized and incorporated in the simulation tool.

- The simulation tool should allow daily adjustments in the monthly target flows and exports to demonstrate the difficulty in managing reservoir releases and Delta

exports in response to rapid changes in hydrologic conditions and in fish habitat or fish density information. One possible option is to start with the historical operation from a recent year (i.e. select from the 25-year period of 1974-1998). The historical water uses (upstream as well as Delta export demands) should then be adjusted to a current or future demand that can be specified by the interactive user of the tool. The required instream flows and Delta objectives must then be updated to reflect the current or projected "baseline" rules for environmental protection. The EWA operations would then be simulated on top of these adjusted daily historical operations.

- A series of graphs should be presented for each portion of the water management system that would compare the specified operation rules and objectives with the specified adjustments in the historical operations. Flood control storage rules and minimum carryover targets would be displayed along with historical and adjusted simulated storage for reservoirs. Minimum and maximum flows together with historical and adjusted simulated flows for river locations. Both monthly operations targets and daily adjusted operations should be displayed to allow interactive changes and adjustments in the monthly targets and daily rules.

- The simulations tool should allow fish habitat and entrainment information to be evaluated relative to life-stage or adult abundance criteria. This information will allow improved habitat conditions or reduced entrainment operations to be demonstrated independently of the corresponding water supply impacts. At least two evaluation scales must be displayed: water diversion patterns and fish habitat/protection performance.

The work group is free to explore any available water planning or operations tool, or start fresh with the basic objectives for the EWA simulation tool and create an appropriate spreadsheet or programmed tool. One possible approach is to continue modifying the DailyOPS (Operations Possibility Simulation) model for Delta operations that was based on a daily Delta simulation model developed for the SWRCB evaluation of the Delta Wetlands project. Historical salvage data were incorporated into the simulations for exploring flexible operations strategies and EWA operations for the DNCT in the fall of 1998. The existing DailyOPS model does not include upstream reservoir operations, although San Luis Reservoir operation and an assumed demand pattern was added for the DNCT efforts. Under this approach the DailyOPS tool must be expanded to include upstream reservoir operations. The work group has the necessary knowledge and should be able to quickly add the basic calculations for simulating the major features of upstream reservoir operations as well as some of the components of integrated system management (i.e. COA accounts and AFRP actions). An initial version of the expanded tool could be ready within two months (i.e. April 1). Testing of the tool by members of the DNCT team,

and any necessary modifications, could then be made throughout the year as the 1999 EWA operations are explored and evaluated.

Proposed Tasks

We can organize our cooperative efforts with a sequence of tasks that may be pursued concurrently, with feedback and course corrections provided at the weekly meetings. Here is an initial list of these necessary tasks.

- Data support. A standardized database of both monthly and daily hydrologic and fisheries information is needed to interface with the simulation tool. The hydrologic and operation data will be easier to collect and organize than the water quality (i.e., salinity and temperature) or biological data.

- Monthly hydrologic forecasting, delivery scheduling, and project planning procedures should be accurately included in the simulation tool. This task should include the water district's local as well as CVP and SWP planning procedures.
- Each tributary basin and major delivery area should be accurately simulated with realistic monthly planning procedures as well as daily operations constraints and objectives. These monthly and daily rules can be obtained from historical records and by discussion with current operations staff. The tool should simulate each tributary and delivery area with compatible rules, but these could be developed by several individuals working cooperatively.

- The rules and procedures for the EWA should be formulated to match the current planning and operations procedures. A small team can provide suggestions for how the accounting of EWA operations should be simulated.

- Another samll group can investigate the graphics and interactive adjustments (i.e. user interface options) that will be allowed with the tool to demonstrate and evaluate the EWA.
- Another group can develop the programming or spreadsheet format for the tool. It is possible to use spreadsheets to explore potential tool features that are then programmed (i.e., C++) in a final version of the tool.

Ron. This is included for your budgeting purposes. More money would be needed to continue working with the tool throughout the year to demonstrate and evaluate EWA

scenarios.

A rough estimate of the staff time required for this initial effort to develop a working version of the simulation tool is given below. The consultant team cost for this initial effort would be approximately $65,000. Continuing support for evaluation of EWA operations would be additional.

Agency staff contributions:	
DWR Planning Staff (i.e. DWRSIM/CALSIM experience)	40 hr/week for 10 weeks
DWR SWP Operations Staff	20 hr/week for 10 weeks
CVP Operations Staff	20 hr/week for 10 weeks
CVPOC and CDEC (Historical Data) Staff	20 hr/week for 10 weeks
CALFED consultant team:	
Senior water resources engineer	30 hr/week for 10 weeks
Environmental scientist	30 hr/week for 10 weeks