STATE OF CALIFORNIA -- THE RESOURCES AGENCY **GRAY DAVIS,** *Governor*

DEPARTMENT OF WATER RESOURCES
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March 24, 2003

Mr. Arve R. Sjovold
Citizen's Planning Association of
Santa Barbara County, Inc.
916 Anacapa Street
Santa Barbara, California 93101

Dear Mr. Sjovold:

Thank you for your comments of October 21, 2002, on the Draft State Water Project Delivery Reliability Report. We welcome the interest this draft report has generated and are pleased to provide a response to your questions and concerns.

The Department of Water Resources released the report to assist local water and planning agencies and the State Water Project contractors in meeting the requirements of Senate Bills 221 (Chapter 642, Statutes of 2001) and 610 (Chapter 643, Statutes of 2001). These laws link certain land-use decisions with the determination of local water supply sufficiency. For the 29 SWP water contractors and the many water agencies receiving water from them, information contained in the report is an important component of the analyses necessary to determine this sufficiency. The SWP Delivery Reliability Report provides the SWP contractors and the general public with the best information available on the delivery ability of the SWP.

Your comments focus on the adequacy of the analytical methods used to develop the information contained in the report. In particular, you state the computer simulation model used to develop the information, CALSIM II, should be calibrated against the historical record. The Department has undertaken an evaluation of the adequacy of CALSIM II for estimating SWP delivery ability. It consists of a simulation of a recent drought period, a simulation of a longer historic period, a sensitivity analysis of the key parameters of CALSIM II, and a peer review conducted by the CALFED Science Program. Attachment 1 describes the study and results of the comparison of CALSIM II results with actual SWP deliveries for the most recent drought period (1987-1992). Attachment 2 describes the historical project operations study. The sensitivity analysis and peer review are expected within the year. Information on the evaluation will be posted on the web (http://swpdelivery.water.ca.gov) as it becomes available. Responses to the other specific comments you have provided are contained in Attachment 3.

DWR plans to finalize the SWP Delivery Reliability Report in the near future. We recognize that this is an ongoing process and plan to revise the report frequently. We commit to involving the public in the discussions and analyses regarding the sufficiency of CALSIM II. In addition, we encourage the exploration of alternative methods of evaluating SWP delivery ability or different ways of using CALSIM II for this evaluation. DWR is committed to working with all interested parties and the Modeling Work Group of the California Water Plan Update 2003 with the expectation that the next report will be improved and have greater support.

Your letter, as well as all others commenting on the draft report, and the corresponding responses will be included in an appendix to the final report. In addition, they are posted on the State Water Project Delivery Reliability Report website (http://swpdelivery.water.ca.gov).

Thank you for your comments. If you wish to discuss this further, please call me at (916) 653-1099. For technical information, please contact Francis Chung, Chief of DWR's Bay-Delta Office Modeling Support Branch, at (916) 653-5924.

Sincerely,

Katherine F. Kelly

Katherine F. Kelly, Chief
Bay-Delta Office

Attachments

CALSIM II Evaluation

DWR's Bay-Delta Office is currently undertaking a "historical project operations study" to investigate the accuracy of the model's water supply estimates. The purpose of the historical project operations study is to compare CALSIM II results with historical operations and investigate the source of any differences in historical and simulated performance. The historical project operations studies is part of a larger CALSIM II evaluation process. Other components of this evaluation will include a survey of stakeholders; a model peer review by leading academics and practitioners; and a sensitivity analysis on model inputs and parameters. Initial results from the historical project operations study are expected to be available by March 2003.

The historical project operations study, conducted by DWR will compare CALSIM II model results to recent historical operations for water years 1975 to 1998. This 24-year period includes both the 1976-77 and 1987-92 droughts. It also includes water year 1998 that is one of two years for which detailed analysis of historical water supply and demand is being conducted as part of the California Water Plan Update (Bulletin 160-03).

For the historical project operations study, input to the current CALSIM II model will be changed to reflect historical conditions. The inflow hydrology will be revised to reflect historical rather than current or projected level of development. Demand will be calculated for the historical land use, based on DWR's land surveys and county commissioners' reports, rather than a fixed level of development. Project contracts and entitlements will be changed to their historical level. Lastly operation logic will be changed to reflect the changing regulatory base line such as the release of the State Water Resources Control Board 1995 Water Quality Control Plan and State and federal biological opinions for Delta smelt and Chinook salmon.

The study will be limited in geographical scope to a dynamic operation of the Sacramento Valley, the Delta, and CVP-SWP facilities south of the Delta. Delta inflows from the San Joaquin Valley and the East Side Streams will be fixed at their historical level. In dry years when the system is system is supply limited, the SWP target demands (including North Bay Aqueduct and Coastal Aqueducts) will be set equal to the historical requests. In wet years when the system is demand driven, target demands will be set equal to historical deliveries. Similarly for the CVP historical requests or annual contract amounts will be an upper bound on CVP deliveries.

Modeling of the CVP-SWP system and areas contributory to the Sacramento-San Joaquin Delta requires considerable input data. The majority of the data relates to either system inflows or demand data for the 73-year period of simulation. As described in page 7 of the report, DWR has committed to undertake a sensitivity analysis on SWP water delivery reliability. This analysis would examine the effects of certain assumptions, parameters and input data on model results. The aim of the sensitivity analysis is to identify the input data that most strongly affect model results so that future

work within the Department can be focused on refining estimates of these key determinants.

The current representation of groundwater in CALSIM II is only a first step towards developing a fully integrated groundwater surface water model. The Department is currently developing the Central Valley Groundwater Surface water Model (CVGSM) with the eventual aim of linking this model to CALSIM II to study impacts of surface water operations, groundwater pumping and land use change on groundwater elevations. The current groundwater model component of CALSIM II affects surface water operations through the calculation of the stream-groundwater interaction. There is considerable uncertainty about the magnitude of this interaction. In areas with high groundwater levels, groundwater inflow to streams is a function of groundwater head. In areas of low groundwater elevation where stream seepage flows to the groundwater, there is an assumed hydraulic disconnect between the stream and the aquifer so that seepage is independent of groundwater elevation. It is acknowledged that groundwater elevations are not accurately modeled in CALSIM II. As calculated by CALSIM II, groundwater inflows to the stream system in the upper Sacramento Valley average 255 taf/yr. Stream losses to groundwater in the lower Sacramento Valley average 40 taf/yr. This compares with an average annual Sacramento River inflow to the Delta (at Freeport) of approximately 16 maf/yr.

In any discussion on model “calibration” it is important to remember that CALSIM II is a mass-balance accounting model and ***not*** a distributed hydrologic model that simulates a physical process. It is also important to understand that the hydrology development is based on historical gage data. Valley floor accretions and depletions are calculated as closure terms in a hydrologic mass balance calculated for each Depletion Study Area. The accretions represent local ungaged runoff into the stream system and are calculated based on gage data for stream inflows and outflows across the hydrologic boundary and estimates of urban and agricultural consumptive use of applied water within the region. The accretions and depletions also contain all the errors in the mass balance stemming from poor gage data or incorrect estimates of groundwater extraction or agricultural and urban water use. True calibration techniques can only be applied to a few components of the CALSIM II model, such as the Artificial Neural Network used for determining flow-salinity relationships in the Delta and the multi-cell groundwater model.

Comparison of Historical and CALSIM II Deliveries for 1987-1992

As explained on page 6 of the draft report, past deliveries cannot accurately predict future deliveries. There have been continual, significant changes in the factors that determine State Water Project water delivery, including water demand. SWP Water contractors' requests for water have increased in recent years and 2001 is the first year that requests exceeded 4.0 million acre-feet per year (as shown in the attached Figure 1).

The 2001 model study used for the draft report assumes that current water-use conditions, including water demands, exist for each year analyzed in the 73-year model study. Since the 2001 model study includes water demands that are significantly higher than historical levels, modeled water deliveries often exceed historical deliveries. One exception to this would be during dry periods because supply, not demand, determines the amount of water delivery.

Historical values for SWP Table A deliveries from the Delta have been compared to the Table A delivery values of the 2001 model study for the dry period of 1987 through 1992 to assess how well CALSIM II simulates supply-limited conditions for a recent period. This comparison requires three adjustments to be made for the results to be comparable. One adjustment is made to the historical delivery data and two are made to the conditions assumed for CALSIM II.

The historical delivery data are adjusted to be comparable to the model results as follows. Historically, a portion of the annual water allocation is carried over in SWP storage facilities and delivered in the following year. The CALSIM II model does not currently have criteria and procedures to allow carryover of allocated water from one year to the next. To make the historical data comparable to model data, the historical Table A delivery data was adjusted to show all the "carryover water" being delivered in the year of allocation rather than the following year. The adjusted historical and 2001 model study deliveries for the 1987 through 1992 dry period are compared in Figure 2.

The modeled average delivery for this period is 1,670 taf/yr compared to the historical average of 2,030 taf/yr in CALSIM II format.

The two adjustments made to CALSIM II are 1) changing the regulatory requirements for Delta operation to match the ones in place during 1987-92, and 2) adjusting the reservoir storages at the beginning of the period to match those that actually existed at that time.

The 2001 model study in the draft report includes regulatory constraints that were not applicable to the 1987-1992 period (State Water Resources Control Board Decision 1641). For comparison purposes, a special 2001 model study was completed with the regulations that were in effect at that time (Decision 1485). As shown in Figure 3, this study produces higher SWP deliveries than the original study with the D-1641

constraints. The study's modeled average delivery for this period is 1,910 taf/yr, compared to the average of 1,670 taf/yr for the original study. A comparison of the revised study results with the historical deliveries is shown as Figure 3.

Modeled SWP demand for 1986, a wet year just before the dry period, is 3,345 taf compared to the historical request of 2,364 taf. As a result of this higher model demand, modeled SWP storage at the beginning of the dry period is approximately 420 taf lower than the historical SWP storage. The modeled storage at the end of the dry period is essentially the same as the historical value. There is, therefore, an additional 420 taf of supply that would have been delivered in the model and the CALSIM delivery amounts during the dry period should be adjusted accordingly. To adjust for the 420 taf difference in storage, 70 taf was added to the modeled delivery for each of the six years in the dry period. This adjustment raises the average model delivery for the dry period to 1,980 taf/yr, 50 taf/yr lower than the historical average of 2030 taf/yr (Figure 4).

Figure 1
SWP Contractor's Table A Request versus 2001 Model Study SWP Table A Demand

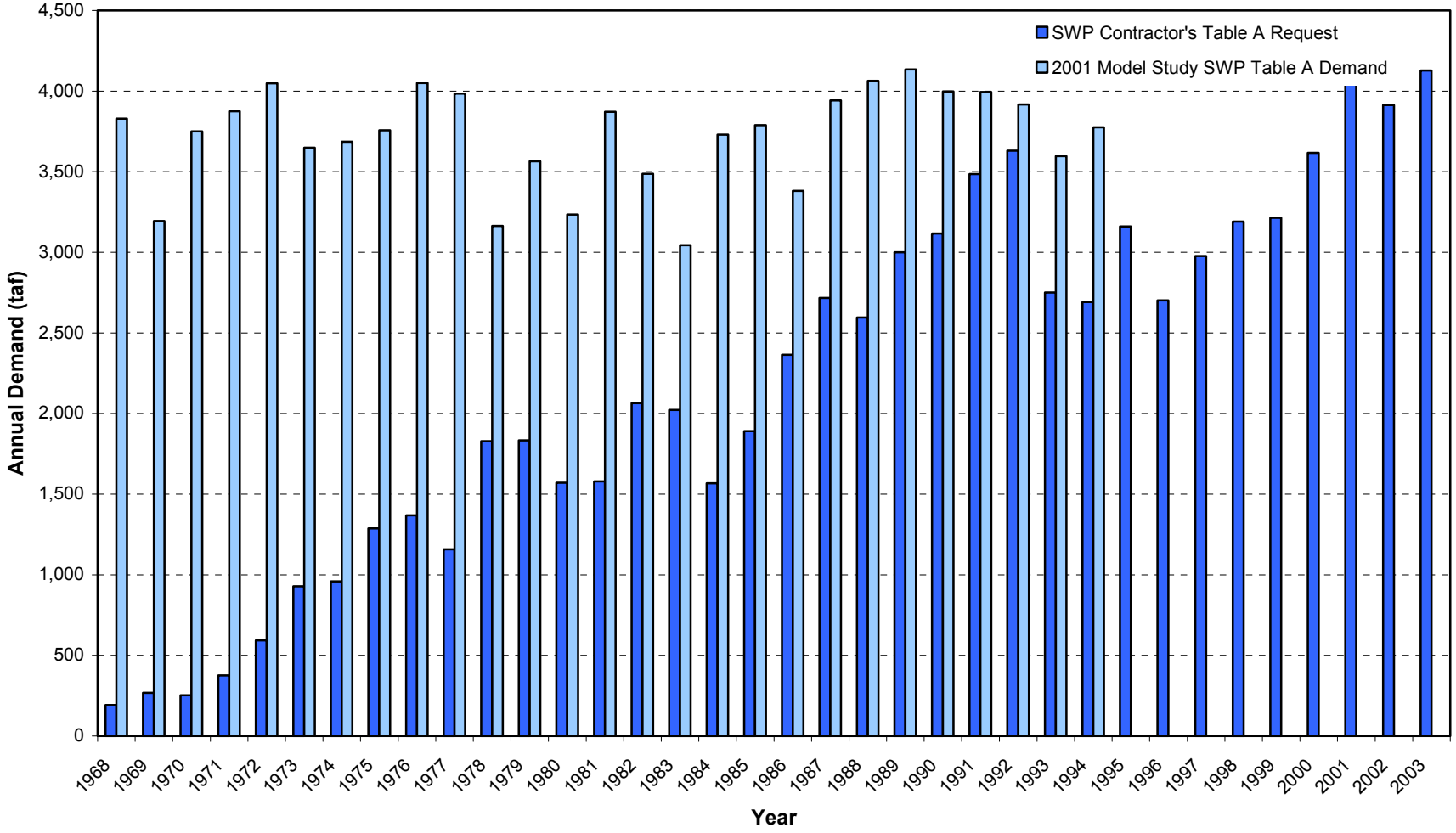


Figure 2
Historical SWP Table A Delivery versus 2001 Model Study SWP Table A Delivery
1987 - 1992 Dry Period

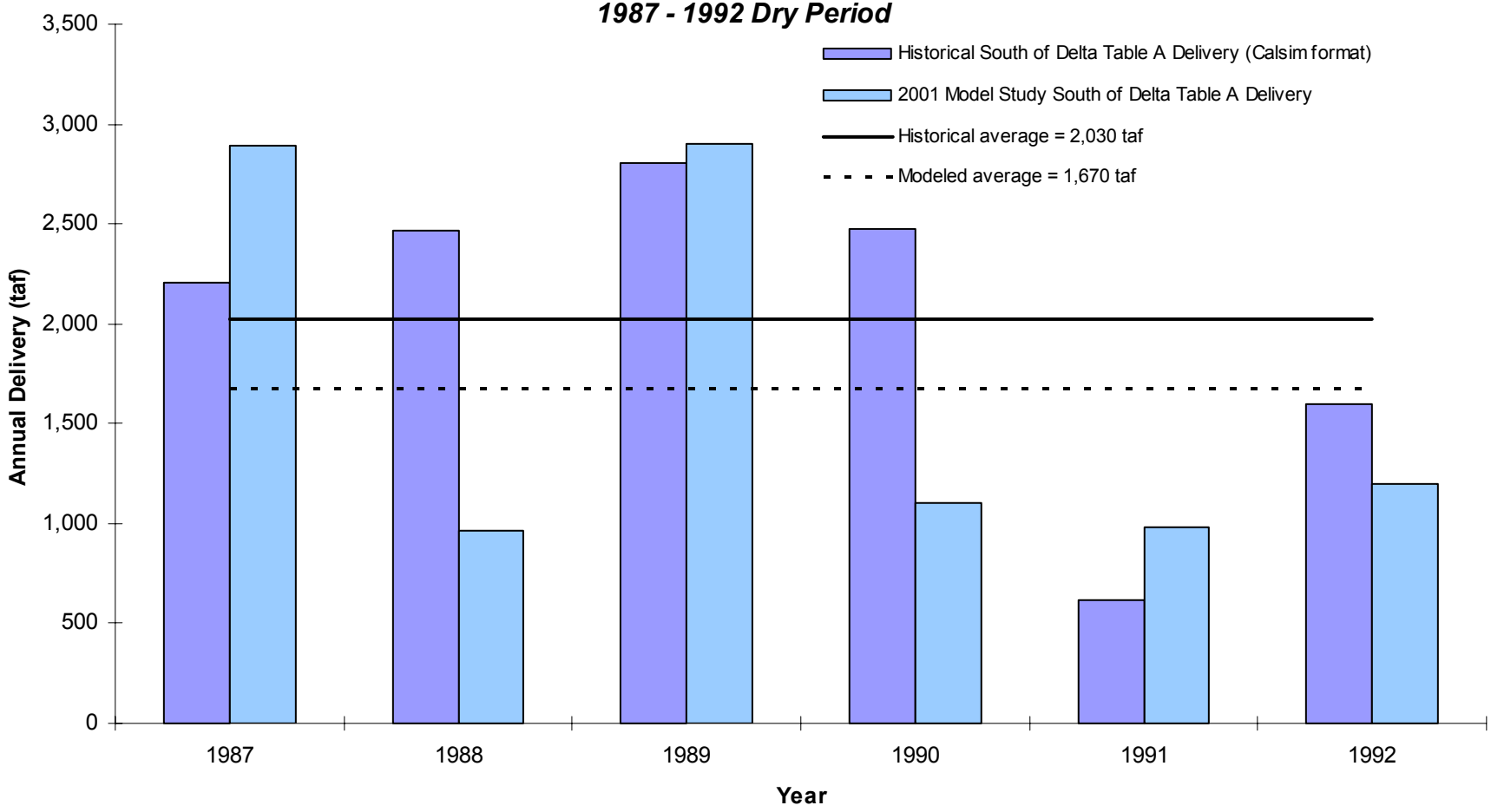


Figure 3
Historical SWP Table A Delivery versus 2001 D-1485 Model Study SWP Table A Delivery
1987 - 1992 Dry Period

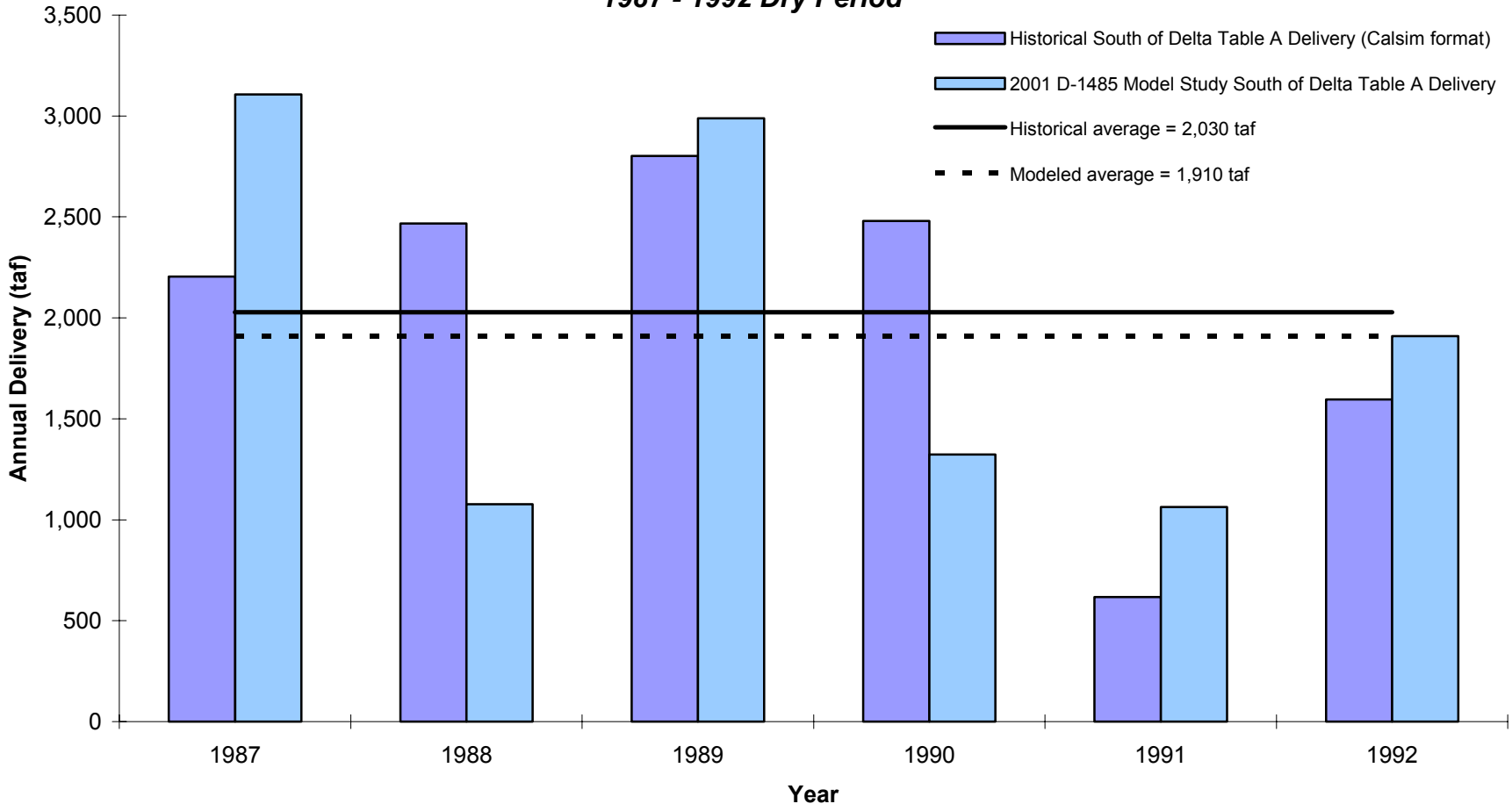
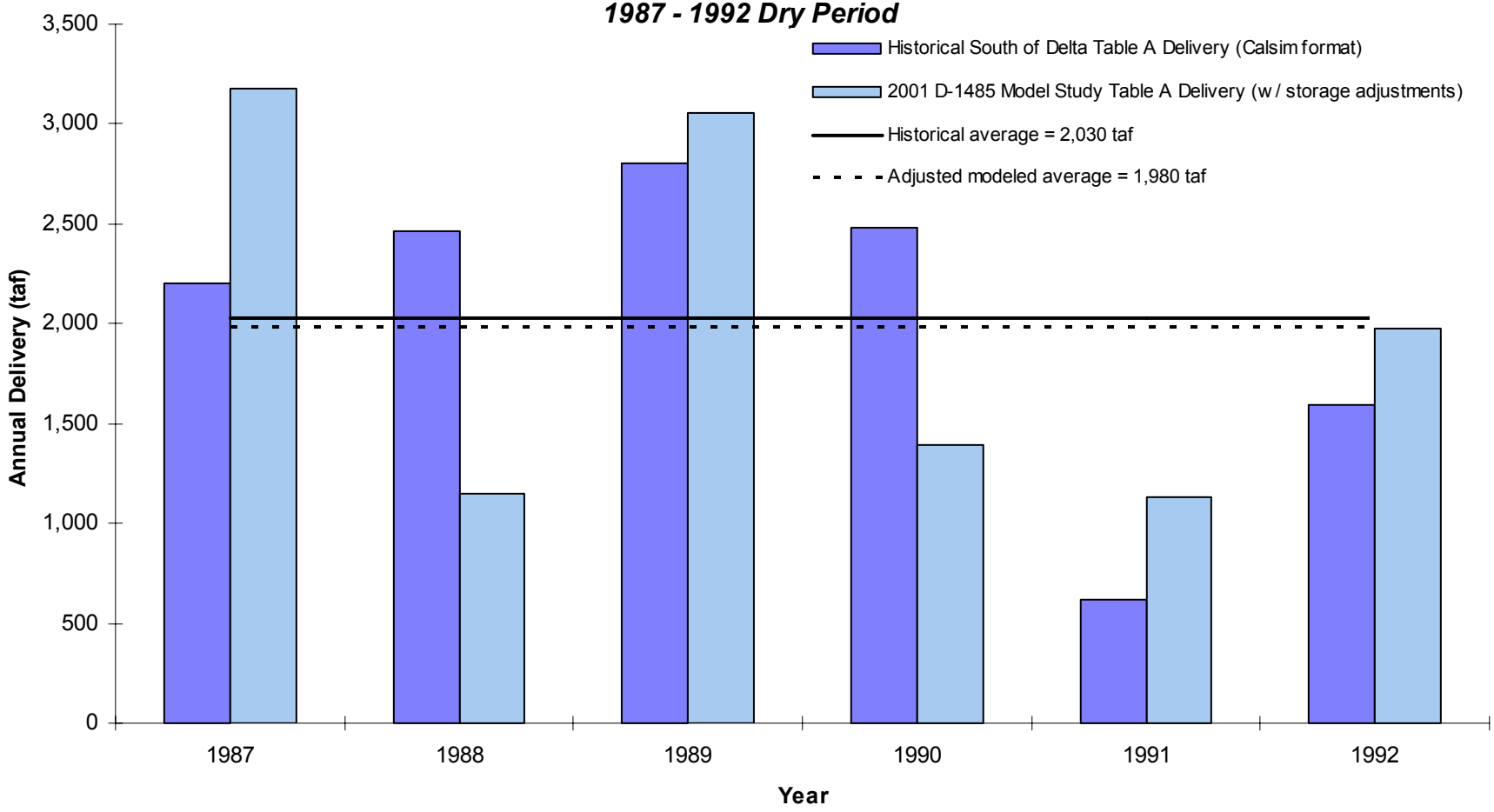


Figure 4
Historical SWP Table A Delivery v. Adjusted 2001 D-1485 Model Study SWP Table A Delivery
1987 - 1992 Dry Period



RESPONSES TO COMMENTS

Modeling of drainage flows from rice fields is not modeled accurately.

DWR's Consumptive Use model is used to calculate irrigation demands for paddy rice for each of the Depletion Study Areas covering the Sacramento Basin. During the growing season rice fields are flooded to control weed growth. In the CU model water applied for flooding in April and subsequent months is treated as a consumptive use. The fields are assumed to be flooded to a depth of nine inches. The water recovered by draining the fields in September is added to the time series of accretions for each basin.

The quantity and timing of irrigation demands represent average planting and harvesting conditions in each DSA. Return flows from rice drainage average approximately 70 taf/yr from a total of 485,000 acres of paddy rice assumed at the 2001 level of development. Over the last few decades there have been substantial changes in the quantities of water diverted for rice production. Applied water demands have dropped as irrigation efficiencies have increased. More recently fall flooding of rice fields for decomposition of rice straw has been adopted as an alternative to burning. Irrigation demands for rice are currently being reviewed and it is anticipated that model demands will be adjusted for the CALSIM II runs required to support the California Water Plan Update 160-03.

Calsim II weights in objective function favor exports.

Operation of the Central Valley Project – State Water Project system must consider a diverse set of objectives that include fishery protection and recreational needs as well as flood protection and water supply. These objectives cannot be quantified in simple commensurate units as required for linear programming. The traditional approach is to include only one objective in the objective function and incorporate all other objectives as constraints set at user-specified levels. In CALSIM II many of the regulatory criteria that govern project operations are modeled as hard constraints that must be met for a solution to be feasible. Other objectives, such as competing contractual water demands and balancing storage between reservoirs are achieved through assigning weights to flows through specific arcs of the network. The absolute value of weights is arbitrary, but their relative size dictates priorities in allocating water. The weights are chosen so that prioritized goals are met sequentially and optimization continues until no further goals can be satisfied without degrading previously satisfied goals. The weight structure in CALSIM II ensures that minimum instream flows and Delta outflow requirements are met prior to water deliveries. The constraint set in CALSIM II ensures that senior water rights and Sacramento in-basin use is satisfied prior to exports. The only sense in which the structure of the LP formulation "favors" exports is that deliveries and storage targets south of the Delta have a higher priority than environmental flows over and above current statuary requirements or discretionary agreements.

The modeling makes an implicit assumption regarding the availability of local storage facilities.

The monthly model demands are based on historical data and information received from SWP contractors. Under some contracts, project water is delivered according to a monthly pattern that assumes the individual contractor will provide local storage facilities when using SWP water to meet local water demand.

An example is provided in the report illustrating how the information could be analyzed for a district that does not have facilities to accommodate its full SWP delivery. (Small Pipe Irrigation District)

Article 21 water should not be delivered in a dry year.

Article 21 may be available regardless of year classification, as long as the four conditions stated in the SWP Delivery Reliability Report are met.

Explain the water delivery categories of carryover and makeup. Where is carryover stored? Where does makeup water come from?

Pursuant to the long-term supply contracts, the DWR has offered contractors the opportunity to carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. The carryover program was designed to encourage the most effective and beneficial use of water and to avoid obligating the contractors to use or lose the water by December 31 of each year. Normally, carryover water is water that has been exported during the year, not delivered to the contractor during that year, and remains stored in the SWP share of San Luis Reservoir to be delivered during the next year.

Deliveries under Article 14B (“make-up” water) are undelivered allocated Table A amounts from the previous year, which may be delivered in the subsequent year, depending on the overall SWP delivery capability. Potential sources of this water are surplus flows in the Sacramento-San Joaquin system, releases from Oroville Reservoir, or storage in SWP reservoirs along the California Aqueduct.