ATTACHMENT B

# The Bay Institute of San Francisco

"Restoring the Bay's ecosystem ... from the Sierra to the sea."

MEMORANDUM

July 7, 2000

TO: CALFED Policy Group

FR: Christina Swanson, Ph.D., Fisheries Scientist, The Bay Institute

RE: Key Concerns with Proposed Environmental Water Account



CALFED's Framework for Action (June 9, 2000) relies heavily on the proposed Environmental Water Account (EWA) as the primary tool for protecting endangered fish species in the Delta, and as the primary vehicle for managing environmental water. Specifically, CALFED asserts (p. 22) that "the EWA will provide water for the protection and recovery of fish" including that needed to satisfy Endangered Species Act (ESA) take requirements.

Based on CALFED's own gaming exercises (i.e., interactive computer modeling exercises), these assertions do not appear to be justified. Our review of the gaming results shows that:

1. Implementing the EWA, in conjunction with increased export pumping for consumptive uses, resulted in levels of take (i.e., fish salvage) of endangered species in excess of historical levels and ESA take limits in a number of years.

2. These increased endangered species take impacts were directly attributable to levels of export pumping well in excess of historic export levels or even the 1995 level of demand.

3. Dry year benefits to endangered species seen in the gaming exercises were largely attributable to existing regulatory protections (i.e., Water Quality Control Plan [WQCP] and other baseline standards), while wet year benefits of the EWA mostly mitigated for new impacts of CALFED's proposed export pumping increases.

4. Implementing the planned future export regime, even as modified by the EWA, failed to achieve CALFED's targets for augmenting Delta inflows and outflows and, in most years, could create significant unforseen impacts from large scale reductions in Delta outflow.

5. The EWA, as modeled to date, does not adequately incorporate CALFED's proposed adaptive management approach, which relies on use of multiple indicators of ecosystem health, hypothesis testing, monitoring and performance assessment, and flexibility in choosing between various management measures.

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**Impacts on endangered species are not mitigated but increased over historical levels under the EWA**

In the Framework, baseline environmental protection (Tier 1) is to be provided by the Biological Opinion for winter-run chinook salmon, portions of the Biological Opinion for delta smelt, the WQCP, and b(2) water from the Central Valley Project Improvement Act (CVPIA). The EWA is endowed with a water supply (Tier 2) derived from sharing benefits from operational enhancement (e.g., Joint Point of Diversion, JPOD) and existing regulatory flexibility (e.g., Export/Inflow ratio flexibility), and purchases. In the event further fish protection actions are needed to satisfy ESA requirements, availability and use of additional assets (Tier 3) is left to the willingness and ability of CALFED agencies to provide.

The Framework states that "it is unlikely that assets beyond those in Tier 1 and Tier 2 will be needed to meet ESA requirements". Our analyses of results of EWA gaming suggest that this is not the case.

The most recent EWA game, Game 6A, simulated the rules, assumptions and assets outlined in the CALFED Framework. In this game (as in most other previous EWA games), ESA take limits for adult delta smelt[1], considered by fisheries scientists to be the life stage most sensitive to adverse population-level impacts from excessive take, were exceeded in at least five of the 14 years modeled (1981, 1982, 1983, 1985, and 1988 during the period 1981-1994). In most of those years (as well as 1993 and 1994), Game 6A salvage exceeded historical levels (Table 1).

Table 1. Historic and EWA Game 6A salvage of delta smelt. Salvage = combined salvage for the Central Valley Project (CVP) and State Water Project (SWP), calculated from fish densities and export rates.

| YEAR and TYPE (W=wet, D=dry) | HISTORIC (#fish salvaged) | GAME 6A (#fish salvaged) | % change from historic | ESA take limit for adult delta smelt exceeded |
|---|---|---|---|---|
| 1981 (D) | 332,609 | 356,718 | 7% increase | yes |
| 1982 (W) | 39,155 | 70,711 | 81% increase | yes |
| 1983 (W) | 16,656 | 27,131 | 63% increase | yes |
| 1984 (W) | 37,071 | 15,535 | 58% decrease | no |
| 1985 (D) | 31,193 | 21,016 | 33% decrease | yes |
| 1986 (W) | 6,624 | 6,954 | 5% increase | probably no |
| 1987 (D) | 51,749 | 18,237 | 65% decrease | probably yes (late spawn) |
| 1988 (D) | 83,842 | 23,421 | 72% decrease | yes |
| 1989 (D) | 21,178 | 12,068 | 43% decrease | no |
| 1990 (D) | 56,695 | 18,067 | 68% decrease | no |
| 1991 (D) | 20,819 | 11,357 | 45% decrease | no |
| 1992 (D) | 5,397 | 3,005 | 44% decrease | no |
| 1993 (W) | 29,706 | 33,696 | 13% increase | no |
| 1994 (D) | 40,482 | 61,809 | 53% increase | no |

[1] Take limits for delta smelt are calculated on a monthly basis and vary with population abundance, season, and water year type. For these analyses take limits were calculated and applied to Game 6A results very conservatively. It is likely that take limits were exceeded in other years not indicated in the Table 1.

Given that historic Central Valley Project (CVP) and State Water Project (SWP) impacts on adult delta smelt in the early 1980s were a major contributor to the population decline[2], these results suggest that the Framework baseline and EWA actions, at least as operated in these games, would be insufficient to satisfy ESA commitments. In the event of hydrological and biological conditions similar to those in 1980-1982, the EWA as it is presently envisioned would be unable to mitigate potentially catastrophic project impacts on delta smelt that could impair their recovery.

Game 6A salvage rates for all other modeled species (chinook salmon, splittail, steelhead, and striped bass) were also greater than historic levels in many years. Results for chinook salmon and splittail are shown below in Table 2. Game 6A salvage of striped bass was higher than historic levels in nine of the 14 years modeled, all years except those during the prolonged drought. Steelhead salvage was higher in 1981, 1987, 1993 and 1994.

Table 2. Historic and EWA Game 6A salvage of chinook salmon and splittail. Salvage = combined salvage for CVP and SWP, calculated from fish densities and export rates.

| YEAR and TYPE (W=wet, D=dry) | HISTORIC Chinook Salmon (#fish salvaged) | GAME 6A Chinook Salmon (#fish salvaged) | % change from historic | HISTORIC Splittail (#fish salvaged) | GAME 6A Splittail (#fish salvaged) | % change from historic |
|---|---|---|---|---|---|---|
| 1981 (D) | 142,820 | 82,899 | 42% decrease | 91,068 | 88,472 | 3% decrease |
| 1982 (W) | 436,400 | 529,901 | 21% increase | 327,900 | 683,974 | 109% increase |
| 1983 (W) | 277,794 | 134,946 | 51% decrease | 369,744 | 569,620 | 54% increase |
| 1984 (W) | 288,359 | 134,034 | 54% decrease | 140,075 | 136,019 | 3% decrease |
| 1985 (D) | 308,412 | 168,441 | 45% decrease | 71,726 | 59,092 | 18% decrease |
| 1986 (W) | 1,097,661 | 1,105,383 | 1% increase | 2,416,594 | 1,747,393 | 28% increase |
| 1987 (D) | 273,382 | 67,297 | 75% decrease | 149,812 | 103,554 | 31% decrease |
| 1988 (D) | 230,556 | 63,051 | 73% decrease | 74,113 | 36,600 | 51% decrease |
| 1989 (D) | 131,200 | 61,226 | 53% decrease | 58,480 | 41,345 | 29% decrease |
| 1990 (D) | 57,626 | 18,922 | 67% decrease | 34,183 | 16,208 | 53% decrease |
| 1991 (D) | 68,544 | 24,118 | 65% decrease | 35,803 | 15,805 | 56% decrease |
| 1992 (D) | 65,826 | 58,785 | 11% decrease | 14,481 | 9,937 | 31% decrease |
| 1993 (W) | 27,096 | 30775 | 14% increase | 203,352 | 248,869 | 22% increase |
| 1994 (D) | 12,610 | 14,349 | 14% increase | 2,416 | 4,865 | 101% increase |

Below we discuss several factors underlying the consistently elevated fish impacts and the EWA's inability to effectively reduce them during the early 1980s, 1986, and 1993-1994.

[2] This interpretation is based on our analyses of the relationships among historic take of delta smelt at the CVP and SWP, delta smelt population abundance, and their distribution in the Delta and is supported by results and analyses reported by W. Bennett at the Annual Meeting of the California-Nevada Chapter of the American Fisheries Society, 2000.

**EWA baseline export levels are unrealistic and cause adverse impacts to endangered species**

The EWA is required to operate such that annual water exports, as defined by model base conditions, are not decreased. In effect, the EWA rearranges export schedules rather than reducing exports, using its limited water assets (usually stored in San Luis Reservoir) to insure supply in the face of its actions to temporarily reduce export levels for fish protection purposes. Decreases in game exports from the model base are attributable to b(2) export reductions or the EWA taking on debt and carrying it forward into the following year. When carrying a debt, the EWA was essentially utilizing Tier 3 water assets, but this water debt was always repaid during the following year.

In the EWA games, model base export levels were defined by the DWRSIM model (or, in later games, the CALSIM model), maximizing exports within the limits of available stored water and the WQCP (i.e., E/I ratios, X2 requirements). In Game 6A (Figure 1), baseline export levels exceeded historic levels in all years except some during the 1987-1992 drought, with some years as much as 50% higher. In several years, base exports exceeded 6 million acre feet (MAF) and were substantially higher than the 1995 demand target of 5.5-6 MAF total annual exports.

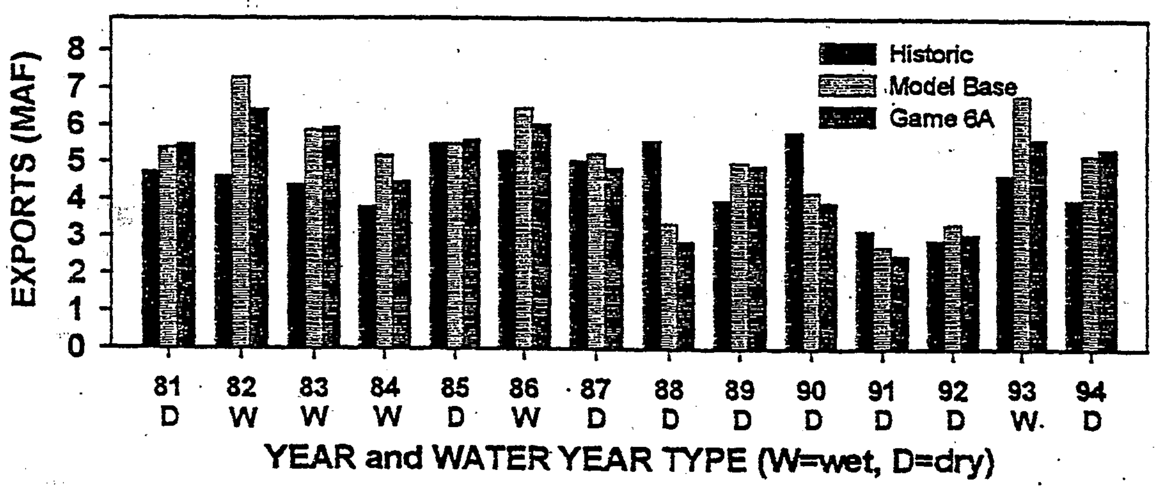


Figure 1. Historic, model base and Game 6A exports (CVP and SWP combined, million acre feet).

While the timely export reductions effected by the EWA undoubtedly provided benefit by reducing salvage (although salvage reductions are almost certainly not as predictable as modeled in the games, see below), these small temporary decreases in salvage were frequently overwhelmed by the large increases in exports, and accompanying elevated salvage rates, at other times. Unrealistically high model base export levels in 1982, 1986, and 1993 contributed to fish salvage at levels higher than historic (and ESA take limits) for delta smelt and for all other species included in the game. In the circumstance of such extreme water export operations and EWA assets as defined by the Framework, the EWA cannot effectively reduce CVP and SWP impacts on protected fishes enough to satisfy ESA regulatory requirements. Rather, in these years, the EWA is incompletely mitigating increased project impacts but providing no positive benefit to the fish or environment.

In contrast to high exports and the necessary but sometimes inadequate efforts of the EWA to reduce pumping impacts demonstrated in wet years, model base export reductions in drought years illustrate the protection afforded to the environment by the WQCP under these conditions (Figure 1). Drought year reductions in exports resulted from E/I and X2 restrictions on pumping, essential to maintain minimal environmental conditions in the Delta and Bay as well as acceptable export water quality, not ESA-mandated or EWA-induced export reductions to protect fishes.

Some have described the EWA as "putting the environment on a budget". Results of EWA gaming and the analyses presented here suggest that this approach will fail unless water exports from the system and their concomitant impacts on fishes and the Delta environment are similarly limited.

**Recommendation**: Increases in export pumping should be limited to levels that do not cause take of endangered species in excess of historical or regulatory levels. Also, rather than limiting the EWA to a fixed size independent of water year type and project impacts on the system, CALFED should consider varying the size of the EWA with the scale of water export operations, for example 8-10% of forecasted exports. The EWA should be described as an experiment that may promote the protection and recovery of endangered fish species if implemented in combination with limited increased use of export capacity and new storage opportunities, and in combination with aggressive implementation of other environmental water management measures.

**Ecosystem restoration actions - beyond reducing salvage**

To date, EWA modelers have not incorporated Ecosystem Restoration Program (ERP) actions (or water assets) into the games. In fact, in some years, EWA actions were contrary to critical ERP actions identified by CALFED, for example enhanced spring Delta inflow and outflow (as water year type-dependent target flow levels and pulse flows) intended to improve both fish abundance and ecosystem functions that support fish populations. In most years, when winter-spring inflows were controlled by reservoir releases, model base and EWA actions tended to reduce Delta inflow, retaining stored water upstream, in concert with reduced exports for fish protection. This combination of actions satisfied WCQP requirements but effectively deprived the Delta and Bay of ecologically important winter and spring freshwater flows. While in most years, some b(2) water was released for enhanced upstream flows, it was usually subsequently exported by the CVP and SWP, thus producing some water assets for the EWA (as now defined by the Framework) but also providing little benefit to Delta or San Francisco Bay habitats.

On an annualized basis, Delta outflows were reduced by as much 5 MAF per year (up to 12%) in wet years (1981, 1982, 1983, 1984, 1985, 1986, 1987, and 1994). In some dry years, WCQP flow requirements functioned to enhance Delta outflow (relative to historic water management operations), but by substantially lower amounts (0.6-1.6 MAF). During the 14-year period modeled, Delta outflow was reduced by nearly 13 MAF (a 5% decrease from historic levels). For many Delta and Bay species, population abundances are correlated with outflow (and the location of X2, particularly during the February-June period). Impacts of further reducing freshwater outflow on in-Delta and downstream Bay habitats and biota (e.g., herring, Dungeness crab) are not certain but, given the scale of projected reductions, are likely to be significant.

One explanation for EWA's narrow approach is the relative difficulty quantifying environmental benefit from these actions compared to calculated reductions in fish salvage. However, to be consistent with CALFED's ERP, enhanced upstream flows (coupled with reduced exports as necessary) that result in increased Delta outflow should be considered as WMS and EWA actions with beneficial impacts on fishes and habitat. Independent of the efficacy of the EWA to reduce fish salvage, a larger ecosystem-level approach will be necessary to ensure sufficient progress toward ESA and ERP goals, achieve maximum efficiency between upstream and in-Delta actions, and secure synergistic environmental benefits.

**Recommendation:** Any CALFED assurances should be linked to achieving instream flow and Delta outflow objectives (which provide numerous benefits for both anadromous and Delta resident endangered fish species), to providing sufficient amounts of water to help do so, and to securing full funding for all ERP actions that benefit endangered species.

**Recommendation:** CALFED should evaluate potential effects on in-Delta and downstream Bay habitats and biota before allowing large-scale increases in use of export capacity and storage that would significantly reduce outflows.

**The EWA modeling exercises are useful but may be inaccurate**

In EWA games, the large changes in water management operations associated with a) WQCP requirements; b) increased levels of export; and c) EWA-induced shifts in exports had substantial predictable and quantifiable effects on in-Delta and upstream flows. For example, during the winter-spring period when the EWA typically reduced exports to protect priority species like winter- and spring-run chinook salmon and adult delta smelt, the CVP and SWP held back stored water in upstream reservoirs. This resulted in reduced winter-spring Delta outflows and increased summer-fall outflows, frequently a striking change from the historic hydrograph.

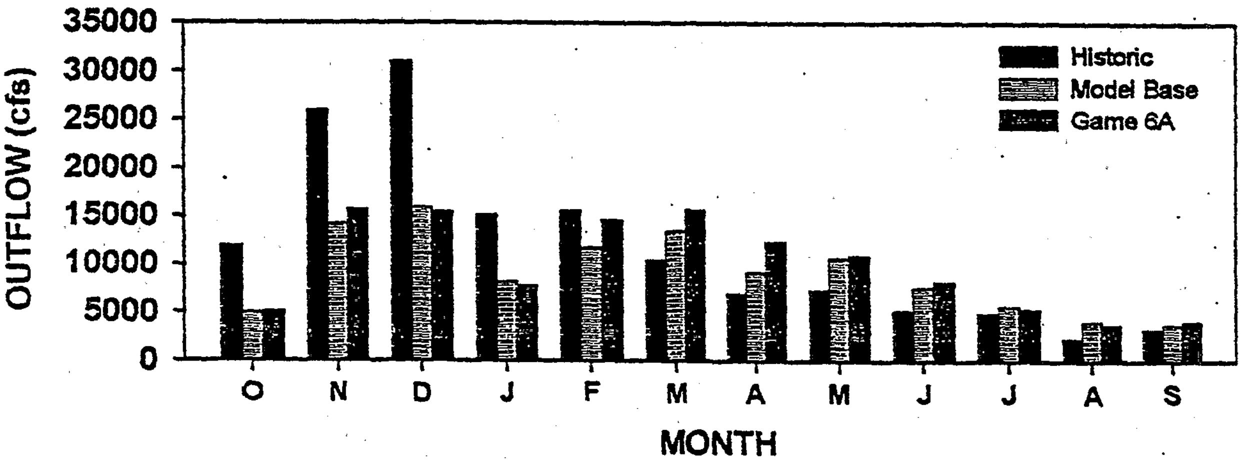


Figure 2. Historic, model base and Game 6A Delta outflow for 1985.

Figure 2 shows Delta outflow for 1985, a dry year in which historic and Game 6A annual exports were similar but, because of baseline requirements and EWA actions, had a substantially different historic and modeled patterns. In this year, the WQCP and EWA actions functioned to improve

Delta outflow during the critical spring period while halving winter outflow rates but, for most of the year, the model base- and EWA-generated Delta hydrographs differed substantially. However, with some exceptions (e.g., relationship between X2 and Delta outflow) ecological consequences of such hydrologic changes, including effects on fish density near the pumps and thus calculated salvage rates, are unknown and have not been incorporated in EWA models. Therefore, calculation of fish salvage rates using historic fish densities could be inaccurate estimates of project impacts.

During gaming, EWA operators relied on a template of actions dictated by historic conditions, for example, a winter export reduction to protect adult delta smelt that were historically near the pumps at this time. Such focused management approaches based on historical fish distributions cannot adequately take into account the effects of other previous or contemporaneous actions, for example, Delta outflow reduced from historical levels and consequent possible shifts in fish distribution within the Delta (although calculations of delta smelt salvage were slightly modified to account for shifts in X2). The larger the magnitude of the baseline- and EWA-induced change in the system hydrology from historical conditions, the more problematic extrapolation of EWA effects on the games' most relied upon quantitative indicator of environment protection, fish salvage, becomes.

In addition, CALFED gaming exercises relied on perfect knowledge of conditions and did not reflect the uncertainties and choices that will be faced by EWA mangers in the real world.

**Recommendation:** CALFED should test the efficacy of the EWA in reducing endangered species take during Stage 1 before making any findings that the EWA, in conjunction with planned future export regimes, will promote protection and recovery.

**The EWA is an experiment, not a sure thing**

CALFED has emphatically proclaimed its dedication to an adaptive management approach for the ERP (and other CALFED programs), with extensive experimentation, hypothesis testing, monitoring, analysis, and responsive management as dictated by program results. The unavoidable uncertainties regarding ecosystem and fish responses to EWA management actions discussed above underscore the necessity that the EWA be operated adhering to these principles. Like the rest of CALFED's programs, the EWA should be considered an experiment and not as a proven tool that can be used as the basis for assurances that assume that endangered species will be protected.

The current level of ecosystem and water quality protections in the Delta are provided by the combination of the WQCP's export and flow requirements, which have greater impacts in dry years, and the constraints of the existing water supply infrastructure on diversion, which limit exports in wet years and result in in-Delta and upstream flows in excess of direct regulatory requirements. The EWA, operated in concert with CVPIA b(2) water, is a valuable and potentially effective water management and ecosystem restoration tool, eminently suited for informed, responsive adaptive management. It is not equally effective in all years and should be used in combination with other environmental water management tools.

For example, EWA actions (Tier 2) are most important in wet years, using timely export reductions to protect fishes during critical periods when they are subject to the influence of the pumps. Unfortunately, under the Framework approach these wet year benefits of an EWA are often used simply to mitigate for increased export pumping.

In contrast, non-EWA (Tier 1) actions mandated by the WQCP are most beneficial to the environment in dry years and prolonged droughts, protecting the ecosystem, fishes, and water quality by requiring minimal outflows (usually by restricting exports under circumstances of low inflow). Unfortunately, the exclusive emphasis on banking assets for the EWA lessens the likelihood that water and money will be used to augment flows above minimum regulatory requirements in dry years.

**Recommendation:** Effective and responsive operation of the EWA will require coordination with CALFED and other member agency programs, including ERP, CVPIA (and the Anadromous Fish Restoration Program, AFRP), VAMP, ESA and water quality programs. Therefore, control of upstream, Delta and service area environmental assets and EWA operations should be combined in one environmental management program, be linked to achieving both ERP and ESA objectives, and be under control of one ecosystem manager.

**Recommendation:** The EWA's effectiveness for reducing project-related impacts on the Delta and greater watershed should be evaluated using multiple indicators, including those for ecosystem function and habitat quality, as well as on the basis of salvage rates. Specific hypotheses regarding the efficacy of the EWA to reduce export impacts on endangered species should be articulated and tested using this approach. Finally, CALFED needs to better articulate how it will respond if fish population declines continue or other measures of ecosystem health are not achieved.