

**CALFED Science Program Lead Scientist and Environmental
Water Account Agencies¹ Joint Response to 2006 Environmental
Water Account Technical Review Panel Report**

¹EWA Agencies are the California Departments of Water Resources (DWR) and Fish and Game (DFG); U.S. Department of the Interior, Bureau of Reclamation (USBR) and Fish and Wildlife Service (USFWS); and U.S. Department of Commerce, National Marine Fisheries Service (NMFS)

This year's Joint Response to the Panel has two parts, (A) an historical overview of Panel findings requested by the CALFED Interim Science Board (ISB) at its February 2007 meeting, and (B) a detailed response to the 2006 Panel recommendations and the Panel comments on the Resources Agency Action Matrix.

PART A. INTRODUCTION AND HISTORICAL SUMMARY

The CALFED Science Program Lead Scientist (Lead Scientist) is responsible for evaluating the Environmental Water Account (EWA) each year. The Lead Scientist assembled an EWA Technical Review Panel (Panel) of independent experts to conduct a review annually from 2001-2004, and biennially starting in 2006. The 2004 Panel recommended reducing the frequency of review to every other year to allow more time for accumulation of scientific knowledge. This recommendation was implemented, so there was no EWA Panel Review in 2005.

To some degree, the Panel findings in any given year were influenced by the charge provided by the Agencies and Science Program, which varied somewhat from year to year. Nonetheless, there are seven "recurring themes" that we have extracted from the 2001-2006 Panel reviews. These recurring themes provide the basis for the historical overview requested by ISB. They also provide insight into the successes and limitations of seven years of EWA implementation.

I. Review Panel Themes

Theme 1 - Environmental water acquisition and water supply reliability: The Panels consistently provided positive comments regarding the logistic implementation of EWA.

- 2002: "Once again the EWA completed a difficult schedule of water purchase, storage, allocation, and carry-over to meet environmental requirements, and did so in a year of below average runoff."
- 2003: "The process of acquiring water for the EWA continues to be one of the most effective elements of the program. The Panel was favorably impressed with this year's efforts to diversify resources in a creative manner and to develop models of acquisition, storage, and debt."
- 2004: "The EWA has done an effective job of assuring water supply reliability to the water contractors, while concomitantly providing an acceptable level of fish protection. The level of fish protection achieved is likely at a higher level than could have been attained by fixed standards."

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- 2006: “The EWA Program continues to assure reliability of water supplies to water users.”

Theme 2 - The resolution of conflict between Agencies and stakeholders: The Panels consistently provided positive comments about the level of collaboration involved in EWA implementation and evaluation.

- 2001: “The cooperation and collaboration between agency biologists and project operators is a highlight of the first year that has broad, positive implications for the subsequent years of the EWA. We were also encouraged by the involvement of stakeholders in the process of managing water in California.”
- 2002: “The most immediate sign of improvement has been a reduced level of conflict, and in the words of another stakeholder, a more effective means of channeling competition.”
- 2003: “...through a combination of favorable natural system features and allocation of EWA (and other) water, fish crises in the Delta were avoided during the past year. We commend the efforts of the EWA team, particularly given the tight budget and personnel challenges they faced during the past year.”
- 2004: “As an experiment in organizational and management policy change, the EWA is unquestionably successful. Agencies and stakeholders feuding over how to protect endangered fish now work together in real time collaborations to provide water for fish protection.”
- 2006: “The efforts to include the public in the full range of EWA activities from annual workshops and reviews to weekly meetings on technical issues, water negotiations, and environmental compliance is highly commendable and has no doubt contributed to the operational success and acceptance of the program.”

Theme 3 - The need for EWA performance measures: The Panels consistently noted the need for strategic planning in their first review, and the likelihood of increased scrutiny on the EWA if it transitioned into a long-term program. The Panel repeatedly suggested that EWA performance measures were necessary.

- 2001: “A strategic plan for learning and adapting as the EWA proceeds was not described to the Panel. The Panel feels strongly that such a plan is necessary and critical to the successful evolution of an adaptive management process such as EWA, because flexibility in EWA management is fundamental to learning about, and protecting Delta fish stocks.”

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- 2002: “The Panel recommends that EWA define the measures that will be used to evaluate the biological performance of EWA actions.”
- 2004: “At some point in the future it seems likely that the issues of overall efficacy and cost effectiveness of the EWA will emerge. While EWA is a small fraction of overall water project costs, the program is expensive to the taxpayers and operators who may share costs. Moreover, the state is a major participant in California water markets. Because competition drives up water prices, other buyers may raise questions. The Panel continues to be concerned about the extent to which the EWA can be held accountable for contributing to fisheries recovery.”
- 2006: “The panel encourages the development of general EWA performance measures and specific EWA performance measures that are linked to critical life stages of the salmonid and pelagic organisms of the Delta.”

Theme 4 - The need to develop life cycle models for target fishes: The Panel consistently suggested that fish life cycle models were necessary to scientifically evaluate the biological performance of EWA.

- 2001: “Improving the effectiveness of the EWA to protect fish species will require a better understanding of the life cycle of these species and the indirect mortality factors associated with water export and Delta hydraulics.”
- 2002: “The Panel firmly advocates the use of a life cycle basis for biological measures of performance. Life cycle analyses would enable the various EWA actions to be expressed in a common metric, such as population responses in adult-equivalents, recruitment rates, and total egg production (as a measure of spawning stock). Life cycle analyses would also allow for measures of performance that reflect the stochastic nature of fish population dynamics.”
- 2004: “As we have stated in each of our previous reviews, the Panel believes strongly that population models can play an important role in understanding the impacts of entrainment or, equivalently, the population-level benefit of preventing entrainment by EWA actions.”
- 2006: “There are several ways to improve the quality of data collected relative to its quantity, and the recommendations of the Panel fall into three general areas: 1. Focus on needs identified during development of population models to elucidate cause and effect, and to inform the models...”

Theme 5 - The need for a dedicated multi-disciplinary EWA staff: the Panels consistently recommended that it was advisable to develop a multi-disciplinary EWA Agencies are the California Departments of Water Resources (DWR) and Fish and Game (DFG); U.S. Department of the Interior, Bureau of Reclamation (USBR) and Fish and Wildlife Service (USFWS); and U.S. Department of Commerce, National Marine Fisheries Service (NMFS)

science team that 1) was dedicated to answering EWA science questions, and 2) included outside expertise to complement agency staff expertise to determine the biological efficacy of EWA.

- 2001: “The current make-up of the CALFED team is probably inadequate in terms of amount and kinds of expertise to fill needed gaps in knowledge, and the team needs to be strengthened.”
- 2002: “...the Panel feels strongly that these critical research activities will have the best chance for success if they significantly incorporate the efforts of scientists and engineers outside the MAs and PAs.”
- 2003: “...the Panel strongly recommends that creative ways to address the many scientific challenges facing EWA be fully explored. The Panel was disappointed that, in spite of the critical importance of these scientific issues, relatively little progress had been made on marshalling resources and people to do the work.”
- 2004: “It seems clear that suggestions by the Panel in past years with respect to carrying out new research that needs to be done to provide the needed scientific information have yet to bear fruit. It is equally clear that staff resources (people and expertise) do not exist within the agencies to accomplish what is needed.”
- 2006: “Staff and funding for EWA related research and analysis is diffuse and too small.”

Theme 6 - The need for systematic water program integration: The Panels sometimes noted the successful, but informal and “opportunistic” integration of sources of environmental water by Agency managers. However, there was also a consistent recommendation to formally integrate various CALFED programs (e.g., ERP and EWA) and federal environmental water programs (e.g., CVPIA b2).

- 2001: “Presentations to the Panel suggested that the project agencies are working to ensure that EWA water is properly credited against pumping restrictions and that the management agencies recognize the importance of coordinating EWA, ERP, and other sources of environmental water. More attention, however, can be devoted to both tasks.”
- 2002: “...we encourage the CALFED Science Program leadership to search for an institutional mechanism to enhance communication among all programs designed to manage living resources...”

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- 2003: “As identified in the first and second EWA reviews the Panel again stresses the need for better integration of EWA with other CalFed programs.”
- 2004: “The Panel recommends that a systematic approach to program integration be considered. Programs with similar goals such as the ERP and EWA or that may overlap in their roles such as EWA, EWP and the CVPIA Water Acquisition Program should be reviewed and a strategy for developing a synergy among these programs and their goals considered.”
- 2006: “The Panel endorses the idea of viewing environmental water from all sources together as a common pool. We encourage efforts to waive or remove, as much as possible, institutional barriers that hinder the pooling of environmental water from among the different sources.”

Theme 7 – Need for EWA-specific monitoring and a budget for EWA experiments: The Panel repeatedly noted that resolving uncertainties regarding the ecological impacts of the EWA required funding that was dedicated to answering critical questions and filling major data gaps.

- 2001: “Ultimately, CALFED will be asked to provide the burden of proof of the science underlying the EWA. CALFED should launch a dedicated research effort to produce a rigorous scientific foundation to guide EWA actions and increase the likelihood of the EWA meeting its goals. Toward this end, the Panel feels strongly that additional resources (personnel and research dollars) should be dedicated to EWA-related research tasks.
- 2002: “Advancing the scientific basis of the EWA necessitates spending money on analyses.”
- 2003: “The Panel is encouraged that the forthcoming PSP will request research directed at the science challenges and that some resources and attention of the agencies have turned toward addressing critical scientific issues.”
- 2004: “The Panel understands that there may be some ability to tailor the call for specific research needs of the EWA in forthcoming Science PSPs. The ability for both general calls for proposals and tailored calls for proposals to address specific needs is a welcomed development. This flexibility, while maintaining the highest standards of peer review, addresses a need expressed by the Panel since the beginning of our reviews.”
- 2006: “...the Panel believes that the improvements in the 2006 review were largely the result of the additional funds made available through

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Pelagic Organism Decline (POD), which reinforces the Panel's recommendations in previous reports that increased funding for research and monitoring was needed and would be beneficial.”

Collectively, the seven recurring themes suggest that the EWA was logistically successful and, at least in the short-term, successful from a conflict resolution perspective. However, the recurring themes also suggest that the pace of scientific understanding on EWA issues proceeded more slowly than the Panels thought it should. As indicated by the following quotes from the 2004 Panel report, the reviewers felt the slow pace of scientific understanding would become a liability to the program, potentially eroding the gains initially made in conflict resolution:

- “Whether the EWA will be able to withstand greater levels of scientific scrutiny in the future depends largely on whether the program is able to provide credible evidence of success in protecting and restoring threatened and endangered fish species. The Panel perceives that a subtle shift in the burden of proof and exposure to risk may be taking place. While at a previous point in time the EWA was a vehicle to attract environmental support for a program that removed any threat of supply shortfalls from the contractors, the long-term security of fisheries protection dependent upon the EWA may hinge upon scientific proof of the program's efficacy and efficiency.”
- “At some point in the future it seems likely that the issues of overall efficacy and cost effectiveness of the EWA will emerge. While EWA is a small fraction of overall water project costs, the program is expensive to the taxpayers and operators who may share costs. Moreover, the state is a major participant in California water markets. Because competition drives up water prices, other buyers may raise questions. The Panel continues to be concerned about the extent to which the EWA can be held accountable for contributing to fisheries recovery. Here, the degree of science underlying the EWA becomes critical.”

One indicator of the EWA's scientific performance to date is to re-evaluate the current state of knowledge regarding the six “Science Challenges” provided by the 2002 EWA Review Panel:

II. Science Challenges

Science Challenge 1 - Determine the factors that cause delta smelt entrainment events

The Delta Smelt Working Group believes it now understands the major factors that drive entrainment events for adult, larval and juvenile delta smelt, as well as the environmental factors that prevent entrainment during summer-fall. Staff

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from the Delta Smelt Working Group and the Science Program will write a comprehensive article that details their hypotheses. This document is described below as a 2007 action item.

Science Challenge 2 - Determine growth, mortality, habitat use, and movement patterns of juvenile Chinook salmon in the Delta

The EWA agencies have not placed a lot of research emphasis on juvenile salmon microhabitat use in the delta for two reasons. First, monitoring has shown that salmon are broadly distributed in the Delta (Kjelson et al. 1982; Brandes and McLain 2001) and movement into the Delta occurs over prolonged periods, making growth assessments for naturally spawned fish problematic. Some growth data on marked fish were shared in 2003 (http://science.calwater.ca.gov/pdf/Agency_2003_EWA_Report_Salmon.pdf). Second, juvenile salmon appear to be most vulnerable to project exports as they emigrate from the Delta. Thus, the agency biologists have focused on broad-scale factors influencing survival during emigration through the Delta. The many years of salmon survival data have been the subject of cutting edge statistical evaluations (Newman and Rice 2002; Newman 2003).

To compliment earlier studies (CALFED Science in Action June 2001), the agencies have incorporated new multi-disciplinary approaches to studying large-scale hydrodynamic influences on salmon movement and survival in the Delta. They have also incorporated newer tagging and tracking tools. For instance, between December 2006 and May 2007, four independent sonic tagging studies were implemented to study the movement and mortality of juvenile salmon as they migrated through the Delta. Additionally, the last two Science Program PSPs have funded several studies that will improve the scientific understanding of juvenile salmon movement patterns through the Delta (Table 1). Once the results of these studies are synthesized, the agencies expect to have greatly expanded mechanistic knowledge of salmon emigration, including integration into particle tracking models by 2008-2010.

Science Challenge 3 - Develop quantitative life cycle models for delta smelt and Chinook salmon

Delta Smelt. The 2004 Science Program PSP resulted in a funded proposal titled "Modeling the delta smelt population of the San Francisco Estuary." This proposal was prepared by a team with a very strong modeling background and strong knowledge of delta smelt biology. The team proposed to couple hydrodynamic models, and several kinds of population-dynamic models, to evaluate factors influencing delta smelt growth, mortality, and extinction risk under historical and future environmental scenarios. Preliminary findings from this research will become available during 2008-2009.

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Chinook salmon: We agree with the Panel that testing hypotheses based on the output of models may ultimately improve our understanding of the factors controlling the abundance and survival throughout the life cycle of Central Valley salmon. Currently, more than a dozen quantitative life cycle models for Central Valley Chinook salmon are being developed. The agency biologists have recommended research based on their assessments of current modeling limitations (Table 1).

Science Challenge 4 - Quantify species-specific predation mortality in Clifton Court Forebay (CCF)

This recommendation was similar to a recommendation stemming from the Science Program's Fish Facility predation workshop in June 2005 (http://science.calwater.ca.gov/pdf/workshops/SP_workshop_predation_report_final_052706.pdf). The expert panel for the predation workshop fleshed out a general roadmap for how to quantify predation losses in CCF. There is an ongoing study to quantify pre-screen losses of steelhead smolts in CCF. The steelhead pre-screen loss study design was viewed positively by the predation panel because it improved upon sampling design limitations of earlier predation experiments using juvenile Chinook salmon.

The 2005 Predation Panel also recommended NOT trying to quantify pre-screen predation losses for delta smelt because delta smelt were presumed not to survive the salvage process, making the mechanism of death during the entrainment process moot. More recently, CALFED-funded fish facilities research has indicated that delta smelt can survive the salvage process. These studies have also preliminarily found that predation losses of delta smelt are sometimes high. Quantification of delta smelt entrainment loss from salvage data requires knowledge of pre-screen mortality of screen-able life stages as well as effective sampling of all life stages that may be entrained. The Science Program has funded a study to determine whether it is feasible to quantify delta smelt entrainment losses. This study proposes to use chemically tagged delta smelt in mark-recapture experiments to quantify pre-screen loss. This research will begin this year and finish in 2010.

Science Challenge 5 - Determine how to optimize DCC operations for fish and water quality protection.

As the Panel was aware, juvenile and adult anadromous fish migration and hydroacoustic studies were conducted during 2000-2001 by a multidisciplinary team of biologists and hydrologists from the IEP. Several technical reports were produced as a result of this effort (Hansen, 2004, McLaughlin and McLain, 2004, Horn, 2004). The team shared the results of this work at previous EWA

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workshops. The 2000-2001 studies lead to a 2006-2007 pilot study to determine how juvenile salmon orient themselves relative to flow and secondary circulation at Clarksburg Bend on the Sacramento River to better understand the context of the impact of the DCC and how it might be operated differently to reduce juvenile salmon entrainment into the central Delta. A larger study is planned for 2007-2008. Together, these studies will provide the additional data needed to meet Science Challenge 5.

In addition, the Agency biologists have developed a model of the effects of DCC operations on winter run loss at the Delta Fish Facilities. This information was incorporated into the Salmon Decision Tree

(http://www.science.calwater.ca.gov/pdf/ewa/EWA_delta_cross_channel_closures_06_111406.pdf).

Science Challenge 6 - Determine whether there are reservoir management strategies that [further] improve coldwater availability for instream habitat enhancement

The 2002 EWA Panel report called for a workshop to examine the potential opportunities that might exist for EWA to use its water to improve cold water availability in Central Valley reservoirs for instream habitat improvement. To date, no cold water management workshop has been held, nor has a CALFED-sponsored reservoir temperature modeling effort taken place. However, the EWA agencies have gained experience managing cold water resources in reservoirs to optimize in-stream water temperatures below dams. To date, the most effective use of EWA assets for instream temperature benefits has been on the American River (in 2001 and 2002) when 16,000 acre-feet (in 2001) and 26,500 acre-feet (in 2002) of cold water in Folsom Reservoir was released through the lower river outlets in fall, to reduce instream temperatures in the American River below Folsom Dam that were causing significant pre-spawning mortalities of adult Chinook salmon. Routing water through the lower river outlets bypassed the power generation system and the EWA paid the Western Area Power Administration for the amount of foregone power. The USBR, DWR, and the Army Corps of Engineers continue to refine their ability to model instream temperatures in the Central Valley, and agency biologists continue to work with them to maximize coldwater availability for instream habitat benefits.

It is also important to note that reservoir management strategies to maximize coldwater availability for instream fishery needs are already being implemented on the larger reservoirs. The 2004 NOAA Biological Opinion on the Long-term Central Valley Project and State Water Project Operations Criteria and Plan (OCAP) contains specific water temperature requirements for Clear Creek and the Sacramento, Feather, American, and Stanislaus rivers. The EWA may be able to assist with instream temperatures in a limited way, and the EWA Team

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will continue to look for additional ways in which EWA assets can be used to provide suitable instream conditions for anadromous fish. However, reservoir structural and operational strategies for coldwater management will continue to be implemented for instream habitat improvement and will likely evolve independent of the EWA.

III. Conclusion

In conclusion, the seven recurring themes suggest that the EWA was logistically successful and, at least in the short-term, successful from a conflict resolution perspective. However, the recurring themes also suggest that the pace of scientific understanding on EWA issues proceeded more slowly than the Panels thought it should. The progress on specific science challenges has been varied, but the Science Program and EWA Agencies expect very significant progress to be made on EWA-relevant science during the next few years.

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PART B. DETAILED RESPONSE TO THE 2006 PANEL REPORT

I. Purpose of the Panel Review

The Panel met on November 28-30, 2006. The purpose of this independent review was to provide an evaluation of the science applied to EWA during 2001-2006, and the science needs of a future environmental water program in 2008 and beyond. The review was not intended to yield judgments about the success or failure of the EWA, nor was it to obtain a recommendation on whether EWA, or a similar program should continue past 2007. The Panel was also asked to comment on the scientific validity of the Resources Agency Action Matrix. The Panel submitted its comments on the Action Matrix to the Lead Scientist in a report dated January 2, 2007. Subsequently, the Panel provided its full EWA Review to the Lead Scientist on January 31, 2007.

The 2006 Panel had a two-part charge. First, the Panel was asked to use technical information provided (<http://science.calwater.ca.gov/workshop/ewa.shtml>) to answer the following seven questions:

1. Has there been enough water in EWA and other environmental water programs to enable actions sufficient to reduce the impacts of water management on species of concern in the Delta and associated tributaries?
2. Have the EWA and the other environmental water programs effectively contributed to recovery of the species of concern in the Delta and associated tributaries?
3. Is there sufficient information and data from all sources to determine the effects of EWA and other environmental water programs to species of concern (i.e., populations of delta smelt and salmonids)?
4. Is the current monitoring effort by the agencies sufficient to provide the needed information on population level effects and responses to EWA and other environmental water use?

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5. If there is insufficient data and information to determine the efficacy of the EWA and other environmental water, what scientific approaches are needed to address the problem to allow that determination?
6. What scientific components should be considered while implementing EWA in 2007?
7. What scientific components and considerations should be included in a future and/or long-term environmental water program? Are there components that could be included to improve our understanding of water management on ecosystem function and species' population dynamics?

Second, the Panel was asked to review the Resources Agency Action Matrix for Pelagic Organisms (Action Matrix). The Panel considered the second part of the charge equivalent to answering question 6 in the first part of the charge.

Here, the Lead Scientist and EWA Agencies respond to the Panel recommendations. Our response includes a goal and an action or actions to be taken, including the timeline for completion. We have grouped the Panel's recommendations into three categories: programmatic recommendations, review process recommendations, and scientific recommendations. We have taken this approach because our ability to take programmatic actions is comparatively limited. In contrast, there is more opportunity for the Science Program and the EWA Agencies to take actions to address the Panel's review process recommendations and scientific recommendations. Note that the numbering of the Panel recommendations is ours. In some cases, similar Panel recommendations have been grouped under one number. In these cases, all of the component recommendations are quoted.

II. Programmatic Recommendations

Recommendation 1, Coordinate environmental water programs: "Changing environmental conditions and greater demands on a potentially shrinking supply of environmental water suggests that the water programs would benefit if they were combined into a single coordinated operation and assessment program. The Panel believes that only through a coordinated environmental water program can efficient trade-offs of water allocations be achieved between tributaries and the Delta and across anadromous and resident species."

"The Panel endorses the idea of viewing environmental water from all sources together as a common pool. We encourage efforts to waive or remove, as much as possible, institutional barriers that hinder the pooling of environmental water from among the different sources."

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Agency/Science Program response to Panel: While the goal of truly integrating all sources of environmental water is a laudable one, the constraints on doing so still remain. In fact, the situation is worse now than it was previously. The CALFED Environmental Water Program (EWP) has never provided real water for instream benefits, and with the exception of a pulse flow study on Clear Creek, has largely become inactive due to lack of funding. There remain only three active environmental water programs, and the future of the EWA may be reduced after 2007. The public money which supported the EWA will have been expended by 2009. There is a Governor-appointed task force (Delta Vision) that will make a major recommendation in December 2007 on future policy direction for how to manage the delta for multiple uses. Additionally, there are two major agency-driven attempts to rethink how fish and water supplies will be managed. The first is the re-initiated ESA Section 7 consultation of the CVP/SWP Operations Criteria and Plan (OCAP) that will culminate in two new biological opinions. The biological opinions are linked to DWR's intent to seek a consistency determination from DFG under the California Endangered Species Act that would require that impacts of take of State-listed species be minimized and fully mitigated. The second is the Bay-Delta Conservation Plan which seeks to manage and conserve "covered species" by implementing a conservation strategy/plan pursuant to the Natural Community Conservation Planning Act and ESA Section 10. The water management-related resources needed to accomplish the purposes of these two processes will be the subject of analysis and discussion in the coming months.

Despite the major policy changes on the horizon, the implementing agencies have taken the charge to integrate environmental water programs seriously, and to the extent possible, have coordinated and integrated the use of the three major programs (i.e., the EWA, and the CVPIA (b)(2) and (b)(3) programs) to protect fish and improve aquatic habitat. See Appendix A for further details.

In November 2004, the implementing agencies specifically responded to a similar recommendation by the previous Panel, and presented a report outlining how the environmental water programs are currently being coordinated and integrated. This report also discussed in detail why a more complete integration is not possible under the current regulatory structure. Meaningful changes that would allow a "common pool" approach to the environmental water programs would require legislative action.

Agency/Science Program Goal: Communicate the need for maximum possible integration among environmental water programs to Agency management, the Delta Vision, BDCP, and OCAP reconsultation processes.

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Agency/Science Program Action: At this writing, we do not have a specific action for this recommendation.

Recommendation 2, San Joaquin River modification: “Both winter run Chinook salmon and delta smelt would benefit if the water exported at the pumps was derived mostly or entirely from the San Joaquin River; thus resulting in positive flows in the Old and Middle Rivers. Such actions would, however, have to be weighed against the potential negative impacts on San Joaquin salmon runs of the increased use of San Joaquin water.”

“It may be necessary to re-engineer the system to maximize the potential for export of San Joaquin River water before it reaches the Delta. This may not be possible if San Joaquin flows are insufficient under current management regime to satisfy the water volume needs at the pumps.”

Agency/Science Program Response: In most years, flow in the lower San Joaquin River is insufficient to satisfy SWP/CVP water demands and exports commonly exceed San Joaquin River flows during salmon migration seasons. Changing diversion points or re-engineering the system will not overcome these limitations. Because Chinook salmon and steelhead populations in the San Joaquin basin are declining, any actions that could further increase negative project impacts on these stocks are not advised.

Additionally, San Joaquin River water is often of very poor quality. Much of the San Joaquin flow entering the delta is irrigation return water that was previously exported from the delta. Undiluted agricultural drainwater is often acutely toxic to fish (Saiki et al. 1992). The lower San Joaquin River adjacent to the Delta also has a very unique, low diversity fish assemblage dominated by short-lived species. Brown and May (2006) speculate that this assemblage may be an indicator of chronic chemical stress. Since DWR has no water right permits/licenses in the San Joaquin River watershed and the Bureau of Reclamation holds only limited rights to water on the Stanislaus River (New Melones Dam/Reservoir) and the upper San Joaquin River (Friant Dam – Millerton Lake), little additional water is available to increase San Joaquin River flows and water quality in most years.

Agency managers understand that Old and Middle River flows are a function of San Joaquin River inflow to the Delta and export pumping rates, and are aware of the influence Old and Middle River flows on the mortality of delta smelt and other species of fish due to entrainment at the SWP/CVP. Given the limited State and federal water rights described above, reducing export pumping is the primary way the agencies have to increase the flow in Old and Middle rivers. Several ideas that could help reduce negative net Old and Middle river flows have been introduced in the various Delta planning forums described above.

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Some of the alternatives include extensive reconfiguring of Delta channels and changing the locations of the SWP or CVP diversions.

Agency/Science Program Goal: Our goal is to communicate the infeasibility of this recommendation to the Review Panel.

Agency/Science Program Action: The above response to the Panel is our action item for this recommendation.

Recommendation 3, Dedicate staff and funding to EWA: “Dedicated staff and funding is needed to achieve the level of quantitative analyses needed in a future environmental water program. A future environmental water program should also have the resources to support research and analysis of its specific questions and issues.”

Agency/Science Program Response: We described several policy planning processes above that make the future of the current EWA uncertain. We hope that future environmental water programs will be sufficiently staffed and will continue the use of expert panels to guide their implementation. The Science Program has used its PSP and Fellows programs to fund EWA-relevant research (Table 1). However, we recognize that there is still no group to strategically plan, guide, publish, and integrate research needs for EWA. We hope this can be remedied in any future environmental water program(s).

Agency/Science Program Goal: Communicate the need for appropriate staffing of future environmental water programs.

Agency/Science Program Action: The Science Program will monitor the development of environmental water plans under the Delta Vision and Bay Delta Conservation Planning processes and make the point that the benefit of environmental water can only be determined if there are well worked out conceptual models (or better still, numerical models) of the relationship between environmental water and species life histories and the monitoring and analysis needed to confirm the modeled effects.

Recommendation 4, Reconcile expectations and resources: “In a future environmental water program, either aiding recovery is a goal and sufficient water is allocated to achieve it, or the goal should be revised so expectations are compatible with the amount of water made available.”

Agency/Science Program Response: This recommendation is critically important to the ongoing policy planning processes described above.

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Agency/Science Program Goal: Elevate recommendation to federal and State resource agency managers for incorporation into the Delta Vision, BDCP, and OCAP reconsultation processes.

Action: This report constitutes the EWA team's communication of this recommendation to their management who are aware of the problems that arise when there is a mismatch between expectations and resources. It should also be noted the U.S. Fish and Wildlife Service recently formed a Delta Native Fishes Recovery Team, which is revising the existing Recovery Plan for delta smelt and other native species (USFWS 1995). The EWA Agencies will participate in the recovery planning process. The recovery planning process will develop recovery criteria and an implementation plan by fall 2007. Recovery criteria and implementation will be important considerations for EWA and for key interrelated programs such as the Operations Criteria and Plan (OCAP) and the CALFED Bay Delta Conservation Plan (BDCP).

The Science Program is trying to develop an adaptive water management experiment to determine if there is an alternative water management strategy that can actually conserve delta smelt and contribute to their recovery.

III. Review Process Recommendations

Recommendation 1, On-line documentation: The Panel recommends more use of web-linked documents in reviews. These could supplement the PowerPoint presentations with background information such as the proposals and work plans of projects presented in the reviews.

Agency/Science Program Response: We agree with this recommendation.

Agency/Science Program Goal: Post more information on the EWA website, further in advance of the review.

Agency/Science Program Action: The Science Program will compile relevant proposals and workplans for future EWA reviews and post these documents to the EWA website. This will include PSP and Fellows proposals, relevant IEP workplans, etc. The Agencies will provide relevant proposals and work plans to the Science Program prior to EWA reviews for posting. The Science Program also will post the latest results from scientific studies that address EWA relevant questions, particularly those addressing concerns previously raised by Panel.

Recommendation 2, Review VAMP: "The multi-tiered review structure is important and the Panel supports the continuation of reviews of EWA on a biennial basis. The EWA review process should serve as a template for other programs such as the VAMP."

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“Programs such as VAMP should apply mechanistic life cycle approaches that identify factors affecting routing and survival of salmonids through the San Joaquin River and the Delta. In particular, the Panel encourages a mechanistic approach to understand the effects of the HORB on Delta dynamics and on the survival of San Joaquin salmonids.”

Agency/Science Program Response: The VAMP is a twelve-year experiment that began in 2000. In addition to feedback from the EWA panel regarding review of the VAMP, the California State Water Resources Control Board in its 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP) recommended that “parties to the San Joaquin River Agreement conduct a peer review of the VAMP study design” requesting that the review “analyze whether the experimental flows are providing adequate protection for San Joaquin River and Delta species and whether changes should be made to the experimental design to ensure adequate information is obtained from the experiment on which to base long term [water quality control plan] objectives.” The SWRCB intends to hold a workshop on San Joaquin River flow issues later in 2007 and expects to hear about several related topics, including the VAMP review and ongoing refinements of DFG’s San Joaquin basin salmon life cycle model.

There are five official years of the VAMP experiment, i.e., with Head of Old River barrier in place, but not all of the flow and export combinations identified in the study plan have been obtained. In 2007 hatchery salmon were unavailable for the VAMP experiment, which resulted in a major departure from the study design based on mark-recapture of coded-wire tagged salmon. This year, an alternative strategy using sonic tags on a smaller number of salmon is being implemented. The evaluation of this new study design and technology relative to its use for future VAMP work based on the results of this year’s study will be among the topics considered for an Agency or San Joaquin River Agreement member review.

Agency/Science Program Goal: Provide support for the scientific analysis of VAMP data and interpretation of study results

Agency/Science Program Action: The Agencies will present VAMP information during the SWRCB workshop in late 2007. The DFG and the USFWS will also be exploring approaches for a VAMP peer review for consideration by the other parties to the San Joaquin River Agreement. The Science Program does not have plans to review the VAMP experiment further at this time, but will revisit this subject in 2008. USFWS staff has requested funds to analyze the 2007 VAMP data using distribution and survival modeling through their Fisheries Operations

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Needs System (FONS) for this year, however funding through this avenue is unlikely. The SJRA group will continue to solicit resources to fund this work.

Recommendation 3, Performance measures: “The panel encourages the development of general EWA performance measures and specific EWA performance measures that are linked to critical life stages of the salmonid and pelagic organisms of the Delta.”

Agency/Science Program Response: We agree with this recommendation and have taken modest steps toward it in the past. For instance, in 2003, the EWA salmon biologists submitted a document to the previous Panel entitled: “Goals, Objectives, and Performance Measures of EWA for salmon and recommended relevant analyses”. This document listed a set of EWA performance measures for winter-run salmon by goal and objective. Many of the tools needed to assess these performance measures are still not available, and the analyses that were identified as necessary to address the performance measures have still not been done due to staffing limitations. Until the staffing limitation is resolved no further progress is expected. In addition, more EWA water is now used for San Joaquin Basin fall-run than winter-run. Thus, the performance measures need to be revised to include San Joaquin Basin salmonids. We think this is an important first step for designing and evaluating a future environmental water program.

The implementing Agencies also want to integrate their programmatic performance measures with the species conceptual models being developed for the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). These conceptual models and programmatic performance measures are intended to facilitate the development of program-specific performance measures, with the goal of restoring at-risk fish populations and their habitats.

Agency/Science Program Goal: Develop a list of specific, desirable performance measures for a long-term environmental water program.

Agency/Science Program Action: The Agencies will refine current performance measures to include San Joaquin Basin fall-run for a long-term environmental water program via a series of meetings by December 2007. When the Agency product is available, the Science Program will attempt to integrate the salmonid performance measures with the CALFED performance measures currently under development.

IV. Science Recommendations

Recommendation 1, peer-review new information: “The panel recommended completion of studies such as Marston and Mesick, Herbold, Swanson, and Miller and, where appropriate, submissions to a peer reviewed journal such as the San

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Francisco Estuary and Watershed Science, fish ecology journals, and the journal Endangered Species Research (Inter-Research).”

Agency/Science Program Response: We agree with the Panel that peer-review of EWA-relevant science strengthens the scientific basis for EWA decisions.

Agency/Science Program Goal: Facilitate the publication of EWA-relevant science

Agency/Science Program Action: The Pelagic Organism Decline overview presented by Herbold was accepted for publication (Sommer et al. 2007). IEP staff also recently published their findings on long-term trends in pelagic fish habitat suitability during fall (Feyrer et al. 2007). This research was similar to, but more comprehensive than, the information presented to the Panel by M. Guerin of CCWD. The EWA analyses presented by Brown, Kimmerer, and Brown have been divided into two manuscripts, a model development paper to be submitted to *San Francisco Estuary and Watershed Science*, and a companion program evaluation paper to be submitted to *Environmental Management* (L. Brown and W. Kimmerer personal communication 5/14/2007). The San Joaquin basin salmon model (presented by Marston and Mesick at the 2006 EWA review) has been subjected to multiple levels of peer-review including a CALFED-funded panel review. The model is currently being refined based on reviewer comments. There is a process in place to have the model go through one more round of Panel review and a manuscript will be prepared by summer 2008.

The Science Program will explore the possibility of requiring manuscripts suitable for peer-review as explicit products required for future research funding funded by the Science Program.

Recommendation 2, Dedicate funding to EWA science questions: “The Panel continues to recommend that research funds be earmarked directly to address EWA issues, and recommended a concerted effort to incorporate the results of new research into EWA actions and management.”

“The Panel believes that knowledge of cause and effect may be enhanced by increased flexibility in the methods and locations of data collection, including new studies and monitoring specifically designed to address process-level questions. We are recommending new studies, both descriptive and experimental, that are informed by the new information gained as a consequence of the POD efforts. There are several ways to improve the quality of data collected relative to its quantity, and the recommendations of the Panel fall into three general areas:

- Focus on needs identified during development of population models to elucidate cause and effect, and to inform the models

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- Narrow the questions attempting to be addressed and focus on the factors affecting the distribution and abundance of all life stages of delta smelt in space and time, including delineation of spawning habitat. Many of these questions can be addressed by amending the existing sampling programs. However, keep in mind that sampling stations used for multiple purposes can compromise their value
- Determine to what extent the lack of understanding and quantification of gear efficiencies can mask relationships, inflate uncertainty, and preclude defensible estimates of population size based upon the monitoring results.

Suggested areas for new research include but are not limited to: behavior of fish in responses to flow; improvements in monitoring in real time; genetics studies for better identification of members of specific salmon runs; estimation of mortality of delta smelt and salmon smolts in the Delta, in the Clifton Court Forebay, and in the pumping facilities; and accurate estimates of entrainment (including indirect effects) of all at-risk species and life stages.”

Agency/Science Program Response: Over the past several years, the Science Program has made a major investment into EWA relevant science that is expected to produce very significant increases in understanding of many EWA-relevant science topics during 2008-2010 (Table 1). The EWA Agencies, through the IEP, have also made significant strides in EWA relevant science through the commitment of funding to the Pelagic Organism Decline studies. Much of this new IEP research was presented at the 2006 CALFED Science Conference and the 2007 IEP Workshop at Asilomar. The EWA Agencies will continue to provide input into the Science Program’s PSP and Science Fellows solicitation processes.

Agency/Science Program Goal: Demonstrate intellectual progress on Panel science recommendations.

Agency/Science Program Action: In addition to funding the studies listed in Table 1, staff from the Science Program and implementing Agencies will collaborate on several products that will improve understanding and/or accessibility of EWA-relevant science topics. First, staff will begin work in June 2007 on an article for the IEP Newsletter that presents a whole life cycle description of factors that lead to delta smelt entrainment during winter-early summer, as well as non-entrainment during midsummer-fall. Second, staff will also begin work in June or July 2007 on a conceptual model of factors that could result in mortality that is unaccounted for as losses at the pumps. This conceptual model also may be submitted to the IEP Newsletter. Both products will be produced during a series of meetings of EWA staff, with input from the CALFED Lead Scientist. The delta

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smelt information will be presented during the 2007 American Fisheries Society Annual Meeting in San Francisco. The salmon survival conceptual model also will be presented in appropriate forums and is considered a precursor to a possible Science Program Workshop on indirect effects as suggested by the Panel. Note that neither of these products is being considered for journal publication at this time. Rather, they are intended to reach a management and stakeholder audience. In late summer or fall 2007, the Science Program will also host a workshop on osmerid (delta and longfin smelt) migrations in San Francisco Estuary. The scope for this workshop is currently being developed.

Recommendation 3 - Improve statistical sophistication of EWA analyses: “While the Panel recognizes the improvement in statistical analysis demonstrated at the 2006 review, there is still a need to improve statistical rigor and discipline in data analysis. Further attempts at data mining that is not hypothesis driven is discouraged. Group collaboration is needed to resolve the apparent discrepancies in conclusions reached by different people seemingly analyzing the same data using similar techniques.”

“The Panel recommended continued and expanded use of internal and external statistical consultants.”

Agency/Science Program Response: The agencies recognize the need for additional statistical expertise. Over the past several years, the Science Program has made a major investment into EWA relevant science through proposal solicitation procedures (Table 1). Likewise, the IEP has made major investments into analysis of existing data and new studies involving academic collaborators. The USFWS Stockton Office recently hired a well-respected statistician to assist the IEP and the IEP has entered into a contract with the National Center for Ecological Analysis and Synthesis (NCEAS) that will provide additional academic collaborators in the POD effort. We expect that all of these investments will improve the analytical discipline, statistical rigor, and ultimately “publish-ability” of EWA-relevant science.

Agency/Science Program Goal: Improve the analytical discipline and statistical rigor of analyses presented to the EWA Panel

Agency/Science Program Action: At this writing, we do not have a specific action for this recommendation other than the actions already taken as described in the response to the recommendation.

Recommendation 4 - Improve understanding of linkages between hydrodynamics, water quality and fish movements: [The] “Panel recommended further application of particle tracking models to understand the movement of delta smelt at junctions and to understand the effects of the Head of Old River

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Barrier (HORB) on the routing of pelagic organisms and salmonids through the Delta. However, conclusions drawn from the particle tracking experiments are contingent on the assumption that delta smelt move like neutrally buoyant particles.”

“The Panel recommended consideration of the behavioral responses of fishes to hydrologic and water quality signals in connection with the study of junctions and other hydraulic and landscape features in the Delta. The Panel also recommended studies to understand the hydraulic and salinity cues that mediate the spatio-temporal distribution of delta smelt and their entrainment into the pumps.”

Agency/Science Program Response: We agree that the development of quantitative tools to predict the outcomes of flow and export changes on target organisms is the primary goal of EWA or any future environmental water program. Our response to scientific recommendation # 2 (above) applies here as well. Below we focus on additional actions relevant to this recommendation that were not described above.

Agency/Science Program Goal: Quantitatively integrate hydrodynamics and particle tracking models with models of fish movement and behavior.

Agency/Science Program Action: The Science Program is supporting Annje Dodd and Russ Perry as CALFED Science fellows (Table 1), both of whom are conducting research on hydrodynamics and salmon movements. Annje Dodd is attempting to link particle tracking model results to juvenile Chinook salmon movements. She is working with agency personnel to model flow and particles using the RMA model and linking RMA outputs to results of recent sonic tagging experiments conducted on juvenile Chinook emigrating through the Delta. Russ Perry is attempting to model route-specific survival for salmon emigrating through different pathways in the delta. In addition, USGS and others are modeling the secondary river circulation in a bend of the Sacramento River near Clarksburg and comparing their hydrodynamic results with concurrent data on the positions of sonic tagged salmon in the bend. They hope this information will help them predict fish responses to tidally influenced hydrodynamics at channel junctions in the delta. The Agencies are also taking steps this year to evaluate and improve current particle tracking capabilities. The IEP Science Advisory Group is reviewing the DSM-2 particle tracking model, which is commonly used to inform the use of EWA assets for delta smelt protective actions. Additionally, DWR is hiring Ed Gross to develop a 3D ptm and compare it to currently available 1D (DSM-2 ptm) and 2D (RMA) models.

Recommendation 5 - Improve understanding of indirect water project effects: “As in past Panel reports, the magnitude of the indirect effects of the pumps through

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mortality multipliers (e.g., as used for Clifton Court Forebay) are important to quantifying entrainment effects but still remain unconfirmed.”

“The Panel recommended the development of models that estimate the indirect routing effects of exports. The impacts resulting from the routing of fish into regions of the Delta that are favorable or unfavorable to growth and survival of particular life history stages need to be better quantified.”

Agency/Science Program Response: We have described three actions above that are pertinent to indirect water project effects on delta fishes. These are presented again briefly below.

Agency/Science Program Goal: To further the scientific basis for indirect effects of water project operations.

Agency/Science Program Action: As stated above, staff from the implementing Agencies and the Science Program will begin work in June or July 2007 on a conceptual model of factors that could result in the unaccounted for mortality in the Delta. This effort will include, but not be limited to, hypothesized indirect effects. The conceptual modeling effort is considered a precursor to a possible Science Program Workshop on indirect effects as suggested by the Panel. In late summer or fall 2007, the Science Program will host a workshop on osmerid (delta and longfin smelt) migrations in San Francisco Estuary. The scope for this workshop is currently being developed, but will include consideration of indirect project effects on the survival of adult osmerids and their progeny. Lastly, the Science Program has funded a study to determine whether it is feasible to quantify delta smelt entrainment losses. This study proposes to use chemically tagged delta smelt in mark-recapture experiments to quantify pre-screen loss. This research will begin this year and finish in 2010.

Recommendation 6, Generate multi-species decision tools: “It is important to view all EWA actions in light of the full range of their potential effects on the multiple species of concern, rather than their effects on single species. To maximize the effectiveness of EWA water, it may be necessary to identify tradeoffs associated with actions that benefit one species at the expenses of others. This may ultimately lead to prioritization of actions based upon the relative risk of jeopardy among species at-risk.”

Agency/Science Program Response: We recognize the possibility that species may “compete” for EWA resources. For instance, there are potential conflicts between San Joaquin salmonids and delta smelt with regard to the Head of Old River Barrier. In general, such conflicts have been resolved using the existing real-time decision groups like WOMT. However, we agree with the Panel’s

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suggestion that formal evaluations and processes are helpful for resolving among-species conflicts.

Agency/Science Program Goal: Maximize the effectiveness of EWA actions for the multiple species of concern.

Agency/Science Program Action: The EWA Agencies will work on identifying possible EWA actions that maximize multiple species benefits. By summer 2008, the EWA Agencies will also generate a multi-species decision tool to aid biologists in prioritizing protective actions.

Recommendation 7, Update determination of environmental water needs: “It is time to revisit gaming to help size and “optimize” the mix of actions under different conditions (e.g., wet versus dry years) in a future environmental water program. A new gaming exercise should also include biological life-cycle models that were not available ten years ago.”

Agency/Science Program Response: The current accuracy of particle tracking models is uncertain though we agree DSM-2 ptm remains an obvious tool available for gaming. There is no current delta smelt life cycle model to inform a gaming exercise. The EWA salmon biologists do not feel current Chinook salmon life cycle modeling capabilities are adequate because stock identification is problematic. Nonetheless, DWR and some of its stakeholders have begun a feasibility exercise to determine whether additional gaming is warranted to size environmental water programs. Following initial testing of tools, other parties will become involved.

Agency/Science Program Goal: Apply appropriate new information to determine the needs of a future environmental water program.

Agency/Science Program Action: At this writing, we do not have a specific action for this recommendation. However, if a policy-level decision is made to use gaming in the development of a long-term environmental water program the EWA Agencies will participate.

Table 1. Studies funded by the Science Program that directly support EWA science needs

Title	Principal Investigators	Status	EWA Science need addressed
Modeling the delta smelt population of the San Francisco Estuary	Kimmerer et al.	Study in progress	Science challenges 1, 3
Life history variation in steelhead trout and the implications for water	Mangel	Study in progress	Science challenge 6

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management			
Chinook salmon rearing in the San Francisco Bay-Delta system: identification of geochemical markers to determine delta use	Ingram et al.	Study in progress	Science challenge 2
A statistical model of Central Valley Chinook incorporating uncertainty	Botsford	Study in progress	Science challenge 3
Review of four juvenile salmon coded wire tag experiments conducted in the delta	Brandes	Study in progress	Science challenges 2, 5
Survival and migratory patterns of Central Valley juvenile salmonids	Klimley et al.	Study in progress	Science challenges 2, 6
Development of a simulation model of juvenile salmon movement in the Sacramento-San Joaquin Delta	Dodd	Study in progress (2008)	Science challenges 2, 5
Effects of water temperature, stream flow, and flood availability on the growth, survival and movement of Central Valley juvenile steelhead with implications for water management	Heady et al.	Study in progress (2008)	Science challenges 2, 5, 6
The application of otolith geochemistry to determine stock structure, survival and the relative impact of water exports on "Threatened" delta smelt	Hobbs et al.	Study in progress (2008)	Science challenge 3
Estimating route-specific survival and distribution of juvenile salmonids migrating through the Sacramento-San Joaquin River Delta	Perry	Study in progress (2009)	Science challenges 2, 5
Validation of a new method for population	Clemento	Study in progress (2009)	Science challenge 3

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assessment of Pacific salmonids using genetic markers			
A calibration-free approach to modeling Delta flows and transport	Stacey et al.	Contracting in progress (2010)	Science challenges 1, 2, 5
An experimental approach to evaluate environmental water effects on threatened delta smelt	Castillo et al.	Contracting in progress (2010)	Science challenges 1, 4
Estimating juvenile chinook salmon spring and winter run abundance at Chipps Island	Brandes et al.	Contracting in progress (2010)	Science challenges 2, 3
The consequences of operational decisions on water quality: reconciling delta smelt, salmon, and human needs	Guerin et al.	Contracting in progress (2009)	Science challenges 5, 6

V. Resources Agency Action Matrix

We agree with the Panel that the actions listed in the Action Matrix should not have been characterized as experiments. They did not have clear hypotheses associated with them, nor did they have experimental controls or replication. The Agencies and the Science Program have not to date revisited the Action Matrix or attempted to improve the document based on Panel comments. The USFWS Delta Smelt Working Group recommended implementation of the winter export reduction action outlined in the matrix and the WOMT implemented slight modifications of it. Similarly, the DSWG recommended a modified version of the “pre-VAMP” export reduction and WOMT implemented this action as well. These actions were taken because of the very low 2006 fall midwater trawl index for delta smelt. It is likely that other actions listed in the Action Matrix will be considered by the DSWG because early indications are that larval abundance is much lower than ever (<http://www.delta.dfg.ca.gov/data/20mm/>). It is unlikely that attempts will be made to convert the Action Matrix into a true experimental design because the USFWS and the DFG are extremely concerned about delta smelt persistence and will not entertain true adaptive experimentation regimes that could further endanger the species.

VI. Conclusions

To conclude, 2007 is expected to be a year of significant new policy direction for the Delta with substantial rethinking of how water is managed to protect fish. It is ¹EWA Agencies are the California Departments of Water Resources (DWR) and Fish and Game (DFG); U.S. Department of the Interior, Bureau of Reclamation (USBR) and Fish and Wildlife Service (USFWS); and U.S. Department of Commerce, National Marine Fisheries Service (NMFS)

likely that EWA or a similar program will continue, at least for a few more years, but the program could be altered in size and scope. As outlined above, the Agencies and the Science Program will continue to implement EWA-relevant science to the extent possible recognizing that many fundamental issues will transcend changes in water management strategies. We anticipate progress on previous Panel science challenges and recommendations during 2008-2010 as results become available from Science Program studies, Fellows studies, POD studies, interdisciplinary salmonid/hydrodynamic studies by IEP agencies, and Agency/Science Program syntheses and workshops.

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