SUMMARY REPORT

Independent Review Panel on Agricultural Water Conservation Potential

December 14-16, 1998

CALFED
BAY-DELTA
PROGRAM

CONCUR

Convened by: CALFED Bay-Delta Program
Facilitated by: CONCUR, Inc.

Report Prepared January 29, 1999

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Convened December 14-16, 1998

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SUMMARY REPORT

Independent Review Panel on
Agricultural Water Conservation Potential

Convened December 14-16, 1998
At the Faculty Club, University of California at Davis

Prepared January 5, 1999

INTRODUCTION

The Water Use Efficiency Program is one of the eight Program Elements of the Preferred Alternative identified in CALFED's Phase II Report released in December 1998. When reviewed earlier as part of the draft EIS/EIR released in March 1998, the Water Use Efficiency element attracted more comments from environmental, agricultural, and urban stakeholders than any other part of the CALFED program. Many of these comments are directed towards conservation potential, and are rooted in concerns that CALFED may be incorrectly forecasting conservation potential, and therefore proposing an inappropriate mix of actions to improve water supply reliability.

Over the coming year, CALFED will be finalizing numerous decisions related to agricultural water conservation. To address concerns already raised by stakeholders and help inform future discussions, CALFED convened an Independent Review Panel on Agricultural Water Conservation in late 1998.

The Independent Review Panel, convened December 14-16, 1998, was preceded by a preparatory Scoping Session on October 19, 1998. During the one-day Scoping Session, interested members of the public were briefed on CALFED's rationale for convening the Panel, and stakeholders and the general public were given the opportunity to provide input to CALFED on the structure and focus of the Panel's deliberations. Panel members were also given the opportunity to provide guidance on the structure of their future deliberations, as well as to identify additional information they required in order to ensure their discussions would be as productive as possible. Both the October Scoping Session and the December deliberations were characterized by a constructive collegial tone that permitted, in most cases, the Panel to arrive at a consensus position or recommendation for each issue it addressed.

Based on the discussions during the one-day Scoping Session, the deliberations of the Independent Review Panel were focused to accomplish several broad objectives:

- Review, critique and provide recommendations to strengthen the technical assumptions and approach of the agricultural section of CALFED's report on the Water Use Efficiency Program (Chapter 4).

- Provide guidance on strategies for identifying Bay-Delta problems, as well as structuring solutions and quantifying potential benefits. (This discussion centered on representative case studies developed by CALFED staff).

· Identify additional data collection and research needs.

These broad objectives were captured in a series of six questions to structure the Panel's deliberations. These questions are listed below. A more detailed explanation providing the context for these questions is included as Attachment 1.

Table 1: Questions Addressed by Independent Review Panel

Question 1a:	***Review Chapter 4:*** What is the conceptual model that structures the methodology? What is the chosen methodology and is it appropriate given the overall goal of the CALFED Agricultural Water Use Efficiency Program? Are the assumptions contained in the overall conceptual model of the methodology appropriate? Are the data sets available to support the methodology?
Question 1b:	***Review Chapter 4:*** What additions and/or corrections are required to make the real water conservation estimates contained in the Agricultural Section appropriate and defensible for a programmatic-level analysis?
Question 2:	***Identify Problems:*** CALFED staff is to provide the Panel with overviews of representative situations in the Bay-Delta problem area. Please identify the Bay-Delta problems evident in these situations, with particular emphasis on timing, location and water quality. Which of these problems can be addressed through changes in agricultural water management? Which of these representative situations (please select three) should be analyzed in greater detail as part of the Panel's deliberations?
Question 3:	***Develop Objectives and Possible Solutions:*** Focusing specifically on the three representative situations chosen for greater analysis, please restate the sample problems from Question 2 in the form of objectives. What are the possible solutions, with an emphasis on flow path?
Question 4:	***Choose Preferred Solution & Quantify Benefits:*** For each of the objectives stated in Question 3, choose a preferred solution. What is the preferred approach for quantifying the potential Delta- and tributary-related benefits? What are the measurable indicators of success (benefits) in accomplishing the objectives developed in answering Question 3? State the specific cause and effect expected between each potential action and its expected benefit(s) in the form of an hypothesis.
Question 5:	***Research & Data Needs:*** What additional data collection and research are required to adequately answer the above questions? What experiments would be useful to verify the hypothesis of cause and effect?
Question 6:	***Assurances:*** What does CALFED have to do to ensure that the expected benefits are realized, and that they are in support of the CALFED solution?

The Independent Review Panel on Agricultural Water Conservation Potential was held December 14-16 on the University of California, Davis campus. The Panel was comprised of five nationally recognized scientists who collectively provided expertise in the areas of irrigation science and engineering, hydrology, plant physiology and evapotranspiration, agricultural economics, and aquatic ecosystem restoration. The deliberations also included eight stakeholder technical representatives with specific expertise in the Bay-Delta system. These technical representatives provided clarification on specific issues as needed, and posed valuable questions and comments for the Panel's consideration. The Panel was convened jointly by CALFED staff and CONCUR, Inc., a professional facilitation team. (A listing of Independent Review Panel participants is provided in Table 2 below. More detailed biographies for panelists,

technical representatives and the facilitation team are included in Attachment 2. Also included in Attachment 2 is a biography for Greg Young, Lead Consultant for CALFED's Water Use Efficiency Program and an important resource throughout the Panel's deliberations.)

Table 2: Independent Review Panel Participants

Panelist	Affiliation	Expertise
Ken Cummins, Ph.D.	Distinguished Scientist, Ecosystem Restoration Department, South Florida Water Management District	Aquatic Ecosystems Restoration
Mark Grismer, Ph.D.	Professor of Hydrology and Agricultural Engineering, UC Davis	Irrigation Science & Hydrology
Theodore Hsiao, Ph.D.	Professor of Water Science and Plant Physiologist, UC Davis	Plant Physiology & Evapotranspiration
Jack Keller, Ph.D.	Professor Emeritus of Agricultural and Irrigation Engineering, Utah State; Founder and Chief Executive Officer, Keller-Bliesner Engineering	Irrigation Engineering & Conservation Verification
Charles Moore, Ph.D.	Agricultural Economist and Lecturer in International Agricultural Development, UC Davis; Consultant	Agricultural Economics
Technical Representative	**Title**	**Affiliation**
Vashek Cervinka, Ph.D.	Agricultural Engineer	Department of Water Resources
Lloyd Fryer	Policy and Administration Manager	Kern County Water Agency
Peter H. Gleick, Ph.D.	Co-founder and President	Pacific Institute for Studies in Development, Environment, and Security
Richard E. Howitt, Ph.D.	Professor of Agricultural Economics	University of California, Davis
Roger Reynolds	Senior Engineer	Summers Engineering, Inc.
Tracy Slavin	Water Conservation Specialist	U.S. Bureau of Reclamation
David Sunding, Ph.D.	Director	Center for Sustainable Resource Development at the University of California, Berkeley
Marc Van Camp	Engineer / Principal	Murray, Burns, and Kienlen
Facilitation Team Member	**Title**	**Affiliation**
Tom Gohring	Program Manager	CALFED
Maria Prokop	Assistant Engineer	CALFED
Scott McCreary, Ph.D.	Principal	CONCUR, Inc.
Bennett Brooks	Associate	CONCUR, Inc.
Lisa Whitman	Associate	CONCUR, Inc.

Prior to the deliberations, CALFED provided both panelists and technical representatives extensive background materials. (A list of these materials is included in Attachment 3.) The deliberations themselves were open to the public, and the agenda specifically allocated time for public comment. Attendees included representatives of environmental, urban, and agricultural interests.

Over the two and one-half day period of its deliberations, the Panel met and participated in the facilitated scientific review. The first hour of the first day was devoted to a general overview of the CALFED Bay-Delta Program. The remainder of the first day and the entire second day was focused on deliberations using the series of questions developed to structure the agenda. On the evening of the second day, the panelists met with the facilitators to review their deliberations and synthesize their recommendations. The third day -- a morning session only -- reported the Panel's findings and recommendations to the public. The agenda for the Panel's deliberations is shown in Attachment 4. Also included are the Ground Rules (Attachment 5) and an overview of the Independent Review Panel process (Attachment 6).

The facilitation team has prepared the attached Final Report, summarizing and synthesizing the Panel's deliberations. Section I presents an overview and synthesis of the Panel's recommendations. Section II provides a more detailed review of the Panel's responses to each specific question. Section III puts forth the Panel's recommended next steps to strengthen the credibility, accountability, and effectiveness of the agricultural water use efficiency program. Supporting materials to this document, including materials prepared to organize the Panel's deliberations, are included in Section IV as attachments.

Panelists have reviewed and provided comments on this Final Report to ensure that it adequately represents the Panel's discussions and recommendations. The results of the Panel's deliberations will, as appropriate, be used by CALFED Bay-Delta staff and agencies to: 1) help guide future development and implementation of the agricultural water use efficiency program; and 2) inform and amend Chapter 4, the revised draft programmatic EIS/EIR, and other relevant CALFED documents.

I. OVERARCHING FINDINGS AND RECOMMENDATIONS

The Independent Review Panel on Agricultural Water Conservation Potential yielded a number of important findings, recommendations and suggested next steps during its December 14-16 deliberations. The Panel's discussions and findings generally centered around two elements of the Water Use Efficiency Program Report:

- Agricultural Section of CALFED's Report on the Water Use Efficiency Program (Chapter 4)
- Program Development and Implementation Recommendations

Below is a brief review of the Panel's major findings and recommendations. A more detailed recounting of the Panel's deliberations on these and other issues is located in Section II of this report.

A. AGRICULTURAL SECTION OF CALFED'S REPORT ON THE WATER USE EFFICIENCY PROGRAM

The Panel spent much of the first day discussing the Agricultural Section of CALFED's Report on the Water Use Efficiency Program (Chapter 4). In its review of Chapter 4, panelists recognized the many important contributions of the report prepared by CALFED staff and consultants. The Panel's findings on Chapter 4 include:

- **Chapter 4 provides a reasonable initial estimate of overall agricultural water conservation potential.** Panelists believe Chapter 4 offers important insights regarding the magnitude of agricultural water conservation potential in the CALFED Solution Area. (Chapter 4 shows that irrecoverable losses are expected to be reduced by 2020. The reduction estimates range from 118,000 to 307,000 acre-feet per year without CALFED, and from 206,000 to 540,000 acre-feet per year with the CALFED Water Use Efficiency Program.) Though panelists were not tasked with recalculating the figures in Chapter 4, they suggested – based on their review of the methodology used – that the figures do offer a reasonable ballpark estimate of overall agricultural water conservation potential.

- **Chapter 4's methodology offers an important starting point.** Based on their review, the panelists suggested that the methodology used in Chapter 4 to calculate agricultural water conservation potential provides an important first step in compiling and synthesizing large amounts of information to support the development of CALFED's Agricultural Water Use Efficiency Program. Similarly, the Panel noted that Chapter 4 devises a more constructive way of looking at agricultural water conservation potential by distinguishing between "irrecoverable losses" and "recoverable losses."

- **Chapter 4's methodology can be strengthened to make it more defensible, more accurate, and more prescriptive.** Panelists' discussions highlighted a series of potentially important shortcomings in the current methodology, limiting its usefulness and possibly undermining Chapter 4's credibility with broader stakeholder communities. In particular, the Panel found that the current methodology should be refined to: 1) estimate region-specific conservation potential; 2) incorporate a more elaborate analysis of evaporation and transpiration;

and 3) include prescriptive information to guide and support planning on a regional basis.

Based on the Panel's findings and its extended discussion of the methodology, the panelists recommended a series of actions that they believe will make Chapter 4 even more useful to the CALFED program and more credible to stakeholders.

1. **Strengthen conservation volume methodology in 1999 to make it more useful and credible.** In their deliberations, panelists devoted much of the first day to analyzing CALFED's existing methodology and stepping out suggestions for strengthening the approach. (Flow charts describing both the current and recommended methodologies are located in Section II.)

   Much of the discussion focused on strategies for improving the underlying methodology. Among the key changes suggested include:

   - ***Develop data at region/crop level.*** Panelists strongly recommended that CALFED refine its baseline data to be as region- and crop-specific as possible.
   - ***Assess/characterize data.*** In its deliberations, the Panel suggested that CALFED look more critically at the data it uses, putting more effort into assessing and characterizing the derivation and accuracy of the numbers underlying its calculations.
   - ***Estimate all ET, in addition to ETAW, and separate E and T.*** Panelists recommended that ET should be estimated independent of the ETAW estimations and that precipitation data should be provided. Comparisons of ET and precipitation with ETAW would provide a means to partially verify the estimates. Similarly, the Panel suggested that the separation of E and T as components of ET be improved to better delineate productive and non-productive crop and environmental water use.
   - ***Screen water conservation actions for cost-effectiveness.*** Panelists recommended that CALFED incorporate a missing economic component into its analysis by adding a screen or formula to ensure that proposed agricultural water conservation actions are the most cost-effective actions available. This screen would be applied to illustrate and forecast cost-effective actions at both the grower / district and CALFED Solution Area levels.
   - ***Do not include discussion of efficiency characteristics.*** Panelists suggested CALFED omit references to efficiency characterizations as those percentages were not actually used in calculations and can be potentially misleading.
   - ***Focus on cost-effective regional programs.*** The Panel recommended that CALFED strive to develop region-specific programs that identify those gains that are cost-effective with and without CALFED involvement. Panelists believe such region-specific cost criteria would greatly improve the benefit of CALFED's agricultural water conservation potential estimates.

2. **Strengthen conservation volume methodology in 1999 to make it more transparent.** Panelists also offered suggestions for improving the way CALFED presents its calculations. The recommendations, designed to make CALFED's work more accessible and credible, focused primarily on:

   · Stating assumptions clearly;
   · Developing confidence bars around key figures; and,
   · Defining terms, explaining their derivations and using them consistently.

B. PROGRAM DEVELOPMENT AND IMPLEMENTATION

In addition to the findings and recommendations pertaining to Chapter 4 listed above, the Panel found that the Agricultural Water Use Efficiency program requires greater definition and a set of specific strategies to meet its objectives. The Panel developed the following recommendations related to Program Development and Implementation to provide these needed elements:

1. **Refine and utilize a flow path strategy to link promising agricultural conservation actions and Bay-Delta objectives.** Based on its discussions of several representative situations in the CALFED Problem Area, the Panel strongly recommended that CALFED utilize a flow path strategy to better understand agriculture's potential role in both contributing to and solving problems in the Bay-Delta area. As depicted by the Panel (and in Figure D), flow paths describe the route that water travels to reach a problem area or another unusable destination. The flow path strategy should incorporate information on:

   · timing of water supply and demand within a season or year and among years;
   · location;
   · quality;
   · primary and secondary objectives;
   · cost-benefit analysis; and,
   · potential multiple benefits (water supply reliability, ecosystem restoration and water quality)

2. **Establish measurable objectives as a basis for planning and tracking desired outcomes.** The Panel strongly suggested that CALFED incorporate measurable objectives into its agricultural water use efficiency program, suggesting that such targets would help CALFED track progress and validate its substantial investments in water conservation programs. Specifically, the Panel recommended that CALFED incorporate specific measurable objectives, including quantitative measurements, that:

   · relate to timing, location and target conditions;
   · incorporate adaptive management strategies; and,
   · are rooted in realistic assessments of baseline conditions.

   Additionally, the Panel suggested that measurable objectives must be developed with the active input and involvement of stakeholders.

3. **Build on existing work.** Panelists strongly recommended that CALFED use existing tools and information wherever possible. This includes building on research now conducted at the plot level, and models and other means to scale up the plot results to field and regional studies that examine full biohydrogeological systems. They further suggested using microscale studies to generate hypotheses to test at larger geographic scales. Specifically, the Panel suggested expanding research efforts into separation of crop evapotranspiration (ET) into evaporation (E) and transpiration (T) components, and other areas related to agricultural water conservation potential.

4. **Move towards measurement of water use – both surface and groundwater -- in California.** In its deliberations, the Panel developed a consensus position that California must move in the direction of measuring all significant components of water use – surface and groundwater -- if state policy-makers and stakeholders are to fully understand and realize water use efficiency potential. In developing its position, panelists agreed that any strategy for moving forward must incorporate and account for several important elements:

   - ***Distinguish between urban and agricultural flows.*** Most notably, panelists discussed the challenges of measuring water use in the agricultural sector, where – unlike its urban counterparts with well defined pipelines -- water supplies often transcend ownership boundaries, and the flows often are diffused and not readily traced.
   - ***Allow for regional flexibility.*** The panelists recognized regions must be given flexibility in implementing measurement programs.
   - ***Create a mechanism for district-level accountability.*** The Panel recommended that the appropriate government agencies work with irrigation districts to formalize the recording and reporting of water use, thereby ensuring that each district has some internal and external accountability.
   - ***Seek to better understand both surface and groundwater use and the links between them.*** Recognizing the interaction between surface and groundwater use, the Panel expressed its strong belief that any credible water measurement program must begin to make an effort at quantifying groundwater use.

5. **Structure a package of assurances to strengthen the credibility, accountability, and effectiveness of the agricultural water use efficiency program.** Panel members felt it is essential that CALFED put together a package of "next steps" to ensure the successful implementation of a wise and effective agricultural water use efficiency program. Specific actions recommended by the Panel include:

   - Adopt a "report card" technique that critiques the agricultural water use efficiency program on: changes in agricultural water use, ecosystem benefits, and user satisfaction. The report card would focus on three types of indicators: effort, process and outcome.
   - Ensure an ongoing mid-course independent technical review and evaluation during 1999 to help CALFED shape and assess its evolving agricultural water conservation program. This effort, according to the Panel, must have strong linkages to the stakeholder community.

6. **Foster cross-disciplinary dialogue with other CALFED programs.** In its deliberations, the Panel has repeatedly encountered and discussed linkages with other program elements. The Panel recommends that the implementation of solutions should link agricultural water use efficiency with other CALFED programs. The Independent Review Panel on Agricultural Conservation Potential strongly recommends convening joint work sessions, with counterparts advising other CALFED programs, to support dialogue across disciplines.

7. **Develop conceptual models.** Panelists repeatedly stressed the value of developing conceptual models as a way to understand ecosystem demands and limitations, create target windows and incorporate issues related to location, timing and CALFED objectives.

8. **Use economic screening.** Panelists emphasized the importance of choosing solutions that are the most cost-effective, both at the grower / district and CALFED levels, for each individual situation and region.

9. **Develop baseline data.** Efforts across the country are often undermined by a lack of solid baseline data. Panel members strongly recommended that CALFED develop reliable baseline data so the results of future efforts can be tracked, measured, and assessed.

II. DISCUSSION SYNTHESIS

A. CRITIQUE OF THE AGRICULTURAL SECTION OF CALFED'S REPORT ON THE WATER USE EFFICIENCY PROGRAM (CHAPTER 4)

During the October 19 Scoping Session, the Panel recommended a deconstruction and evaluation of the methodology used to develop the estimates presented in Chapter 4. This analysis was intended to determine if the methodology is sound enough to support the goals and objectives of the Program, open the discussion to ways the methodology can be strengthened, and identify possible data gaps. At this Scoping Session, CALFED consultant Greg Young presented an overview of the data and assumptions used to structure the methodology that serves as the foundation for Chapter 4.

At the December 14-16 session, the Independent Review Panel focused at length on Chapter 4. Again, CALFED consultant Greg Young presented an overview of the methodology used to develop the conservation potential presented in the chapter. His presentation emphasized, in particular, the derivation of the water conservation volume figures included in the chapter. Panelists then reviewed the conceptual model, the chosen methodology and data sets used to support it, and the assumptions that drive the use of that data.

Current Methodology:

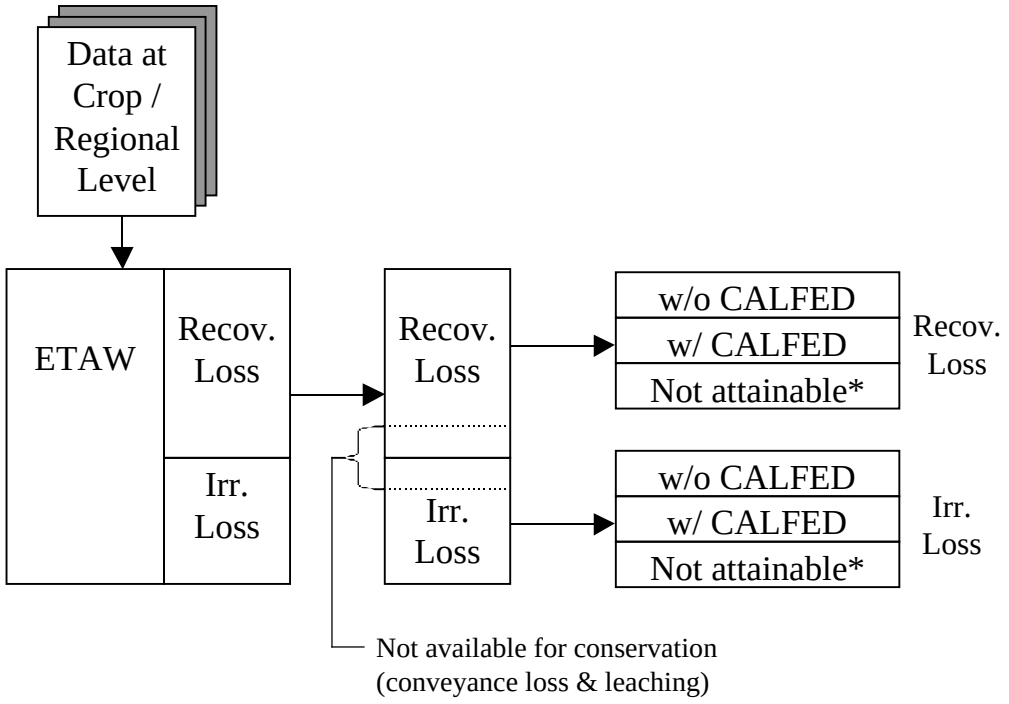
The current methodology used to estimate agricultural water conservation potential was developed using normalized 1995 data on applied water, depletion, and evapotranspiration of applied water (ETAW) provided by the California Department of Water Resources (DWR). This data was then used to calculate total existing losses (the total applied water reduction feasible if CALFED assumed 100% irrigation efficiency) and existing irrecoverable losses (the fraction of the total applied water reduction that could be made available to other beneficial uses assuming 100% irrigation efficiency). Using the method described below (and depicted in Figure A), and recognizing that no system can ever be 100% efficient, these estimates of total losses were apportioned into estimates of conservation expected with and without CALFED. The current methodology also incorporates two other elements:

- **An assumed level of water conservation.** This figure was developed for three scenarios: with CALFED, without CALFED, and not attainable.

- **Efficiency characteristics.** Average existing irrigation efficiency (assumed at 73%) and potential future efficiencies (assumed at 80% without CALFED and 85% with CALFED) were presented to illustrate the level of effort that will be required to reach the given conservation forecasts.

FIGURE A: Agricultural Water Conservation Volume Potential:

Current Methodology



*Not attainable due to technical or economic limitations.

In its review of Chapter 4, panelists recognized the many important contributions of the report prepared by CALFED staff and consultants. Among Chapter 4's most valuable contributions:

- **Chapter 4 provides a reasonable estimate of overall agricultural water conservation potential.** Panelists believe Chapter 4 offers important insights regarding the magnitude of agricultural water conservation potential in the CALFED Solution Area. (Chapter 4 shows that irrecoverable losses are expected to be reduced by 2020. The reduction estimates range from 118,000 to 307,000 acre-feet per year without CALFED, and from 206,000 to 540,000 acre-feet per year with the CALFED Water Use Efficiency Program.) Though panelists were not tasked with recalculating the figures in Chapter 4, they suggested – based on their review of the methodology used – that the figures do offer a reasonable ballpark estimate of overall agricultural water conservation potential.

- **Chapter 4's methodology offers an important starting point.** Based on their review, the panelists suggested that the methodology used in Chapter 4 to calculate agricultural water conservation potential provides an important first step in compiling and synthesizing large amounts of information to support the development of CALFED's Agricultural Water Use Efficiency Program. Similarly,

the Panel noted that Chapter 4 devises a more constructive way of looking at agricultural water conservation potential by distinguishing between "irrecoverable losses" and "recoverable losses."

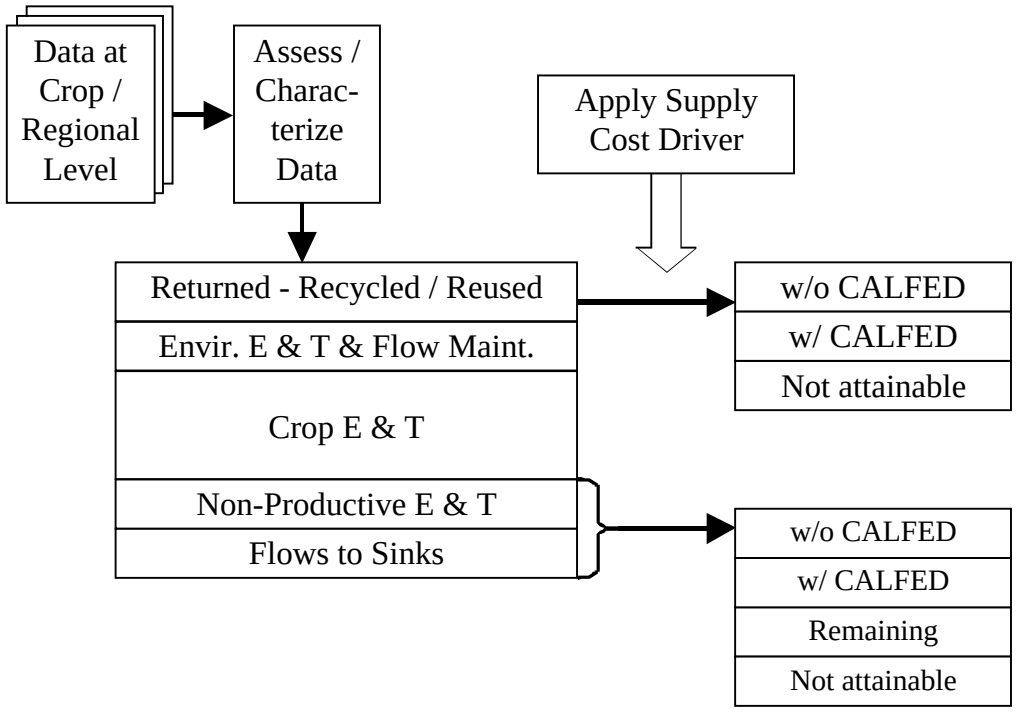
Suggested Changes to Methodology

At the same time, the Panel's discussions highlighted a series of potentially important shortcomings in the current methodology, limiting its usefulness and possibly undermining Chapter 4's credibility with broader stakeholder communities. In particular, the Panel found that the current methodology should be refined to: 1) estimate region-specific conservation potential; 2) incorporate a more elaborate analysis of evaporation and transpiration; and 3) include prescriptive information to guide and support planning on a regional basis. The panelists' recommendations fell into two broad categories:

- Suggested changes to methodology; and
- Other recommendations for improving Chapter 4.

Their suggestions for revising the current methodology are represented in the following figure:

FIGURE B: Agricultural Water Conservation Volume Potential: Suggested Methodology



In developing a revised methodology for determining agricultural water conservation potential, panelists recommended four specific changes that they believe will make the approach more useful, transparent and defensible:

1. **Assess and characterize data.** The Panel recommended revising the methodology to incorporate a step to clearly assess and characterize the crop and regional data being used to calculate agricultural water conservation volume potential. This step, as articulated by the Panel in its deliberations, would make clear the derivation, strengths and limitations of the data being used. It also would allow for and necessitate developing confidence bars around data in order to include a range of accuracy.

2. **Calculate conservation potential based on separate evaporation and transpiration data.** Traditionally, crop evaporation (E) and transpiration (T) were combined for use in irrigated agriculture and typically referred to as evapotranspiration (ET). This method of data characterization was necessary with the older irrigation technologies that made it nearly impossible to distinguish between evaporated and transpired water. However, new irrigation technologies are allowing scientists to recognize that E and T are not bound together; the relationship between them differs, and they can be measured separately. For example, with surface and subsurface trickle / drip irrigation it is possible to practically eliminate the E. With surface or sprinkler irrigation, E cannot be eliminated, but may be reduced somewhat by reducing row spacing, increasing planting density, and possibly reduced irrigation frequency. On the other hand, with high frequency overhead sprinkler irrigation, such as with the center pivot system, E is typically much higher than with surface irrigation, especially in the early growth stage when the canopy cover is low. In view of this, the Panel strongly recommended a more detailed evaluation of the potential of saving a part of the E of ET in the context of cost effectiveness and with due attention to the crop and irrigation technology specific nature of the problem. Related to this is the need to assess ET for the Planning Subareas in addition to the assessment of ETAW.

3. **Revise and expand terminology used to describe agricultural water conservation potential.** Rather than calculate conservation potential by using ETAW, recoverable losses, and irrecoverable losses – as is done in the current methodology-- panelists suggested a more detailed approach -- reflected in Figure C -- that analyzes the evaporation and transpiration of:

   - **Returned – Recycled/Reused.** This is the portion of the water diverted from surface flows or pumped from wells that is not consumed or depleted by evaporation (E) or transpiration (T) from vegetation or discharged directly to a salt sink. Thus it is returned either to the surface flows or to the groundwater and reused.
   - **Environmental E, T, and Maintenance Flows.** These flows are the E from open water surfaces, T from riparian vegetation and flows in streams and estuaries necessary for maintaining fisheries and wildlife habitat.
   - **Crop E & T.** These are the E from water and wetted soil surfaces following irrigation or rain and the crop T necessary for optimum production.

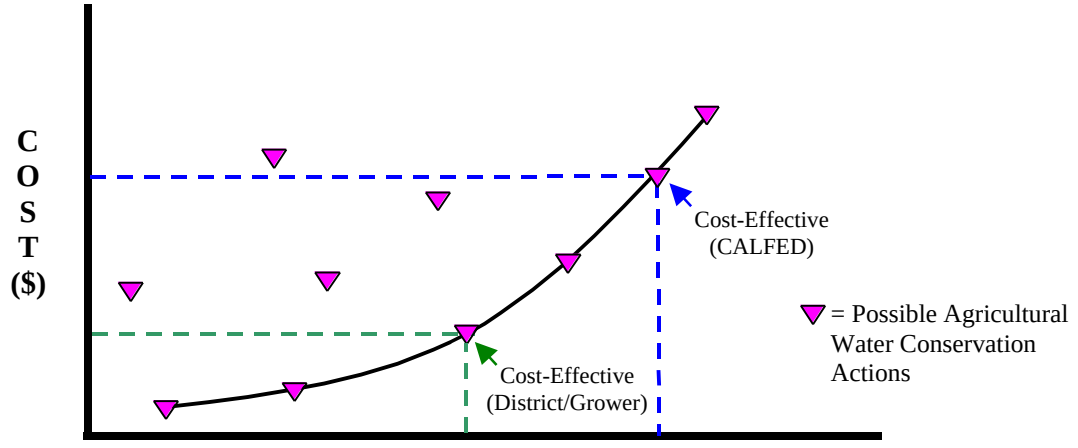
- **Non-Productive E & T.** These are E and T depletions that could be reduced or eliminated without adversely affecting the environment or reducing the productivity of irrigated agriculture.
- **Flows to Sinks.** These are flows that are either lost to salt sinks (like oceans or salinized depressions) or to aquifers that are too deep for economic recovery of the water.

Water savings earned through the reduction of irrecoverable losses (non-productive E & T, crop E and flows to sinks) can be transferred and are, therefore, potentially available to market. The potential gains earned by reducing "returned – recycled / reused flows" may be very important environmentally in specific circumstances (rerouting flows, etc.), but would not typically result in transferable savings.

4. **Apply a supply cost driver to determine conservation possibilities.** This approach is rooted in the Panel's conviction that conservation potential should and will (at least for the grower) be rooted in cost-effective actions. This supply-cost driver, as depicted in Figure C on the following page, would calculate – on a regional or basin-wide basis – agricultural water conservation potential that is cost-effective on two levels: for the grower / district and at the CALFED Solution Area. It would also demonstrate what agricultural water is not currently attainable, due to cost-effectiveness barriers or technical impracticalities. Finally, this approach will show the most economical progression of adopting conservation options.

5. **Clarify efficiency values.** Clarify the geographic (e.g. farm or basin) and temporal (e.g. single field or seasonal average) nature of any efficiency values discussed in the Water Use Efficiency report.

Figure C: Cost-Effectiveness Frontier for Water Conservation Actions



Other Recommendations for Improving Chapter 4

The Panel's deliberations spawned additional recommendations to clarify and strengthen Chapter 4, beyond improving the methodology. During their discussion, panelists provided a list of suggested changes, including the clarification of certain assumptions, definitions, and data. Panelists' recommendations included:

- Remove or recast efficiency as a characterization, not a calculation. In general, the Panel did not believe it was helpful to include average efficiency levels across regions.
- Reassess the assumptions that resulted in the decision to remove some possible agricultural water conservation gains from the table (such as leaching and crop ET).
- Clarify the derivation and definition of certain key terms (such as ETAW, ET, applied water, and evapotranspiration) to identify specifically the bases or estimations giving rise to the numbers presented in the chapter. The terminology defined then needs to be used consistently, and the assumptions contained within the chapter need to be stated clearly.
- Make methodology transparent – explain more precisely how figures were calculated -- to increase the accessibility and credibility of the document.
- Clarify the development of "no action" water gains. Clearly articulate that the calculation of that potential assumed no change in the cropping mix.
- Review cost per acre-foot saved calculations. During the deliberations, one panelist flagged a potential correction to the calculations of the cost-per-acre-foot savings included in Chapter 4. The Panel recommended CALFED closely review the cost-per-acre-foot-savings figures currently in Chapter 4.
- Clarify water use information included in Chapter 4 to delineate the point of diversion (e.g. district or farm).
- Test evapotranspiration assumptions against one or two case studies.
- Implement a peer review process that is accountable to CALFED and the stakeholder community. The stakeholder community should continue to have a role in future reviews.

It is the Panel's belief that the above recommended changes, if incorporated, would build on the foundation developed in Chapter 4.

B. REPRESENTATIVE SITUATIONS THAT COULD BE ADDRESSED THROUGH IMPROVED AGRICULTURAL WATER CONSERVATION

During its deliberations, the Independent Review Panel on Agricultural Water Conservation Potential was asked by CALFED staff to look closely at a handful of situations in the Bay-Delta system and:

- identify problems;
- frame objectives;
- structure solutions;
- devise strategies for quantifying potential benefits; and,
- detail further information / research needs.

The goal of this effort, as articulated by CALFED staff, panelists and stakeholders during the October Scoping Session, was to devise, test and refine methodologies CALFED and interested stakeholders could use to better understand and address Bay-Delta concerns.

To structure the discussion, CALFED staff prepared a detailed list of Bay-Delta problems, as well as a shorter synopsis of eight situations in the Bay-Delta system, with each example representing typical and challenging problems. Panelists were asked to select three situations for more focused deliberations. (A brief listing of the situations is provided below. A more detailed synopsis of all eight situations is included as Attachment 7a.)

Table 3: Representative Problem Situations

Situation 1: Low-dissolved oxygen concentration and oxygen depleting substances	**Situation 5:** Evaporation losses
Situation 2: Pesticides	**Situation 6:** Hydraulic conditions
Situation 3: Salinity	**Situation 7:** Stream temperatures
Situation 4: Irrecoverable losses	**Situation 8:** Water supply reliability

In choosing three situations, the Panel agreed to focus on those examples that offered the potential to: incorporate discussions of timing and flow paths; consider agricultural water management practices; look across CALFED programs and objectives; and focus on a wide range of Bay-Delta issues. Based on these criteria, the Panel discussed three situations at length:

- Salinity
- Evaporation losses
- Hydraulic conditions

The Panel's discussion on each of these three representative situations is summarized on the following pages. But it is worth highlighting the key crosscutting themes and conclusions that emerged from the deliberations on all three situations. They include:

- ✓ **Select and prioritize objectives.** Given CALFED's varied aims, panelists stressed the importance of piecing together strategies that identify and satisfy the top priorities and optimize competing objectives, benefits and impacts. Desired outcomes and measurable objectives must be considered and stated explicitly or desired outcomes are unlikely to be met.
- ✓ **Focus on flow paths.** The Panel emphasized the importance of using flow paths to understand Bay-Delta problems and devise solutions to meet CALFED objectives. The Panel further suggested that each flow path be evaluated for its impact on or relation to: water quantity, water quality, timing, location, ecosystem restoration and water supply reliability.
- ✓ **Develop conceptual models.** Panelists repeatedly stressed the value of developing conceptual models as a way to understand ecosystem demands and limitations, create target windows and incorporate issues related to location, timing and CALFED objectives.
- ✓ **Choose cost-effective solutions.** Panelists emphasized the importance of choosing solutions that are the most cost-effective, both at the grower / district and CALFED levels, for each individual situation and region.
- ✓ **Support region-level field models.** While detailed information on the structure and function of ecosystems is fruitfully investigated at the plot- or micro-scale, the Panel believes it is essential to build landscape-scale models to more completely understand and evaluate the impacts of different management practices.
- ✓ **Build on earlier work.** In its brief deliberations, the Panel identified numerous sources of beneficial research already undertaken or ongoing. Panelists stressed the importance of building on and taking advantage of existing research.
- ✓ **Develop additional baseline data.** Efforts across the country are often undermined by a lack of solid baseline data. Panel members strongly recommended that CALFED develop reliable baseline data so the results of future efforts can be tracked, measured and assessed.

Representative Situation One: Reduce Evaporation Losses

Problem/Objective:

This representative situation focuses on the problem of water lost to evaporation in non-productive manners in the Delta region. The Panel quickly framed the objective as reducing non-productive evaporation (irrecoverable loss) from three specific areas: 1) on-farm activities; 2) water surfaces; and, 3) riparian corridors.

Key Elements of Discussion:

The discussion of this representative situation highlighted several key strategies for tackling problems tied to evaporation. Among the steps suggested by the panelists and others attending the deliberations include:

1. **Develop an overall approach for each loss type (on-farm, surface, riparian corridor).** Panelists outlined a three-step process for working through this situation:

   - Assess the current losses, being certain to separate out evaporation ("E") from transpiration ("T").
   - Develop a list of technical improvements and management practices available to address evaporation.
   - Screen the potential improvements and practices to ensure the most cost-effective steps are taken first. This screening necessitates assessing the cost/unit of water saved.

2. **Weigh/balance competing CALFED objectives.** The Panel's discussion of this situation highlighted the need to consider and balance competing CALFED objectives. Two examples cited:

   - Devise strategies for replacing existing riparian vegetation with species that minimize evaporation loss yet still contribute to ecosystem needs.
   - Reduce non-productive crop evaporation without negatively impacting crop transpiration.

3. **Ensure that discussion encompasses all issues.** Though it was beyond the scope of the Panel to consider actions such as fallowing, crop rotation and genetics as a way to minimize non-productive evaporation, panelists did recommend that others within the CALFED Bay-Delta Program not preclude these and other potential solutions. Panelists identified a range of possible solutions that includes: groundwater linkages; irrigation management; weed management; agronomic adaptation (crop spacing); and increased use of groundwater storage. They also stressed the importance of not minimizing the difficulties in changing cultural practices such as crop spacing.

4. **Expand plot-level tests to field and regional experiments.** Recognizing the plot-level tests now underway (for example, assessing the impact of canopy cover and crop spacing on evaporation), panelists strongly recommended that CALFED support efforts to undertake field and region-level tests. Areas to examine include estimating E & T for different soils, plants, and agronomic practices.

Possible Solutions:

The Panel's discussion yielded the outline of a solution rooted in a range of possible responses.

- **On-Farm.** To reduce on-farm evaporation, the Panel suggested a range of possible actions that includes: structural changes (e.g., employing new irrigation methods); management changes (e.g., reducing frequency); crop fallowing; crop selection; genetic adaptation of crop species; weed management; and agronomic adaptations (e.g., crop spacing).

- **Surface Water.** A possible solution to reducing evaporation from water surfaces is to use groundwater storage instead of surface storage. As panelists pointed out, however, this necessitates developing a better understanding of a region's overall water balance.

- **Riparian Corridor.** Solutions to reducing riparian evaporation involve selecting, whenever possible, native riparian plant species that -- consistent with the ecosystem enhancement objectives -- are less water intensive.

Quantification/Research Needed:

During the Panel's deliberations, one panelist presented the results of research he and colleagues are conducting to determine the impact of crop spacing and canopy cover on evaporation. His presentation – and subsequent discussions – yielded a number of suggestions on studies and research that would help quantify potential gains and guide future policy in this area. Among the suggestions:

- Develop research studies that enable measurement and modeling of distinctions between E and T.
- Further explore the limits that energy places on total E and T.
- Develop / parameterize a model of E and T for each crop type.
- Compute and display district-level E and T at various times of year and with varying canopy covers.
- Establish test plots to examine -- in side-by-side comparisons -- the relative E and T with different agronomic practices.
- Examine the effect on E and T of:
  - regional differences
  - soils
  - agricultural practices, such as crop spacing and canopy density
  - crops
  - seasonality
  - irrigation methods
- Evaluate non-crop E and T in riparian zones (herbaceous, shrub, or tree dominated).
- Conduct experiments across a range of habitat types dominant in the CALFED study region.
- Critically assess the value of vegetation established in drainage ditches.
- Experiment across a range of riparian habitat types.

Representative Situation Two: Control Salinity in the Lower San Joaquin River

Problem/Objective:

For its second representative situation, the Panel considered the problem of excessive salt concentrations in the Lower San Joaquin River between April and March. This salinity has multiple negative impacts in a number of areas, including:

- Diminishing crop growth for agricultural uses;
- Lowering water quality for urban uses; and,
- Degrading ecosystem for environmental uses.

The objective in this situation, as framed by the panelists, is to maintain favorable salinity levels in and downstream of the Lower San Joaquin River.

Key Elements of Discussion:

The discussion among the Panel, technical advisors and stakeholders yielded several important suggestions that are applicable beyond specific discussions around salinity concentrations in San Joaquin River and other systems. These include:

1. **Understand system's needs and limitations.** In their discussion of this situation, panelists stressed the importance of understanding the system's needs as thoroughly as possible, creating bands of acceptable and unacceptable levels for a range of conditions and indicators. Some examples cited:

   - Before addressing specific solutions, it is essential that effort be made to understand the shape of the damage function in the Delta (detailing the relationship between stream salinity and damage to aquatic species).
   - Panelists recommended developing salinity envelopes that identified salinity levels acceptable for agricultural, urban and ecosystem needs.
   - Similarly, panelists stressed the importance of determining flows needed – level, timing and seasonality – to keep salt concentrations within each sector's required salinity envelopes.

2. **Need to assess and prioritize competing demands and objectives.** Building on its earlier discussions around evaporation, the Panel emphasized the need to shape a program that recognizes and then prioritizes among competing demands and objectives. For example, in this particular situation, the Panel recommended the following approach:

   - Recognize differences in the way various water users look at salinity. Agriculture, for example, focuses on minimizing salinity and maintaining the salt balance in the overall tributary area. Environmental interests, meanwhile, are concerned with meeting appropriate salinity envelopes for plant and aquatic species. And urban interests focus almost exclusively on minimizing salinity.
   - Within the context of competing demands, establish a clear primary objective and then prioritize the remaining objectives. Be as specific and explicit as possible.

- Develop a solution that optimizes the salinity needs of each user. In doing so, recognize the multiple benefits and impacts associated with each action.

Possible Solutions:

The Panel recognized that the salinity situation demands both reducing overall salt loads and discharging salt at strategic times. Accordingly, the Panel developed a three-prong strategy for addressing excessive salinity concentrations in the Lower San Joaquin River:

- Reduce salt import to tributary agricultural lands through improved water application techniques;
- Remove, treat and market salt; and,
- Delay the discharge of salt to the Lower San Joaquin River until high-flow periods.

The Panel stressed the need to use the mix of tools that satisfies the primary objectives and optimizes the salinity needs of the various water users. Moreover, as a program to address salinity is developed, the Panel's discussion yielded other relevant suggestions:

- Do not underestimate the importance of looking at location and timing needs.
- Take advantage of the value of using trace marker elements.
- Build on earlier work. (For example, one technical advisor made an extensive and well-received presentation on work he and others are doing with agricultural users to concentrate, harvest and market salt and selenium from agricultural drainage water.)
- Focus on both on-farm and the district as possible solution areas.

Quantification/Research Needed:

During its discussion, the Panel further developed a strategic list of issues warranting further study – both to help develop more targeted solutions and to track progress as corrective measures are undertaken. Among the suggestions:

- Establish salinity tolerance boundaries, with an emphasis on survival, growth, and reproduction. Identify target organisms; conduct analysis on a mesoscale.
- Test strategies to limit the amount and timing of salt discharge off a given field.
- Clarify the damage function associated with high levels of salinity; develop a dose / yield response.
- Use contingent valuation methods to quantify the value of non-market benefits.
- Develop / establish seasonal salt tolerance levels by crop type.
- Create test plots at strategic locations to enable side-by-side comparisons of alternative water management techniques.
- Perform a salt balance analysis on a district or regional basis.
- Investigate alternative methods of salt removal. Examine both integrative drainage management and membrane technologies.
- Examine upslope / downslope differences.
- Refine methods of crop selection based upon location of planted areas relative to salt accumulation / drainage characteristics.

Representative Situation Three: Emulate Historic Flows in the Stanislaus River

Problem/Objective:

As described by CALFED staff, the flow (hydraulic conditions) in a 20-mile stretch of the Stanislaus River below the Goodwin Dam has been significantly altered by on-stream storage and river diversions. These altered flows have detrimental impacts on desired aquatic organisms. Moreover, this problem is exacerbated by the fact that the river system is over-allocated and the adjacent groundwater basin to the north is over-drafted. The objective in this situation, as agreed to by the Panel, is to emulate pre-project flow processes in the relevant river segment and maximize the beneficial water uses in the lands adjacent to the river segment.

Key Elements of Discussion:

This discussion, like the others, highlighted the importance of prioritizing objectives and developing a logical, well-thought out approach. In this particular situation, the Panel recommended an approach built on understanding:

- current flow (baseline);
- historical flows (perspective);
- increment needed (flow windows based on species/ecosystem needs);
- geographic specific (points of infusion and outflow);
- agriculture's possible contribution to flow needs; and,
- cost-effective actions.

But it also focused attention on two other approaches that most certainly have broader applicability beyond the situation being considered by the Panel. These include:

1. **Recognize the value of flow path tools.** One panelist developed and presented a model for targeting flow path changes to meet various CALFED objectives. The model – outlined in Figure D on the following page – provides a strategy for seeing how various flow paths both impact a problem and offer possible solutions. To ensure a flow path tool is used as effectively as possible, the Panel stressed the need to:

    - Incorporate information on: timing; location; quality; primary and secondary objectives; cost-benefit analysis; and, potential multiple benefits (water supply reliability, ecosystem restoration and water quality);
    - Make explicit that multiple flow paths can be and often are impacted by a single action;
    - Understand a region or district's complete water balance; and
    - Recognize that many flow paths (e.g. deep percolation returned to a stream) are long and deep.

Figure D: Targeting (Water Balance) Flow Path Changes Associated with Irrigation Management to Meet a Specific CALFED Objective

Specific CALFED Objective

The objective provides the purpose of a plan in quantifiable terms to solve a specific water quality or flow problem at a specific location and time for a specific use or process.

The objectives would fall under three categories:
- Ecosystem Quality
- Water Supply
- Water Quality

Targeted Flow Path Changes
At Specific Locations During a Specific Time Period

Water Balance and Flow Paths	Quantity % of Total Supply		Quality Tons of Load					
			Salt		Pollutants		Silt	
	Base	Target	Base	Target	Base	Target	Base	Target
Total Diversions	100	84						
GW Extraction	0							
Internal Reservoir Releases	0							
Precipitation	0							
Total Water Supply	100	84						
* Habitat ET	2							
* W.S. Evaporation	2							
Channel Seepage	5							
Leakage	1							
Operational spill	10	•						
Total Farm Delivery	***80***							
* Crop E	8							
* Crop T	49	•						
* Habitat E & T	2							
* Non-productive E & T	1							
* Direct Evaporation	2							
Ditch Seepage	2							
Deep Percolation	7	•						
Farm Runoff	9	•						
All Evaporative Depletions	-66							
Surface Water Storage Changes								
Soil Water Storage Change	0							
Total Outflows	-34							

* Evaporitive Depletions • Items Targeted for Reductions

2. **Focus on emulating – not recreating -- natural processes.** The Panel's deliberations included extensive discussion of the need to emulate, but not necessarily recreate, natural flow processes. As explained by one panelist, the goal is to trigger desired reactions in target species; in essence, emulating flows that effectively hit a species' "restart button." The key is to: 1) have a solid historical perspective of recurrence intervals; and 2) know what's needed to hit a species' "restart button." Solutions of this nature are inherently more complex than those that rely on minimum flow standards, but may ultimately offer more benefits to both water users and the environment.

Possible Solutions:

Though the Panel did not develop a specific solution to the problem presented on the Stanislaus River, the deliberations did suggest a suite of actions that – simultaneously – would likely result in flows that better create and sustain habitat, while doing no harm to other water users. The actions – focused around reducing diversions and augmenting flows -- include:

- Strategically altering the flow to emulate the pre-project flow processes, using a minimum of water from reservoir releases;
- Reducing on-farm and district evaporation losses;
- Reducing flow-through losses on adjacent agricultural lands to increase in-stream flows;
- Reducing applied water;

- Reducing spillage (reregulating flow, using secondary / lateral canals and automatic gates); and,
- Using groundwater to store excess water during wet periods and then releasing it to augment flows during times of shortage.

Quantification/Research Needed:

Panelists felt strongly that measurable objectives are both important and attainable. In this situation, panelists suggested a number of measures to quantify results, including the measurement of: flow through losses (spill, deep percolation, etc.); flow in river; diversions; indicator species; and evaporation.

Panelists also identified a number of research needs, including suggestions to:

- Conduct studies that integrate the disciplines of surface water hydrology, fluvial morphology and ecology. Take advantage of the rapidly evolving "frontier of interest" of both terrestrial and aquatic researchers in riparian systems restoration.
- Calibrate / validate the need for stated flow processes. Use techniques such as satellite imagery to track channel morphology (including large woody debris) over time.
- Examine opportunities to find timing matches that involve shifting: 1) cropping choices; and 2) hatchery manipulations.
- Emphasize the role of measurement; develop better water balance information on a regional basis.
- Examine flow paths on a basin-by-basin basis, with an emphasis on deep percolation, operation spills and lag times.
- Clarify the source(s) and derivation (and appropriate extrapolation) of the Detailed Analysis Unit (DAU) data pool.

III. ASSURANCES and NEXT STEPS

In their deliberations, panelists recommended that CALFED structure a package of assurances to strengthen the credibility, accountability, and effectiveness of the Agricultural Water Use Efficiency Program. The panelists believe strongly that the Program will be more effective, and therefore more valuable, if a clearly defined process is put in place to track program progress towards its stated goals, provide ongoing guidance during implementation, and build in additional revisions when necessary. The panelists recommended that the package of assurances be structured to incorporate:

1. **The Use of a Report Card.** The Panel believes the creation of a report card would offer an important and necessary opportunity to track program progress and shape any adaptive management strategy. Typically, report cards tied to initiatives such as these focus on identifying and monitoring indicators of ecosystem integrity and health, ecosystem elements critical to sustainable function, and/or organisms of special value or concern. The report card could assess progress in three areas: effort, process and outcome.

   A report card related to agricultural water conservation would periodically monitor and assess the balance of key indicators related to both ecosystem and agriculture needs. For example:

   - A nutrient cycling evaluation should relate nutrient requirements of crops to the normal cycling rates in the receiving ecosystem (e.g. river, bay, wetlands). The reported value would relate the range of nutrient enrichment acceptable to agriculture to the range of nutrient turnover judged acceptable to the receiving ecosystem, as measured by such entities as nitrate concentrations and chlorophyl levels.

   - The report card should clearly compare and assess the balance between the competing needs of the crops in question and the species of concern. For example, the assessment should compare the minimum flow requirements of agriculture with the minimum flow requirements for the given species populations, such as salmon.

2. **Ensure Ongoing Mid-course Independent Technical Review and Evaluation.** It is the Panel's strong suggestion that CALFED put in place an ongoing, mid-course independent technical review and evaluation during 1999 to help CALFED shape and assess its evolving agricultural water conservation program. To be most effective, any such effort must have strong linkages to the stakeholder community and could include the following elements:

   - Assessing and characterizing data;
   - Reviewing CALFED's strategic planning effort;
   - Guiding the development of an adaptive management strategy;

- Helping CALFED shape technical advice to irrigation districts and growers regarding conservation strategies, with a particular emphasis on evaporation, irrigation scheduling and optimizing delivery systems;
- Gauging the appropriateness of measurement strategies and efforts to quantify measurable objectives; and,
- Assisting CALFED's efforts to track progress benefits (including hypothesis testing).

3. **Linkages to Other Program Elements.** In its deliberations, the Panel has repeatedly encountered and discussed inherent linkages with other CALFED program elements and the value of coordinating those elements. The Panel believes this cross-disciplinary dialogue is essential and recommends that any implementation effort should link agricultural water use efficiency with other CALFED programs. The Panel strongly recommends convening joint work sessions – with counterparts advising other CALFED programs – to support dialogue across disciplines.

   This recommendation, called out in other sections of this report, expresses a need to recognize and prioritize competing CALFED objectives. Within the context of competing demands, a clear primary objective needs to be established, and the remaining objectives prioritized.

Final Thoughts:

It is CALFED's intention that this Final Report will be used to help guide future development of the agricultural water use efficiency program, and inform and amend Chapter 4, the revised draft programmatic EIS/EIR, and other relevant CALFED documents.

In conclusion, the Independent Review Panel on Agricultural Water Conservation wishes to acknowledge the significant effort put forth by CALFED staff to develop the potential agricultural conservation savings and recognizes it as an important body of work. The panelists congratulate CALFED for its willingness to open up its work to such detailed review and praise the structure of the review process.

IV. LIST OF ATTACHMENTS

The following documents, with the exception of Attachment 3, were provided as handouts at the December 14-16, 1998 deliberations of the Independent Review Panel for Agricultural Water Conservation Potential. Attachment 3 was created specifically for this document, as reference information.

ATTACHMENT 1:	Context of Questions for Panel Deliberations
ATTACHMENT 2:	Panelist, Technical Advisor, and Facilitation Team Biographies
ATTACHMENT 3:	Background Materials, and Additional Information Provided to the Independent Review Panel on Agricultural Water Conservation Potential
ATTACHMENT 4:	Agenda
ATTACHMENT 5:	Meeting Procedures / Ground Rules
ATTACHMENT 6:	Process for Independent Review Panel on Agricultural Water Conservation Potential
ATTACHMENT 7a:	Representative Situations in the CALFED Bay-Delta Solution Area
ATTACHMENT 7b:	Detailed Objectives

ATTACHMENT 1

CONTEXT OF QUESTIONS FOR PANEL DELIBERATIONS

On October 19, 1998, CALFED convened a one-day Scoping Session to brief interested members of the public on CALFED's rationale for convening the Independent Review Panel on Agricultural Water Conservation Potential. The one-day session also offered an important opportunity for stakeholders, Panelists and the general public to provide input to CALFED on the structure and focus of the Panel's deliberations.

The questions the panel will be deliberating between December 14-16 are informed and shaped by several key themes discussed during the one-day Scoping Session. Chief among those themes:

- **NEED TO FRAME PROBLEM-DRIVEN SOLUTIONS:** There was broad agreement that the Panel's expertise is best used by piecing together solutions to specific problems identified by CALFED, rather than developing a comprehensive list of water conservation techniques. The discussion around this issue identified several advantages to such a problem-driven approach, including:

    1. Allows the Panel to focus its deliberations around actual problems;

    2. Enables the Panel to identify solutions best suited to match flow paths, regional characteristics and other specific concerns, and then develop criteria for measuring the success/impact of any water conservation efforts undertaken; and,

    3. Provides the opportunity for the Panel to consider the full range of water conservation solutions, yet still allows those affected by such solutions to decide which suite of solutions to implement.

- **IMPORTANCE OF QUANTIFYING BENEFITS:** Discussion among the panelists and stakeholders highlighted the importance of and challenges tied to identifying potential benefits of problem-specific agricultural water conservation efforts. Panelists agreed that an adaptive management strategy, though difficult to apply, is necessary to measure the benefits of agricultural water conservation benefits. Accordingly, the Panel agreed to develop advice for CALFED on strategies for:

    1. Identifying appropriate reference conditions (flow rates, keystone and/or charismatic organisms, salinity levels, etc.);
    2. Developing measures to monitor problems; and,

3. Measuring progress / outcomes.
4. Designing and implementing experiments that would test the hypotheses on which the actions are based

- **USE OF FLOW PATHS:** The Panelists intend to use flow paths to connect problems to the Solution Area. Flow paths describe the route that water travels to reach a problem area or another unusable destination. Examples of flow paths include evapotranspiration and farm runoff. By focusing on the flow paths, the Panel hopes to develop the most practical strategy for solving a given problem.

- **VALUE OF A CONCEPTUAL MODEL:** Panelists agreed upon the importance of developing an overarching conceptual model that accounts for the numerous linkages among the water conservation issues being discussed and with other CALFED issues. The probable elements of such a model would include: problem identification; solution possibilities (aligned by flow paths); desired outcomes / benefits; and measurement strategies.

- **EXPLANATION OF METHODOLOGY:** The Panelists recommended a deconstruction and evaluation of the methodology used to develop the Agricultural Water Use Efficiency Technical Appendix. This investigation would help determine if the methodology is sound enough to support the goals and objectives of the Program, open the discussion to ways the methodology can be strengthened and identify possible data gaps.

- **ROLE OF ECONOMIC ANALYSIS:** The Panel debated the appropriateness of assessing the economic feasibility of potential solutions. It was noted that the early use of an economics-driven screen would help the Panel eliminate technically practical but economically infeasible water conservation solutions. After much discussion, however, the Panel agreed not to apply a cost-benefit screen during its future deliberations of technical feasibility for two primary reasons:

  1. An economic analysis would likely fail to capture non-monetary benefits beyond the on-farm and district level; and
  2. The economic feasibility of any conservation practice can change dramatically based on government-driven water pricing decisions, and location

  The Panel did agree, however, to develop a list of categories to consider and a process to employ when carrying out a cost-benefit analysis.

- **IMPLEMENTATION:** Panelists debated their ability to measure the benefits of agricultural water conservation without knowing how any real water savings are to be allocated (i.e., to what region and for what use). While it was noted that

transfers and assurances are beyond the scope of its deliberations, panelists agreed to outline some critical actions that CALFED can take in the future to develop an implementation plan that links real water savings to environmental benefits.

As a result of these discussions, panelists agreed to a series of six questions that best focuses the Panel's deliberations around these broad themes. A list of these questions – and the time each will be discussed – follows below.

Monday, December 14:

10:20 a.m. – 12:15 p.m.	**Question 1a (Review Chapter 4):** What is the conceptual model that structures the methodology? What is the chosen methodology and is it appropriate given the overall goal of the CALFED Agricultural Water Use Efficiency Program? Are the assumptions contained in the overall conceptual model of the methodology appropriate? Are the data sets available to support the methodology?
1:00 p.m. – 2:45 p.m.	**Question 1b (Review Chapter 4):** What additions and/or corrections are required to make the real water conservation estimates contained in the Agricultural Section appropriate and defensible for a programmatic-level analysis?
2:55 p.m. – 4:30 p.m.	**Question 2 (Identify Problems):** CALFED staff is to provide the panel with overviews of representative situations in the Bay-Delta problem area. Please identify the Bay-Delta problems evident in these situations, with particular emphasis on timing, location and water quality? Which of these problems can be addressed through changes in agricultural water management? Which of these representative situations (please select three) should be analyzed in greater detail as part of the Panel's deliberations?

Tuesday, December 15:

9:00 a.m. – 10:30 a.m.	**Question 3 (Develop Objectives and Possible Solutions):** Focusing specifically on the three representative situations chosen for greater analysis, please restate the sample problems from Question 2 in the form of objectives. What are the possible solutions, with an emphasis on flowpath?
10:40 a.m. – 1:30 p.m.	**Question 4 (Choose Preferred Solution & Quantify Benefits):** For each of the objectives stated in Question 3, choose a preferred solution. What is the preferred approach for quantifying the potential Delta- and tributary-related benefits? What are the measurable indicators of success (benefits) in accomplishing the objectives developed in answering Question 3? State the specific cause and effect expected between each potential action and its expected benefit(s) in the form of an hypothesis.
1:30 p.m. – 2:50 p.m.	**Question 5 (Research & Data Needs):** What additional data collection and research are required to adequately answer the above questions? What experiments would be useful to verify the hypothesis of cause and effect?
3:00 p.m. - 4:30 p.m.	**Question 6 (Assurances):** What does CALFED have to do to ensure that the expected benefits are realized, and that they are in support of the CALFED solution?

Wednesday, December 16:

10:00 a.m. - 11:30 a.m.	Presentation and discussion of Panel findings and recommendations.

ATTACHMENT 2
PANELIST, TECHNICAL ADVISOR, AND FACILITATION TEAM BIOGRAPHIES

Panelist Biographies

KEN CUMMINS currently holds the position of Distinguished Scientist in the Ecosystem Restoration Department of the South Florida Water Management District, and is located at the Tarpon Bay Environmental Laboratory on Sanibel Island, Florida. Prior to this position, Dr. Cummins held academic appointments at the universities of Pittsburgh and Maryland, Oregon State University, Michigan State University, and Northwestern University. His areas of expertise are stream and river ecology and riparian ecosystems.

Dr. Cummins completed his doctoral work in Zoology at the University of Michigan. He has since published extensively in the following areas: stream / river ecosystem structure and function; general stream / river ecosystem theory with special emphasis on land-water interactions, especially sources and the fates of organic matter from the riparian zone; functional group analysis of stream organisms and factors that regulate their growth and mortality; and the restoration of large river-floodplain ecosystems, invertebrate food webs of wetland ecosystems, ecosystem metabolism in littoral, floodplain, and estuarine ecosystems.

Dr. Cummins has had a strong influence on many of the nation's largest restoration projects. He is currently guiding the biological component of the Caloosahatchee River Restoration project, a joint effort of the U.S. Army Corps of Engineers, the South Florida Water Management District, and the Florida Center for Environmental Studies. He is also a member of several advisory boards, including the Environmental Protection Agency Science Advisory Board Executive Committee, the State of Oregon Timber-Salmon Panel, and the Riparian Monitoring Panel for the State of Washington's Olympic Peninsula. In November of 1997, he served as panel chair to the scientific review of CALFED's Ecosystem Restoration Program Plan.

MARK GRISMER is currently Professor of Hydrology and Agricultural Engineering at the University of California, Davis, for the Departments of Land, Air and Water Resources, and Biological and Agricultural Engineering. He received his Ph.D. in Agricultural Engineering from Colorado State University, with an emphasis in Groundwater Hydrology. He also earned an M.S. in Environmental Engineering from Oregon State University, with an emphasis in Hydrology and Water Quality.

Dr. Grismer's field research has focused on hydrology, irrigation, and drainage engineering, as well as soil salinity and cracking, water quality issues associated with agricultural runoff, the restoration of tidal marshes via drainage channel design and construction, and the use of constructed wetlands for treatment of agricultural process waters. In the laboratory, he has studied soil physics, the measurement of solid hydraulic parameters, multi-phase transport through soils, adsorption / desorption of

VOC's on clay minerals, strength of clays, and general aspects of flow in porous media. He has also completed extensive modeling of the impacts of regional irrigation / drainage on soil salinity and shallow groundwater, river water quality, pesticide runoff from orchards and seepage from impoundments. He has published extensively on these topics.

Dr. Grismer has served as chair for the Hydrologic Sciences Graduate Group, the Committee of Consultants on San Joaquin River Water Quality, and the interdisciplinary Graduate Program of Earth Sciences and Resources.

THEODORE HSIAO is Professor of Water Science and Plant Physiologist in the Department of Land, Air and Water Resources at the University of California, Davis. He received his Ph.D. in Crop Physiology and Biochemistry from the University of Illinois, and his M.S. in Soil Chemistry and Fertility from the University of Connecticut.

Dr. Hsiao's research interests center on plant-water soil relations and underlying processes, particularly as applied to agriculture under environmental stresses. His main interests are growth responses, evapotranspiration, photosynthesis and canopy carbon dioxide assimilation, crop water requirement, efficiency of water use, irrigation scheduling, and quantification of productivity. He has published numerous articles based on his research.

Dr. Hsiao has served as an editorial board member or editor *of Plant Physiology*, *Irrigation Science*, *Physiologium Plantarum*, and *Planta*. Recently he served on several and managed one grant panels of the U.S. Department of Agriculture's National Research Initiative Competitive Grant Program. He is active as a consultant or advisor in agriculture and water related research internationally, with emphasis on arid or semi-arid zones. He has been invited to speak at numerous national and international meetings and symposiums. In 1985 Dr. Hsiao was awarded an Alexander von Humboldt Award by the government foundation of the same name, of the Federal Republic of Germany.

JACK KELLER is currently Professor Emeritus of Agricultural and Irrigation Engineering for the Biological and Irrigation Engineering Department at Utah State University, and founder and Chief Executive Officer of Keller-Bliesner Engineering. He received his Ph.D. in Irrigation Engineering from Utah State University, and his M.S. in Irrigation Engineering from Colorado State University.

During his tenure at the University, Dr. Keller has taught and carried out research in sprinkle and trickle irrigation, and served as Department Chairman from 1979 through 1985. While at the University he was the Co-Director (from 1978 through 1989) of the multi-disciplinary Water Management Synthesis Projects, funded by the U.S. Agency for International Development, to provide socio-technical assistance for transferring

irrigation technologies worldwide. Before joining Utah State University in 1960, Dr. Keller was the Chief Irrigation Engineer for W.R. Ames Company, a leading manufacturer of irrigation equipment in the United States. Over the years, he has served as a consultant to the Ames Company, as well as several other irrigation system manufacturing companies.

Through his public and private activities, Dr. Keller has provided advisory services on irrigation matters in over 50 different countries in all regions of the world. He is recognized as an international expert in the field of irrigation technology transfer, irrigation and irrigated agricultural policy formulation, and the problems associated with improving irrigated agriculture in both developed and developing countries. Since his early retirement from the University, he has been serving as a Senior Policy Advisor for resources development, analysis of water conservation programs, and systems operations in areas where irrigated agriculture is of major importance. He is currently serving as such an adviser in California, Kansas, Egypt, and Morocco. He is also serving as the Science Liaison Officer and Fellow for the international Water management Institute, which is one of the CGIAR Centers. He is the author of 88 technical papers, 15 popular articles, 46 consulting reports, 5 handbooks, 2 textbooks, and 4 patents.

CHARLES MOORE, an agricultural economist, is currently a lecturer in International Agricultural Development for the Department of Human and Community Development at the University of California, Davis. He received both his Ph.D. and M.S. in Agricultural Economics from Ohio State University. He completed his postdoctoral work in agricultural economics at U.C. Davis.

Dr. Moore has over 40 years of experience in the academic, consulting, and public agency arenas. He has taught courses in resource economics, regional planning, agricultural financial management, basic farm management, and managerial accounting. In addition to his current position at U.C. Davis, he has also served, through Ohio State University and U.S. AID, as an Associate Professor at Punjab Agricultural University in India. Other professional experience includes serving as a Consulting Economist with the Center for Cooperatives, the Director of Research and Planning for the Rice Growers Association of California, and as an Agricultural Economist with the U.S. Department of Agriculture. He also worked with the Saudi Arabian Government as the Senior Agricultural Economist for the Stanford Research Institute Central Planning Organization. He has worked as a consultant for state and federal agencies, municipalities, international organizations, and private companies.

Dr. Moore has been awarded the Administrators Special Merit Award for Outstanding Research from the USDA, has served as the Vice President of the Western Agricultural Economics Association, and has served on the Board of Directors for the Freedom from Hunger Foundation.

Technical Advisor Biographies

VASHEK CERVINKA, Ph.D., presently works with the Department of Water Resources and has worked with the State of California since 1972. He received both his M.S. and Ph.D. from UC Davis in Engineering Systems in Agriculture. Dr. Cervinka has provided his expertise on drainage and water management issues to many different conferences and technical panels across the U.S. and around the world. Since 1985, he has performed research and development work on integrated on-farm drainage management. He is a registered professional engineer in the state of California and is a member of American Society of Agricultural Engineers.

LLOYD FRYER is currently the Policy and Administration Manager for the Kern County Water Agency. He holds a B.S. in Biological Sciences with minors in Earth Sciences and Economics from California State College, Bakersfield. Since 1980, he has worked in the area of water resources planning, including computation of agricultural water demands, water use efficiencies, M&I demands, and groundwater recharge. He has authored or co-authored several publications related to agricultural water supply needs, water measurement, and economic strategies, and has provided technical expertise for the Kern County Water Agency in numerous negotiation and collaborative processes. Mr. Fryer is a member of the Department of Water Resources AB 3616 Agricultural Advisory Committee, the American Society of Soil and Water Conservation, the ACWA Water Management Committee, and the State Water Conservation Coalition Agricultural Water Conservation Task Force.

PETER H. GLEICK, Ph.D., is co-founder and President of the Pacific Institute for Studies in Development, Environment, and Security. He received his M.S. and Ph.D. from the Energy and Resources Group of the University of California, Berkeley. He is a leading expert on global freshwater resources, including sustainable use of water, demand management and water-use efficiency concepts, regional and international water conflicts, water planning and management, the hydrologic impacts of climate change, and the connections between water, population, and development. Dr. Gleick received a MacArthur Foundation post-doctoral fellowship in 1986 to look at the impacts of the greenhouse effect for water resources, and a MacArthur Foundation Research and Writing Fellowship in 1988 to explore the implications of global environmental changes for water and international security.

RICHARD E. HOWITT, Ph.D., is a Professor of Agricultural Economics at the University of California, Davis, and an Agricultural Economist for the Experiment Station and Giannini Foundation at the University of California, Davis. He received his Ph.D. from the University of California, Davis. His primary fields of interest include resource economics, environmental economics, quantitative methods, and econometrics. His current water research interests include studies on the impact of water markets on groundwater, optimal non-point source sediment control,

sustainable rice production, capitalization, and the design and implementation of an electronic water market that would allow cheap and rapid trades between users and districts.

ROGER REYNOLDS, of Summers Engineering, Inc., holds a B.S. in Civil Engineering from the University of California, Davis and is a registered civil engineer in the State of California. He has worked for 26 years in the field of irrigation and drainage in the San Joaquin Valley and other areas of California. Reynolds was appointed to be a member of the AB 3616 Committee that developed the MOU on efficient water management practices and was elected Co-Chair of the Agricultural Water Management Council formed under that MOU. In addition to that significant collaborative effort in the field of agricultural water management, Reynolds is a member of the American Water Works Association, the U.S. Committee on Irrigation and Drainage, and the ACWA Groundwater and Water Management Committees.

TRACY SLAVIN currently serves as a member of the U.S. Bureau of Reclamation Mid-pacific Region Water Conservation Team. Prior to joining the Bureau of Reclamation, he worked for Westlands Water District where he served as Water Conservation Specialist, and later as the district's Water Conservation Coordinator. He has extensive experience preparing water conservation plans, and providing technical assistance in water management to farmers. Mr. Slavin has an M.S. in Agriculture from CalPoly in San Luis Obispo. He has served on the AB 3616 Technical Advisory Committee, on the State Water Resources Control Board's Technical Advisory Committee on Irrigated Agriculture, and on the State Water Conservation Coalition's Agriculture Conservation Task Force.

DAVID SUNDING, Ph.D., is Director of the Center for Sustainable Resource Development at the University of California, Berkeley. He earned his Ph.D. in Agricultural and Resource Economics from U.C. Berkeley. His areas of expertise include agricultural water use, water markets, and water quality. He is a former senior economist for the President's Council of Economic Advisors.

MARC VAN CAMP holds a B.S. degree in Civil Engineering from California State University, Sacramento and is a registered civil engineer in California, Nevada and Oregon. Since 1984, Van Camp has worked with numerous clients, primarily agricultural water agencies, on the Sacramento and San Joaquin River systems in the areas of water rights, water supply, and water use analysis. Van Camp has been involved in water transfer negotiation processes that include detailed evaluations of quantities of water available for transfer as a result of water conservation, land fallowing, and groundwater substitution. Van Camp is also familiar with water quality issues in the Sacramento River system. Van Camp has been involved as a technical resource in recent negotiations and collaborative processes involving water rights settlements, including the San Joaquin River Agreement. Van Camp is also a member of the American Society of Civil Engineers and the U.S. Committee on Irrigation and Drainage.

CALFED Team Biographies

THOMAS R. GOHRING is currently a Technical Team Leader for the U.S. Bureau of Reclamation with responsibility for studies that will provide a basis for water contract renewal negotiations for many Sacramento Valley water purveyors. He is on temporary loan to the CALFED Bay-Delta Program to assist with the Water Use Efficiency Common Program.

Mr. Gohring's previous agency experience included developing and managing a multi-county agricultural water management program as Water Management Division Chief for the Kings River Conservation District. Mr. Gohring's consulting engineering assignments have included general civil engineering and agricultural water resource planning for local, state, and federal agencies. His most recent assignments focused on district-level water conservation programs.

In addition to his California Civil Engineering license, Mr. Gohring holds a Bachelor of Science in Agricultural Engineering from the California Polytechnic Institute, and a Master of Science in Irrigation Engineering from the University of California, Davis.

MARIA PROKOP is an assistant engineer with the U. S. Bureau of Reclamation. She is a recent graduate of the Biological and Agricultural Engineering Department at the University of California, Davis with a Bachelor of Science in Agricultural Engineering. Ms. Prokop's degree emphasis is in irrigation and international development. Previously, Ms. Prokop has worked as a quality control engineer for an almond producer/processor and has developed irrigation scheduling software for the UC Cooperative Extension.

GREG YOUNG, P.E., currently serves as Lead Consultant for the CALFED Water Use Efficiency Program, and Program Manager for the CALFED Water Transfer Program. As a Water Resources Engineer, Greg has been employed by CH2M HILL for more than 8 years. The past 3 years have been spent working on the CALFED Bay-Delta Program. During this time, Greg has been the Program's lead consultant for the Water Use Efficiency component and Program Manager for the Water Transfers component.

Greg has also worked on other water management projects ranging from the Bureau of Reclamation's 1995 *Least-Cost CVP Yield Increase Plan* to various irrigation district projects from Imperial County to the Central Valley.

Greg received his Agricultural Engineering degree from Cal Poly, San Luis Obispo in 1990 and is a registered Civil Engineer in the state of California. He was awarded the ASCE Sacramento Section Engineer of the Year Award in 1997.

CONCUR Facilitation Team Biographies

SCOTT T. McCREARY is Co-founder and Principal of CONCUR, Inc., a firm providing services in environmental policy analysis & strategic planning, agreement-focused facilitation, and negotiation training. Since its establishment in 1987, the firm has resolved over 30 complex environmental disputes across a wide range of environmental and natural resource issues. Most recently, in July of 1998, Dr. McCreary concluded the successful mediation of a solution to a 15-year impasse over flood control and associated habitat mitigation for the Guadalupe River in downtown San Jose. Dr. McCreary's past work with CALFED includes the facilitation of last year's Scientific Review Panel, which examined CALFED's Ecosystem Restoration Program Plan.

Dr. McCreary earned his Ph.D. in Urban Studies and Planning and Conflict Resolution from MIT, where his dissertation emphasized the design of decision-making processes to resolve science intensive environmental policy disputes. He earned his Masters of Landscape Architecture and Environmental Planning from the University of California, Berkeley, and his B. A. in Biology and Environmental Planning from the University of California, Santa Cruz. He has taught over 50 courses in environmental negotiation, and has authored and co-authored numerous publications, including a chapter on joint fact-finding to be published in the forthcoming *Consensus Building Handbook* (1999).

BENNETT BROOKS is an Associate in the Berkeley office of CONCUR, Inc., a firm specializing in environmental policy analysis and strategic planning, agreement-focused facilitation, and negotiation training. He earned his M.P.P. from the Kennedy School of Government, Harvard University, and his B.A. in Political Science from Tufts University. At CONCUR, Mr. Brooks provides services in policy analysis, facilitation, and process design. He develops teaching materials for CONCUR's Professional Development Courses on negotiating effective environmental agreements. He currently is co-facilitating a stakeholder analysis of the Fort Ord Military Base Review Advisory Board for the U.S. EPA. He contributed to the preparation of the Tijuana National Estuarine Research Reserve Management Plan.

LISA WHITMAN is an Associate in the Berkeley office of CONCUR, Inc., a firm providing services in environmental policy analysis, strategic planning, agreement-focused facilitation, and negotiation training. She earned her B.S. in Environmental Science and Philosophy from Allegheny College. At CONCUR, Ms. Whitman provides services in facilitation, natural resource planning, and execution of negotiation training courses. Most recently, she teamed with Dr. McCreary to coordinate the preparation of the Tijuana Estuary Research Reserve Management Plan.

ATTACHMENT 3

Background Materials, and Additional Information Provided to the Independent Review Panel on Agricultural Water Conservation Potential

1. Sacramento Delta San Joaquin Atlas

2. CALFED: Programmatic EIS/EIR Executive Summary

3. CALFED: Water Quality Program (Excerpt)

4. CALFED: Programmatic EIS/EIR (Partial Excerpt Copy)

5. CALFED: Ecosystem Restoration Program Plan, Vol. II (Excerpt)

6. CALFED: Water Use Efficiency Component EIS/EIR Technical Appendix, Chapter 4 (Internal Review Revised Draft)

7. CALFED: Phase II Interim Report, (Executive Summary), p 1-42

8. Overheads from Economics presentation at the 11/23/98 Meeting on Storage and Conveyance;

9. An Environmentally Optimal Alternative for the Bay-Delta by NHI, p 45-57

10. Blueprint for an Environmentally and Economically Sound CALFED Water Supply Reliability Program by EWC.

11. Presentation by Greg Young, CALFED consultant, on the methodology and assumptions contained in Chapter 4 of the Agricultural Water Conservation Potential Technical Appendix. (Excerpted materials distributed).

12. Presentation by Vashek Cervinka, Ph.D., Technical Advisor for the Independent Review Panel on Agricultural Water Conservation Potential, on work he and colleagues are doing with agricultural users to concentrate, harvest and market selenium.

13. Presentation by panelist Theodore Hsiao, Ph.D., of the results of research he and colleagues are conducting to determine the impact of crop spacing and canopy cover on evaporation.

Independent Review Panel on
Agricultural Water Conservation Potential
University of California, Davis – University Club
December 14 through December 16, 1998

AGENDA

DECEMBER 14
DAY ONE

9:00	Welcome Panel Introductions Process / Ground Rules
9:35	Overview, CALFED Program
9:55	Overview, Panel Deliberations
10:10	**Break**
10:20	Panel Deliberations: Question 1A
11:45	Public Comment: Question 1A
12:05	Summary: Question 1A
12:15	**Lunch**
1:00	Panel Deliberations: Question 1B
2:15	Public Comment: Question 1B
2:35	Summary: Question 1B
2:45	**Break**
2:55	Panel Deliberations: Question 2
4:00	Public Comment: Question 2
4:20	Summary: Question 2
4:30	Adjourn

DECEMBER 15
DAY TWO

9:00	Panel Deliberations: Question 3
10:10	Public Comment: Question 3
10:25	Summary: Question 3
10:30	**Break**
10:40	Panel Deliberations: Question 4
12:15	**Lunch**
1:00	Public Comment: Question 4
1:20	Summary: Question 4
1:30	Panel Deliberations: Question 5
2:35	Public Comment: Question 5
2:45	Summary: Question 5
2:50	**Break**
3:00	Panel Deliberations: Question 6
4:00	Public Comment: Question 6
4:20	Summary: Question 6
4:30	Adjourn

DECEMBER 16
DAY THREE

10:00	Panel Presentation / Discussion of Findings and Recommendations
11:00	**Public Comment**
11:15	Wrap-Up *Scott McCreary, CONCUR*
11:30	Adjourn

Schedule for discussion items is approximate and subject to change.

All meetings of the Independent Review Panel are being held at the University of California, Davis University Club

ATTACHMENT 5

MEETING PROCEDURES/GROUND RULES
Independent Review Panel on Agricultural Water Conservation Potential
December 14-16, 1998

Participation

1) Participants in the facilitated Independent Review Panel on Agricultural Water Conservation Potential include:

   - scientific panelists;
   - technical advisors;
   - stakeholder representatives and the general public; and,
   - CALFED staff and the CONCUR Facilitation Team.

2) Panelists have been recruited based on their:

   - technical capability to provide expertise in the required disciplines;
   - objectivity as reflected in non-alignment with any stakeholder group;
   - ability to work collaboratively; and,
   - availability.

3) Technical Advisors have been recruited to assist the panel based on their:

   - expertise in relevant areas;
   - strong communication skills;
   - willingness to disclose their various affiliations; and,
   - availability.

4) Stakeholder representatives and the general public are invited to observe the deliberations of the panel. In addition, specific time is allocated for public comment on each of the three days. Throughout the deliberations, observers will be able to pose comments on 4 X 6 notecards, which will be conveyed to the Panel for their consideration.

5) CALFED staff and the Facilitation Team will be responsible for guiding the deliberations and moderating the discussion during all portions of the meeting. The agenda will be structured according to a series of six broad questions. The Facilitation Team will be responsible for summing up the panel's response to each question.

6) Additionally, key CALFED Agency staff and consultants with expertise in areas relevant to the discussions will attend the Panel's deliberations and be available as an additional resource. Some of the staff have co-authored Water Use Efficiency Program documents or appendices.

7) During the public comment portions of the meeting, the Panel will take comments in the order speakers request to be recognized. (A sign-up sheet will be available at the CALFED staff desk.) A three-minute time limit on comments and questions will be observed. Stakeholders will be encouraged to organize their thoughts in writing and to be as concise as possible.

Agenda and Meeting Structure

1) The Day One agenda begins with a welcome and introductions. This is followed by an overview of the CALFED program and a brief review of the process to be used in structuring the meeting.

2) The main portion of the agenda for the Independent Review Panel has been organized according to a series of six broad questions that focus primarily on:

   · Reviewing and critiquing the technical assumptions and approach of the agricultural conservation sections of the CALFED Water Use Efficiency Component Technical Appendix (Agricultural Section).

   · Providing guidance on strategies for identifying Bay-Delta problems, as well as structuring solutions and quantifying potential benefits. This discussion will center around representative case studies developed by CALFED staff.

   · Identifying additional data collection and research needs to inform refinement and implementation of the Water Use Efficiency Program.

3) At its discretion, the Panel may choose to reword or reorder questions, or to add or delete questions.

4) Each agenda item will begin with a brief statement of the question, followed by a 10-minute presentation by CALFED Program staff to set the context for the deliberations. Next, the Panel will deliberate on the main question and subquestions.

5) During the deliberations, Technical Advisors will be called upon by panelists to illuminate questions relevant to their expertise. If Technical Advisors feel

strongly that an important point needs to be interjected, they will signal to the Facilitation Team.

6) At the end of the Panel's deliberation of each question, the Public will be given an opportunity to make comments or pose questions. The Facilitation Team will then sum up the results, with particular emphasis on the following items, as appropriate:

- the "sense of the group," including apparent areas of scientific agreement and residual uncertainty or disagreement;
- recommendations for strengthening the agricultural conservation sections of the CALFED Water Use Efficiency Component Technical Appendix (Agricultural Section);
- suggestions on recommendations for methodology that can be applied beyond the problem "case studies" considered by the Panel; and,
- additional data collection and research required to pursue the preferred approach.

7) On Day Three of the Panel, the group will review the deliberations and recap its findings and recommendations for each question. At this time, the Panel may find that its deliberations on a later question could amend the preliminary summary for an earlier question.

Meeting Summary

1) The Facilitation Team, working with the Panel and CALFED staff, will be responsible for preparing a draft Final Report summarizing the results of the deliberations.

2) Independent Review Panelists will receive the working draft by the end of the first week of January and will have a ten-day period to review and revise the draft.

3) The Final Report is envisioned as a synthesis of discussion; it is not intended to be a transcript. A 20-30 page document is envisioned, with responses to each of the questions, as well as a synthesis of public comments. The Final Report will be completed by early February 1999.

4) The Final Report will then be reviewed and discussed by management of CALFED agencies and CALFED staff.

5) The results of the Panel's deliberations will, as appropriate, be: 1) used to help guide future development of the agricultural water use efficiency program; and 2) considered for inclusion in the revised draft programmatic EIS/EIR.

ATTACHMENT 6

PROCESS FOR INDEPENDENT REVIEW PANEL ON AGRICULTURAL WATER CONSERVATION POTENTIAL

The Water Use Efficiency Program. The CALFED Bay-Delta Program is a cooperative effort among state and federal agencies and the public to ensure a healthy ecosystem, reliable water supplies, good quality water, and stable levees in California's Bay-Delta system. The Water Use Efficiency Program is one of six Program elements common to each of the three potential solutions CALFED has developed. The Water Use Efficiency Program represents a significant investment in the system and will greatly reduce system conflicts.

The Water Use Efficiency Program (as described in the draft programmatic EIS/EIR, March 1998) has attracted more comments from environmental, agricultural, and urban stakeholders than any other part of the CALFED program. Most of these comments are concentrated on two categories: 1) conservation potential; and 2) assurances. The Independent Review Panel on Agricultural Water Conservation is being convened December 14-16, 1998, and will address part of the conservation issue. The comments related to assurances are being addressed through separate efforts with CALFED agencies and stakeholders.

Comments related to conservation projections are rooted in concerns that CALFED may be incorrectly forecasting conservation potential and, therefore, proposing an inappropriate mix of actions to improve water supply reliability. In response, CALFED is convening the Independent Review Panel on Agricultural Water Conservation. The results of the Panel's deliberations will, as appropriate, be: 1) used to help guide future development of the agricultural water use efficiency program; and 2) considered for inclusion in the revised draft programmatic EIS/EIR.

Purpose of the Independent Review. As initially framed by CALFED staff, the purpose of the Independent Review Panel was to review the technical assumptions and approach of the agricultural conservation sections of the CALFED Water Use Efficiency Technical Appendix (Chapter 4).

On October 19, 1998, CALFED convened a one-day Scoping Session to brief interested members of the public on CALFED's rationale for convening the Panel, and to offer stakeholders and the general public an opportunity to provide input to CALFED on the structure and focus of the Panel's deliberations. Panel members were also given the opportunity to provide guidance on the structure of their future deliberations, as well as to identify additional information they require in order to ensure their discussions are as productive as possible

Based on the discussions during the one-day Scoping Session, the deliberations of the Independent Review Panel are focused to accomplish several broad objectives:

- Review, critique and provide recommendations to strengthen the technical assumptions and approach of the agricultural conservation sections of the CALFED Water Use Efficiency Component Technical Appendix (Agricultural Section).

- Provide guidance on strategies for identifying Bay-Delta problems, as well as structuring solutions and quantifying potential benefits. This discussion will center around representative case studies developed by CALFED staff.

- Identify additional data collection and research needs.

More specifically, the Panel will consider the following questions in meeting its objectives:

[See questions on following page.]

QUESTIONS TO BE ADDRESSED AT DECEMBER 14-16 DELIBERATIONS:

Question 1a: ***Review Chapter 4:*** What is the conceptual model that structures the methodology? What is the chosen methodology and is it appropriate given the overall goal of the CALFED Agricultural Water Use Efficiency Program? Are the assumptions contained in the overall conceptual model of the methodology appropriate? Are the data sets available to support the methodology?

Question 1b: ***Review Chapter 4:*** What additions and/or corrections are required to make the real water conservation estimates contained in the Agricultural Section appropriate and defensible for a programmatic-level analysis?

Question 2: ***Identify Problems:*** CALFED staff is to provide the Panel with overviews of representative situations in the Bay-Delta problem area. Please identify the Bay-Delta problems evident in these situations, with particular emphasis on timing, location and water quality? Which of these problems can be addressed through changes in agricultural water management? Which of these representative situations (please select three) should be analyzed in greater detail as part of the Panel's deliberations?

Question 3: ***Develop Objectives and Possible Solutions:*** Focusing specifically on the three representative situations chosen for greater analysis, please restate the sample problems from Question 2 in the form of objectives. What are the possible solutions, with an emphasis on flowpath?

Question 4: ***Choose Preferred Solution & Quantify Benefits:*** For each of the objectives stated in Question 3, choose a preferred solution. What is the preferred approach for quantifying the potential Delta- and tributary-related benefits? What are the measurable indicators of success (benefits) in accomplishing the objectives developed in answering Question 3? State the specific cause and effect expected between each potential action and its expected benefit(s) in the form of an hypothesis.

Question 5: ***Research & Data Needs:*** What additional data collection and research are required to adequately answer the above questions? What experiments would be useful to verify the hypothesis of cause and effect?

Question 6: ***Assurance:*** What does CALFED have to do to ensure that the expected benefits are realized, and that they are in support of the CALFED solution?

The Independent Review Panel will not be expected to develop numerical values or ranges. Rather, the Panel will be asked to describe potential agricultural conservation / management solutions and benefits in general or programmatic terms.

Composition of the Independent Review Panel. The Independent Review Panel on Agricultural Water Conservation Potential is comprised of five nationally-recognized scientists who collectively provide the following types of expertise:

- On-farm and district conservation practices (to determine feasible practices)
- Hydrologic and hydraulic connections between the CALFED solution and problem areas (to determine Delta and tributary impacts)
- Aquatic ecology (to provide descriptions of preferred conditions in the CALFED problem area)

In selecting panelists, CALFED staff relied on four criteria: 1) technical capability to cover the required disciplines; 2) non-alignment with any stakeholder groups; 3) ability to work collaboratively; and, 4) availability. A list of the panelists, along with their expertise and affiliation, is provided in the chart below.

Panelist	Affiliation	Expertise
Ken Cummins	Distinguished Scientist, Ecosystem Restoration Department, South Florida Water Management District	Aquatic Ecosystems Restoration
Mark Grismer	Professor of Hydrology and Agricultural Engineering, UC Davis	Irrigation Science & Hydrology
Theodore Hsiao	Professor of Water Science and Plant Physiologist, UC Davis	Plant Physiology & Evapotranspiration
Jack Keller	Professor Emeritus of Agricultural and Irrigation Engineering, Utah State; Founder and Chief Executive Officer, Keller-Bliesner Engineering	Irrigation Engineering & Conservation Verification
Charles Moore	Agricultural Economist and Lecturer in International Agricultural Development, UC Davis; Consultant	Agricultural Economics

Stakeholder Technical Representatives to the Panel. Stakeholder Technical Representatives with specific expertise in the Bay-Delta system will be assembled to assist the Scientific Panel in its review if additional technical expertise or clarification of specific issues is needed. Technical Representatives also will have the opportunity at specific points in the deliberations to present information and ask questions of the panelists.

The Technical Representatives are nominated by stakeholders to satisfy three criteria: 1) expertise in relevant areas; 2) strong communication skills; and 3) a willingness to disclose their various affiliations. The number of Stakeholder Technical Representatives will be limited to nine (three from agricultural interests, three from environmental interests, and three from CALFED agencies).

Additionally, CALFED agency staff will attend the Panel's deliberations and be available as a resource.

Public Participation. Members of the public are invited to attend all phases of the deliberations. There will be public comment periods keyed to each question on the agenda and opportunities to submit written comments to the Panel throughout the course of the workshop.

Requirement of Panelists. Panelists will have responsibilities before, during and after their deliberations. First, panelists will be asked to review the CALFED Water Use Efficiency Component Technical Appendix (Agricultural Section) and other relevant background information which will be provided by CALFED staff before the Panel meets. Panel members will be allowed to request additional information, as needed. Next, panelists will be asked to actively participate in the public Panel deliberations to be held December 14-16. Finally, panelists will be asked to review and contribute to a final report. All distributed information and information requests will be provided to each Panel member and stakeholder technical representative.

Process and Structure of the Independent Review Panel Workshop. Over a two and one-half day period, the Panel will meet and participate in a facilitated scientific review. The Panel will be convened jointly by CALFED staff and CONCUR, Inc., a professional facilitation team.

The first hour of the first day will be devoted to a general overview of the CALFED Bay-Delta Program. The remainder of the first day and the entire second day will focus on deliberations using the series of questions developed to structure the agenda. The third day -- a morning session only -- will be devoted to reporting out the Panel's findings and recommendations. All phases of the review will be open to the public and there will be opportunity for public comment each day.

The facilitation team, in close coordination with CALFED, will prepare a written summary of the Panel deliberations. Panelists will be asked to review and provide comments on the draft summary to ensure that it adequately represents the Panel's discussions and recommendations. The final report will be forwarded to the CALFED Bay-Delta Program. The results of the Panel's deliberations will, as appropriate, be: 1) used to help guide future development of the agricultural water use efficiency program; and 2) considered for inclusion in the revised draft programmatic EIS/EIR.

ATTACHMENT 7a

Selection of Representative Situations in the CALFED Bay-Delta Solution Area

1) LOW DISSOLVED OXYGEN CONCENTRATION AND OXYGEN DEPLETING SUBSTANCES (Water Quality Program)

The objective is to correct the causes of oxygen depletion in the San Joaquin River near Stockton between June and November, to reduce incidences of low dissolved oxygen, and to reduce the impairment of beneficial uses. Oxygen depletion occurs at isolated locations in the Delta causing dissolved oxygen concentrations to fall below water quality criteria (5mg/L). Oxygen depleting substances are found in various discharges. The substances may either exert a direct oxygen depleting effect (i.e. biochemical oxygen demand) or by an indirect method (i.e. nutrients that cause algal growth which eventually dies off and exerts an oxygen demand.) Low dissolved oxygen impairs or blocks fish migration, kills aquatic organisms including fish, creates odors, and impairs fish reproduction and juvenile rearing.

Background Information: Water Quality Program, Sections 1.1 – 1.4.1

2) PESTICIDES (diazinon and chlorpyrifios) (Water Quality Program)

The objective is to manage diazinon and chlorpyrifios pesticides through existing regulatory agencies and voluntary cooperation of pesticide users such that the beneficial uses of the waters of the Bay-Delta and its tributaries are not impaired by toxicity originating from pesticide use. Certain pesticides have been identified in surface waters of the Bay/Delta estuary and its watersheds at levels that are reported to impair aquatic life beneficial uses.
Toxicity from diazinon and chlorpyrifos has been detected in surface water during the winter and early spring from applications on orchards during the summer from irrigation return water.

Background Information: Water Quality Program, Sections 4.1 – 4.4.3

3) SALINITY (Water Quality Program)

The objective is to reduce or manage salinity in the San Joaquin River and in the Delta Region to meet water quality objectives. Portions of rivers and the Delta are impaired by discharges from agriculture. Significant amounts of total dissolved solids enter the rivers and the Delta from this source. Water in the lower San Joaquin River and southern Delta frequently has salt concentrations that exceed desirable levels for agricultural beneficial uses from April to August. Currently the timing of the discharges of drainage from Grasslands area is not coordinated with reservoir releases; consequently, the assimilative capacity of the SJR is frequently exceeded at Vernalis.

Background Information: Water Quality Program, Sections 6.1 – 6.4

4) REDUCE IRROCOVERABLE LOSSES (excluding Evaporation) (Water Use Efficiency Program)

The objective is to reduce the non-ET irrecoverable losses, water lost to a salt sink from a conveyance facility, drainage canal or fringe area in the Delta region.

Background Information: Water Use Efficiency Program Appendix, pages 4-47

5) REDUCE LOSS OF EVAPORATION (Water Use Efficiency Program)

The objective is to reduce irrecoverable losses from evaporation in the Delta region.

Background Information: Water Use Efficiency Program Appendix, page 4-43

6) RESTORE PRE-PROJECT HYDRAULIC CONDITIONS (ERPP II)

The objective is to restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant populations in the East San Joaquin Basin. Maintain the following base flows in the Stanislaus River below Goodwin Dam:

- In critical, dry, and below-normal years, minimum flows should be 200 to 300 cfs, except for a flow even of 1,500 cfs for 30 days in April and May;

- In above-normal years, minimum flows should be 300 to 350 cfs, except for 800 cfs in June and 1,500 cfs in April and May;

- In wet years, minimum flows should be 300 to 400 cfs, except for 1,500 cfs from April through June.

Background Information: Ecosystem Restoration Program Plan, Vol. II, pages 397-401, 421

7) STREAM TEMPERATURES (ERPP II)

The implementation objective for Central Valley stream temperatures is to maintain, improve, and restore water temperature regimes to meet the life-history needs of aquatic organisms. One objective for the Sacramento River between Keswick Dam and Redbluff Diversion Dam, is to maintain daily water temperatures at levels suitable for maintaining all life-history stages of chinook salmon and steelhead in all year types.

Background Information: Ecosystem Restoration Program Plan, Vol. II, pages 125-132

8) WATER SUPPLY RELIABILITY

One of the main objectives of CALFED is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system.

As more water has been dedicated to non-consumptive uses such as the environment; concern has been expressed that the amount of water available, especially during a series of dry years, does not meet either the consumptive or non-consumptive requirements for water. There are a variety of beliefs on the solution to this problem including building more storage, improving conveyance efficiency, and improving water use efficiency both in the municipal and industrial sector and in the agricultural sector.

Background Information: Phase II Interim Report, Executive Summary, p1-42;
Overheads from Economics presentation at the 11/23/98 Meeting on Storage and Conveyance;
An Environmentally Optimal Alternative for the Bay-Delta by NHI, p 45-57;
Blueprint for and Environmentally and Economically Sound CALFED Water Supply Reliability Program by EWC.

ATTACHMENT 7b

Detailed Objectives

	Ecological Zone: Sacramento-San Joaquin Delta	Ecological Units:	North Delta, South Delta, East Delta, Central and West Delta
	Objectives	***Specific Location***	***Source Document***
1	Protect and improve existing tidal slough habitat and restore a portion of the historical Delta slough distribution.	Delta Sloughs	ERPP Volume II
2	Cooperatively manage agricultural lands to provide high quality wildlife values for associated species, and maintain or increase the economic viability of agricultural lands.	Agricultural Lands	ERPP Volume II
3	Reduce entrainment of aquatic organisms and nutrients at water diversions to increase survival of all life stages of fish and maintain the foodweb.	SWP and CVP Intakes	ERPP Volume II
4	Reduce pesticide-caused toxicity in the Delta Region.	Delta Islands	CALFED WQP
5	Reduce toxicity by lowering nutrients and ammonia levels in agriculture drainage water.	Delta Region	CALFED WQP
6	Minimize pathogen loads entering the Delta Region by controlling discharges from confined animal facilities or rangelands.	Delta Region	CALFED WQP
7	Lower agriculture-caused elevated levels of sediment discharges.	Delta Region and its Tributaries	CALFED WQP
8	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Entire Zone	ERPP Volume II
	Ecological Zone: Sacramento River	**Ecological Units:**	**Keswick to Red Bluff, Chico Landing to Colusa, Red Bluff to Chico Landing, Colusa to Verona**
	Objectives	***Specific Location***	***Source Document***
9	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Keswick to Red Bluff, Chico Landing to Colusa, Red Bluff to Chico Landing, Colusa to Verona	ERPP Volume II
10	Establish sufficient quantities to riverine and estuarine systems to restore or reactivate stream channel meander and point bar formation, to rebuild wetlands and shallow-water habitats, and provide for nutrient transport.	Keswick to Red Bluff	ERPP Volume II
11	Maintain, improve, or restore natural stream meander processes to allow the natural recruitment of sediments, to create habitats, and promote riparian succession.	Red Bluff to Chico Landing	ERPP Volume II
12	Maintain, improve, or restore water temperature regimes to meet the life-history needs of aquatic organisms such as chinook salmon and steelhead.	Keswick to Red Bluff	ERPP Volume II
13	Reduce entrainment of juvenile fish such as salmon, steelhead, sturgeon, and splittail.	**Keswick to Red Bluff**, Chico Landing to Colusa, Red Bluff to Chico Landing, Colusa to Verona	ERPP Volume II
14	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Keswick to Red Bluff, Chico Landing to Colusa, Red Bluff to Chico Landing, Colusa to Verona	ERPP Volume II
	Ecological Zone: Colusa Basin	**Ecological Units:**	**Stony Creek, Thomes Creek, Elder Creek, Colusa Basin**
	Objectives	***Specific Location***	***Source Document***
15	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Stony Creek, Thomes Creek, Elder Creek, Colusa Basin	ERPP Volume II
16	Establish sufficient quantities to riverine and estuarine systems to restore or reactivate stream channel meander and point bar formation, to rebuild wetlands and shallow-water habitats, and provide for nutrient transport.	Thomes Creek and Elder Creek	ERPP Volume II
17	Manage agricultural lands to provide high quality wildlife values for associated species, and maintain or increase the economical viability of agricultural lands.	Stony Creek, Thomes Creek, Elder Creek, Colusa Basin	ERPP Volume II
18	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Stony Creek, Thomes Creek, Elder Creek, Colusa Basin	ERPP Volume II

ATTACHMENT 7b

Detailed Objectives

	Ecological Zone: Feather River / Sutter Basin	Ecological Units:	Yuba River, Feather River, Bear River, Sutter Bypass, Honcut Creek
	Objectives	***Specific Location***	***Source Document***
19	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Feather River	ERPP Volume II
20	Maintain, improve, or restore natural stream meander processes to allow the natural recruitment of sediments, to create habitats, and promote riparian succession.	Yuba River, Feather River, Bear River	ERPP Volume II
21	Maintain, improve, and restore water temperature regimes to meet the life-history needs of aquatic organisms.	Yuba River, Feather River, Bear River	ERPP Volume II
22	Manage agricultural lands to provide high quality wildlife values for associated species, and maintain or increase the economical viability of ag. Lands.	Yuba River, Feather River, Bear River, Sutter Bypass, Honcut Creek	ERPP Volume II
23	Reduce juvenile fish entrainment into water diversions to increase survival and population abundance.	Yuba River, Feather River, Bear River	ERPP Volume II
24	Promote rangeland management practices and livestock stocking levels to maintain high-quality habitat conditions for wildlife, aquatic, and plant communities.	Yuba River, Bear River	ERPP Volume II
	Ecological Zone: Yolo Basin	**Ecological Units:**	**Cache Creek, Putah Creek, Solano, Willow Slough**
	Objectives	***Specific Location***	***Source Document***
25	Emulate natural seasonal patterns.	Cache Creek and Putah Creek	ERPP Volume II
26	Restore gravel recruitment	Cache Creek and Putah Creek	ERPP Volume II
27	Restore riparian scrub, woodland, and forest habitat to create riparian vegetation corridors.	Cache Creek, Putah Creek, Solano, Willow Slough	ERPP Volume II
28	Reduce entrainment of juvenile fish into water diversions.	Cache Creek, Putah Creek, Solano, Willow Slough	ERPP Volume II
29	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Cache Creek, Putah Creek	ERPP Volume II
	Ecological Zone: San Joaquin River	**Ecological Units:**	**Vernalis to Merced, Mendota Pool to Gravelly Ford, Merced to Mendota Pool, Gravelly Ford to Friant**
	Objectives	***Specific Location***	***Source Document***
30	Restore riparian scrub, woodland, and forest habitat along largely nonvegetated riprapped banks.	Vernalis to Merced, Mendota Pool to Gravelly Ford, Merced to Mendota Pool, Gravelly Ford to Friant	ERPP Volume II
31	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Vernalis to Merced, Gravelly Ford to Friant	ERPP Volume II
32	Restore natural stream processes to allow the natural recruitment of sediments.	Vernalis to Merced	ERPP Volume II
33	Maintain, improve, and restore water temperature regimes to meet the life-history needs of aquatic organisms.	Vernalis to Merced	ERPP Volume II
34	Cooperatively manage agricultural lands to provide high quality wildlife values for associated species, and maintain or increase the economic viability of agricultural lands.	Vernalis to Merced, Mendota Pool to Gravelly Ford, Merced to Mendota Pool, Gravelly Ford to Friant	ERPP Volume II
35	Reduce entrainment of juvenile fish into water diversions.	Vernalis to Merced	ERPP Volume II
36	Promote rangeland management practices and livestock stocking levels to maintain high-quality habitat conditions for wildlife, aquatic, and plant communities.	Vernalis to Merced, Mendota Pool to Gravelly Ford, Merced to Mendota Pool, Gravelly Ford to Friant	ERPP Volume II
37	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Vernalis to Merced, Mendota Pool to Gravelly Ford, Merced to Mendota Pool, Gravelly Ford to Friant	ERPP Volume II

ATTACHMENT 7b

Detailed Objectives

	Ecological Zone: East San Joaquin Basin	Ecological Units:	Stanislaus River, Merced River, Tuolomne River
	Objectives	***Specific Location***	***Source Document***
38	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Stanislaus River, Merced River, Tuolomne River	ERPP Volume II
39	Maintain, improve, and restore water temperature regimes to meet the life-history needs of aquatic organisms.	Stanislaus River, Merced River, Tuolomne River	ERPP Volume II
40	Reduce juvenile fish entrainment into water diversions to increase survival and population abundance.	Stanislaus River, Merced River, Tuolomne River	ERPP Volume II
41	Promote rangeland management practices and livestock stocking levels to maintain high-quality habitat conditions for wildlife, aquatic, and plant communities.	Stanislaus River, Merced River, Tuolomne River	ERPP Volume II
	Ecological Zone: West San Joaquin Basin	**Ecological Units:**	
	Objectives	***Specific Location***	***Source Document***
42	Lower salinity levels in the Delta Region due to agricultural practices in the San Joaquin River Region.	Delta Region	CALFED WQP
43	Restore basic hydraulic conditions to reactivate and maintain ecological processes that create and sustain habitat required for healthy fish, wildlife, and plant population.	Streamflows	ERPP Volume II
44	Reduce concentrations and loadings of contaminants in the aquatic environment and the subsequent bioaccumulation of them in aquatic species.	Contaminants	ERPP Volume II
45	cooperatively manage agricultural lands to provide high quality wildlife values for associated species, and maintain or increase the economic viability of agricultural lands.	Lower San Joaquin and Delta Region	ERPP Volume II
46	Lower agriculture-caused elevated levels of sediment discharges.	Delta Region and its Tributaries	CALFED WQP