Attachment A
ISB 2005 Workplan (as updated at May 2005 ISB Meeting assuming Business as Usual)

Topic	Planned Activity	Timeframe for Completion	Action Product[1]
Delta Improvements Package **Continuing activity – 2005 activities focus on two questions.**	**What science is currently being used to support decision-making and what could be used, both in the short-term and the long-term?** **Current** • Identify and appraise sources of information, e.g., IEP, draft EIS/EIR	Pending: - Ongoing review of IEP will provide source info (by end 2005) - Release of draft EIS/EIR.	Commentary
	• Work with WMSB & ERPSB to explore the scope of issues necessary to fully evaluate changes in water delivery and flow characteristics.	Issues delivered to WMSB May 2005. Final memo June 2005	Original Approach
	Future • Work with CWEMF to plan workshop (Fall 2005) to explore use of modeling in determining the role in inc. pumping rates in allow more flexible approaches to water quality management and ecosystem restoration.	Ongoing as of May 2005 Complete December 2005	Original approach

[1] Actions/products identified under the "Planned Activity" column in the table refer to specific deliverables as defined in the draft Operating Guidelines for the ISB. Abbreviated definitions for these six types of activities are provided at the end of table.

Topic	Planned Activity	Timeframe for Completion	Action Product[1]
Lead Scientist/Authority Requests ISB Review of Science Agenda	• Review and refine draft Science Agenda. o Research (New Vision) o Information Transfer (Communication Strategy)	 May 30 2005 June 15 2005.	 TBD
System Monitoring and Data Assimilation	• Survey existing monitoring programs and assess their utility in addressing selected hypotheses underlying the program. • Explore use of monitoring and data assimilation to address specific management and policy questions regarding: o Permanent operable South Delta Barriers o Salt management in San Joaquin • Explore the formation of technical panel to evaluate potential for an integrated observation and data assimilation system for components of the Bay-Delta and its watershed.	February 2005 – Completed May 2005 - Completed Sept. 2005 Work session June 2005	Original approach
Assessing Science Needs	• Evaluate PSP approach as a tool for addressing the scientific needs of the Bay-Delta Program o Other programs funding proposals o Contracting challenges o Science timeline vs. decision timeline	May 2005 interim report - completed September 2005 final report	
Modeling	• Develop recommendations regarding community models that can be shared among agencies and other interested parties.	Future work	
Integrated Use of Environmental Water	• Subcommittee to begin evaluation of use of current resources including EWP, EWA, CVPIA b2 & b3 water	Superseded by Task Force recommendation May 2005	Commentary
ISB Annual Report	• Prepare annual report summarizing 2004/5 activity of the ISB.	Draft September 2005 Final December 2005	Original Approach

Topic	Planned Activity	Timeframe for Completion	Action Product[1]
Levees	• Subcommittee to prepare ISB recommendation based on work of Mount/Twiss/Keller and additional fact-finding.	May 2005 – completed June 2005 reported to CBDA	Original approach
Performance Measures	• Conduct fact finding to understand status of PM and their relationship to goals and objectives • Develop standardized methodology to guide **development** of performance measures. Test and finalize methodology. • Review staff assessment of PM within programs	May 2005 – completed June 2005 Fall 2005	Briefing Original approach

Actions/Products

Consultation: Oral advice on a technical issue prior to having staff begin substantive work on that issue.
Advisory: Written advice on technical works-in-progress.
Review: Assessment on the application of science within CBDA, including how scientific reviews are organized and how recommendations are used.
Commentary: Forward-looking comment in the form of a short communication.
Original Approach: Original ideas and suggestions developed by the ISB regarding emerging or overarching scientific or technical issues.
Briefing: Presentation and other information provided to the ISB regarding pertinent scientific and technical issues and activities.

ISB Subcommittee and Task Force Membership

Work Plan Topic	ISB Members															
	Adams	Cummins	Dunne	Freyberg	Glaze	Ingram	Keller	Luoma	Melack	Meyer	Mount	North	Patten	Reed	Rose	Twiss
Delta Improvements Package																
Appraise sources of information										**X**			**X**			
~~Develop Research Questions~~				~~**X**~~				~~**X**~~								
Work with CWEMF									**X**						**X**	
ISB Review of Science Agenda																
Research					**X**					**X**						
Information Transfer	**X**															**X**
System Monitoring and Data Assimilation																
Salt management in San Joaquin								**X**				**X**				
South Delta Barriers/Exploring Tech Panel				**X**							**X**					
Assessing Science Needs	**X**													**X**		
~~**Integrated Use of Environmental Water**~~	~~**X**~~	~~**X**~~		~~**X**~~		~~**X**~~							~~**X**~~		~~**X**~~	
ISB Annual Report			**X**													
~~**Levees**~~	~~**X**~~			~~**X**~~		~~**X**~~	~~**X**~~				~~**X**~~	~~**X**~~		~~**X**~~		
Performance Measures		**X**				**X**	**X**			**X**		**X**				**X**
X – Shade denotes lead investigator or subcommittee chair/co-chair.																

CBDA INDEPENDENT SCIENCE BOARD
LEVEE INTEGRITY SUBCOMMITTEE
REPORT AND RECOMMENDATIONS

Helen Ingram, PhD
Richard Adams, PhD
David Freyberg, PhD
Jack Keller, PhD
Jeff Mount, PhD
Warner North, PhD
Denise Reed, PhD

May 11, 2005

Background

These recommendations of the ISB Levee Integrity Subcommittee (hereafter the Subcommittee) are based on our reading of the ROD, our review of past publications and other fact-finding by ISB members, and by our review of a paper by Mount and Twiss of the ISB (Mount and Twiss, 2005) dealing with the potential for catastrophic levee failures due to seismic activity, flooding and subsidence. However, these are not the only concerns for levee failure. For example, ongoing settlement and deterioration of levees, boat wakes, burrowing rodents, and hidden defects also contribute to levee failure risk. Risks to levee integrity are concerns for the entire set of CALFED programs, not just the Levee System Integrity Program.

The potential for catastrophic failure on the levees has been apparent for many years, and we recognize we are recasting some of the concerns that have been expressed previously. CBDA, DWR and other agency personnel have been helpful in providing copies of reports and keeping us informed of ongoing discussions regarding levee system integrity. The Subcommittee is aware that addressing levee integrity is considered a high priority by the Authority and recognizes that any detailed recommendations of the ISB may rapidly be overtaken by events. Consequently, the Subcommittee has focused primarily on long-term scientific needs associated with furtherance of levee integrity and mechanisms that can be used to assure the Authority that their decisions and policies are informed by the most current scientific understanding of the issues involved.

Findings

1. The Mount and Twiss (2005) publication has played an important role in focusing attention on the interface between the goals and objectives of the CBDA programs and the potential for catastrophic levee failure due to some or all three of the forces identified in this publication. The report notes that the probabilities of significant flood flows and earthquake occurrences over the next fifty years are high. These events are expected to cause dramatic changes within the infrastructure of Delta levees, and result in associated effects to land uses, ecosystem services and the ability of the state to deliver water to contractors. The publication concludes by noting the need for additional studies into the physical and economic feasibility of alternatives to

current policies and programs to protect and maintain the levee system. *The Subcommittee agrees with the authors that a "business as usual" (continuing current policies and programs with current low levels of funding) approach would embed high risk to ecosystems, stakeholders and to society.*

2. Several important ongoing activities by CALFED and associated programs and activities are addressing some of the issues raised in Mount and Twiss (2005). Some examples include:

- Findings from the Torres et al. (2000) report have been used to identify and prioritize areas of emphasis within the levee management and maintenance program.
- DWR is initiating follow-up economic studies to Illingworth et al. (2005) to 1) investigate the economic losses from levee failure under a probabilistic framework which includes a broader range of options and to 2) assess the cost-effectiveness of alternative actions to allow decision makers to understand the tradeoffs between costs of Delta levee management actions and the outcomes of those actions.
- DWR is performing a series of hydrodynamic analyses of levee failures on Delta salinity changes.
- DWR has assembled and supported teams of water resource economists to perform analysis of levee options and actions.
- DWR initiated the Delta Levees Seismic Risk Analysis in 2003 to develop a risk model of Delta levee failure and the consequences of such failure for Delta export water quality.
- DWR and USGS have engaged in studies to advance the scientific understanding of subsidence and have performed demonstration projects for establishing Best Management Practices (BMP's) to slow Delta subsidence.
- The Ecosystem Restoration Program Plan (ERPP Vol. II) includes several actions involving various degrees of flooding of Delta islands, which will likely reduce the future rate of subsidence on some Delta islands. Such projects seek to provide non-tidal perennial habitats. Creation of tidal wetland habitat in appropriate areas can also reduce subsidence rates. Further emphasis on the habitat value of working landscapes in the Delta, especially uses that include flooding of soils during summer months, may also reduce oxidation of peat soils.

The ISB acknowledges the magnitude of effort currently being devoted to studying Delta levee instability and subsidence by various CALFED programs and agencies.

3. The specific risk of levee failure due to seismic activity was assessed by Torres et al. (2000). This report highlights areas of greatest risk within the general system of Delta levees and performs a series of scenario analyses to simulate levee breaching under different magnitude and location of earthquakes. The assessment is generalized in nature due to the lack of specific soil and substrate information available for Delta levees and some uncertainty regarding the location of specific fault structures near the Delta*. The Subcommittee recognizes that one of the key uncertainties in assessing the risks associated with Delta levee fragility is the limited extent of geotechnical information for hundreds of miles of levees.*

4. A recent study of the economic consequences of catastrophic levee failure (Illingworth et al, 2005) was funded by DWR. While the report is exploratory in nature and is structured as a

deterministic analysis of two hypothetical events (simultaneous breaching of 30 or 50 levees in mid-summer), it does provide the first assessment of the potential costs to stakeholders and taxpayers in California, should the catastrophic events described in Mount and Twiss or in Torres et al. come to pass. Specifically, the study estimates costs to agricultural users in the San Joaquin valley to range from $300 to $500 million (in 2003 $), while costs to urban water districts and their customers will range from $500 to $3,000 million, depending on the scenario. These costs represent a lower bound on the economic consequences of such catastrophic events, given that the analyses assume a short-term set of conditions under which water users easily accommodate the shortfalls. Longer-term disruptions increase cost by at least an order of magnitude. In addition, these costs do not reflect costs to Delta agricultural lands, to infrastructure, and to ecosystem services. Thus, these estimates are viewed by the authors as lower bounds on the economic consequences of the two scenarios evaluated. Despite the uncertainties inherent in the estimates, the substantial magnitude of the damages reported in Illingworth et al. can inform policy makers as to whether this is an issue of high priority for action and can suggest where additional information is needed in terms of assessing alternative policy responses. The magnitude of potential damage from multiple levee failures is supported by data from the June 3, 2004 dry-season, single levee failure in the Upper Jones Tract, which resulted in damages estimated (CALFED 2004) as $90 million. *The Subcommittee appreciates that potential costs of levee failure are significant; responding to such events after the fact would impose severe financial stress on public and private resources.*

5. Within this technical context, the passage of the CALFED Bay-Delta Authorization Act (HR 2828) in 2004 states "the Secretary of the Army is authorized to undertake the construction and implementation of levee stability programs or projects for such purposes as flood control, ecosystem restoration, water supply, water conveyance, and water quality objectives." The Act also calls for the Corps of Engineers to submit a report that describes the levee stability reconstruction projects and priorities that will be carried out during each of fiscal years 2005 through 2010. Although the Act authorizes $90 million for levee stability activities, these funds have not yet been appropriated. Existing appropriations for this work are minimal, and thus far have been insufficient for the Corps to even complete the report. *The Subcommittee agrees that levee stability projects are multi-purpose in nature. The Subcommittee notes that the current authorization of federal funds, not yet appropriated by Congress for the Army Corps of Engineers, is unlikely to address the problem adequately.*

6. DWR, in conjunction with the Department of Fish and Game and the Corps of Engineers, has recently initiated a Delta Risk Management Study (DRMS), which will address the ecological as well as economic consequences of levee failures. Scoping for this study has involved a variety of agencies and stakeholders and a Technical Advisory Committee has been formed to guide the development of specific study tasks. *The Subcommittee supports the efforts of the agencies in moving this study forward so quickly and endorses the broad scope envisaged for the study*.

Subcommittee Recommendations

The Subcommittee proposes a set of recommendations to the CBDA that will assist the CALFED agencies in 1) enhancing our understanding of the inherent risks posed by the levee system to water quality, ecosystem processes and economic activities, 2) identifying long-term,

economically feasible solutions to the challenges presented by the probability of levee system failure and 3) ensuring that studies and reports used to support decisions and policies reflect current scientific understanding.

1. **Enhanced Understanding**.

    a. The Illingworth et al. study places one set of events described in Mount and Twiss and Torres et al. in an economic context. To make these findings more relevant to the understanding of the consequences of levee failure for society, **the Subcommittee recommends additional economic studies that link the cost of various actions to the benefits of likely outcomes**. Additional economic assessments (cost-effectiveness analyses) under the DRMS are being considered to assist public decision makers in selecting actions that meet societal goals at least cost. Such information is needed in the public debate over alternative levee futures. These studies need to address the issue of economic valuation of damages/costs in a probabilistic framework. In addition, we commend the DRMS for the broad range of effects that are included in future economic assessments, such as effects of levee failure on Delta infrastructure, agricultural lands, water quality, and ecosystem services. In addition to measurement of private costs and benefits, DRMS should include public values (e.g., ecosystem services, recreation) in its economic analysis of the consequences of levee failure.

    b. The Subcommittee recommends that the **DRMS should evaluate possible management strategies and policies in the context of a broad range of long-term future scenarios for the Delta. These scenarios should include projections of climate change and sea level rise, land use changes, and demand for exported water over the next 50 to 100 years.** Maintenance and enhancement of levees is one class of management strategies. Abandonment or removal of levees in changing land from agricultural use to wetlands or freshwater storage is another class of strategies.

    c. Planning for and responding to levee fragility within the Delta will require significant improvements in geotechnical information and the exploitation of emerging technologies. The complexity and costs associated with developing adequate geotechnical information preclude a rapid response to and resolution of this issue. Meeting this need demands both the strategic application of emerging technologies (e.g., LiDAR, ground penetrating radar, nanosensors for detection of seepage) and the use of expert judgment on potential levee failure mechanisms. **The Subcommittee recommends that, as a high priority product, the DRMS should develop a multi-year plan for addressing data gaps, prioritizing data collection, and incorporating or assimilating new information into risk assessments.**

2. **Development of Long-term Economically Feasible Solutions.**

a. Long-term solutions must fully embrace actions of all program elements and non-CBDA activities that can enhance levee system integrity. As part of the DRMS, **the Subcommittee recommends that the evaluation of management strategies and policies consider the risk, cost, and benefits on all appropriate programs. DRMS should identify linkages among levee system stability, water management, navigation, agricultural practice, recreation, and ecosystem restoration activities on Delta levees** to enable agencies at all levels to identify possible synergies and/or conflicts among their policies and plans.

b. Substantial financial resources will be required to address the challenges presented by the current levee situation in a meaningful way. This raises issues of equity with respect to who benefits and who pays for current policies. There are well-known economics tools that can analyze the consequences of choice among different funding mechanisms. **The Subcommittee recommends that the fairness and feasibility of the present system of funding these programs and policies be examined by CBDA. This analysis should also consider alternative mechanisms for the distribution of costs, including user fees.**

3. **Quality and Transparency of Science.**

a. **The Subcommittee recommends that past and present research and analysis by CBDA agencies associated with levee integrity be made broadly accessible and be made available for peer review,** including publication in the scholarly literature as appropriate.

b. **The Subcommittee recommends that external review be incorporated into the DRMS using one or more workshops to evaluate the DRMS methodology, findings, and conclusions.** Such workshop review would be most useful if conducted midcourse of DRMS, at a point where the basis for risk estimates and the set of risk management strategies to be considered are available for review. Further external review will be appropriate at the conclusion of the study.

Summary

The integrity of Delta levees is one of the most important issues facing the CBDA in the near-term and in years to come. Levee failure portends economic damages in the tens of billions of dollars. The Subcommittee is concerned that a broad range of alternative solutions needs to be developed and evaluated. These alternatives must reflect the implications of long-term trends on physical and anthropogenic forces, including sea level rise, climate change, human demographics and land use patterns. The DRMS is a useful first step but will only provide policy-relevant guidance to CBDA if it develops and evaluates a broad range of solutions. The cost of these remedies will undoubtedly be substantial. Alternative funding mechanisms need to be evaluated using analytical tools.

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References

Mount, J. and R. Twiss. 2005. Subsidence, sea level rise, and seismicity in the Sacramento-San Joaquin Delta. *San Francisco Estuary and Watershed Science*. Vol. 3, Issue 1 (March 2005), Article 5.

Torres, R., N. Abrahamson, F. Brovold, G. Cosio, M. Driller, L. Harder, D. Marachi, C. Neudeck, L. O'Leary, M. Ramsbotham and R. Seed. 2000. *Seismic Vulnerabilty of the Sacramento-San Joaquin Delta Levees.* Seismic Vulnerability Subteam, Levees and Channels Technical Team of CALFED. 30 pages plus appendices.

Illingworth, W., R. Mann, S. Hatchett and R. Hoagland. *Economic Consequences of Water Supply Export Disruption Due to Seismically-Initiated Levee Failures in the Delta.* Executive Summary of White paper prepared for DWR, February, 2005.

CALFED Bay-Delta Program, Annual Report, 2004, p. 34.

Attachment C

May 19, 2005

TO: Dr. Johnnie Moore, Lead Scientist, CALFED Science Program
FROM: Performance Measures Subcommittee, Judy Meyer (Acting Chair)
RE: Performance Measures Subcommittee Report

Observations on Performance Measures

The subcommittee recognizes that implementation of performance measures in any organization is a participatory process that requires not only development of indicators but also agreement on how those measures will be interpreted and used. Application of performance measures to a program has to be done in the context of resources available to that program.

Lessons can be learned from performance measures used in other settings:

- Assessment of performance of complex economic systems are based on multiple indices of economic health; furthermore, economic systems have a data assimilation system that allows real time assessment. The Bay-Delta system is also very complex; assessment of CALFED programs should not be based on single measures (e.g. condition of a single species), but rather on multiple measures. The ability of programs to assess performance is dependent on the nature, quality and availability of monitoring data.
- In medicine epidemiological data collected over decades are used to assess effectiveness of public health programs. It is important to recognize that CALFED is a 30-year program.

Not all performance measures respond on a time scale that can help guide immediate management decisions.

Some performance measures can be clearly linked to CALFED actions while others respond to a complex set of factors, only some of which are under the control of CALFED.

Digital maps and imagery are available (See attachment A) to provide a framework for monitoring and interpretation of performance measures. Geospatial representation can help provide:

- Context for information coming from isolated stations
- Illumination of relationships between parameters
- Graphic representation of data and analysis
- Input to modeling and scenario development and testing

ISB Road Map to CALFED Performance Measures

The ISB Performance Measures Subcommittee has developed the following road map to outline how we intend to work with the Science Program to facilitate the implementation of performance measures in CALFED programs.

1. Members of the Performance Measures Subcommittee will refine the guidance framework (below) which is intended to help guide development and implementation of performance measures. We will refine the framework by applying it to existing performance measures (supplied to us by Science Program staff) addressing:
    (a) Water supply/reliability (Keller)
    (b) Water quality (Meyer)
    (c) Habitat (Patten)
    (d) Species populations (Rose)

The individuals identified will report initial results of this to Judy Meyer (jlmeyer@uga.edu) before early June, and the subcommittee will revise the guidance framework prior to the next ISB meeting.

2. Science Program staff will collaborate with the agencies to assemble a package of performance measures currently being used in CALFED programs, recognizing three types of measures:
    - Level 1: Amount spent, number of projects funded
    - Level 2: Management actions implemented
    - Level 3: System response
        - Direct local responses to individual actions implemented
        - Accumulated responses to multiple implemented actions

    This subcommittee will focus its attention on level 3 measures.

    Existing measures can also be divided into categories based on what is being assessed (e.g., water quantity, water quality, levee stability, habitat availability, populations of key species, watershed groups, reduction of conflict)

    The subcommittee was pleased to learn that Donna Podger has been hired by the Science Program to work on performance measures. We anticipate working with her as this process unfolds.

3. Science Program staff will collaborate with agency personnel in an iterative process to refine the package of performance measures using the revised guidance framework, (from 1 above). Recommendations resulting from this process would address the following kinds of questions:
    - Is the set of performance measures adequate?
    - Are new performance measures needed? (Is there a better set of indicators to assess performance? e.g. would the performance measure be more clearly linked to CALFED actions if a different life history stage were targeted?)
    - Are any performance measures misleading? (Would they be more meaningful if evaluated at a different time scale?)
    - Is the current methodology for data collection adequate? Are there new methods that would significantly improve the performance measure (e.g. reduce uncertainty in its interpretation)?
    - Is the rigor of monitoring, analyzing, and evaluating the performance measures adequate for adaptively managing the package of implemented actions.

4. Science Program staff will report their progress on development of a package of performance measures to the ISB Performance Measures Subcommittee at the next ISB meeting.

A Guiding Framework for the Development of CALFED Performance Measures

This framework is structured as a set of questions. It is unlikely that a performance measure will meet all of the criteria identified, but the list of questions can be used to clarify strengths and weaknesses of proposed performance measures and to choose among them. The questions are intended to indicate issues that need to be addressed in the development or improvement of performance measures and to identify potential uncertainties in interpretation of the behavior of performance measures.

1. Is the performance measure clearly described?
2. Is the CALFED objective being address by this performance measure clearly articulated? Does the measure address more than one objective?
3. Are the causal links between the proposed performance measure and the CALFED objective(s) clearly explained using conceptual or mathematical models? Have uncertainties been identified?
4. Are the causal links between CALFED action(s) and the proposed performance measure clearly explained using conceptual or mathematical models? Have uncertainties been identified? If this measure responds to more than one CALFED action, are all responses in the same direction, and can the relative importance of different actions be assessed? Have consequential effects of the CALFED action (other than the intended focus of the CALFED action) either adverse or positive been taken into account?
5. Have other factors (non-CALFED human actions or natural variability) that impact the performance measure been identified? Are they likely to have a greater effect on the measure than CALFED actions?
6. Have the data that will be used to calculate the performance measure been adequately described?
   a) Spatial distribution and replication
   b) Sampling frequency
   c) Error around measurements (sampling error)
   d) Variability in the measure (signal to noise ratio)
   e) Are these data currently being collected? If not, what are the barriers to collection?
   f) Are they being collected in a manner that will enable them to be used in calculating the measure? Are better methods available?
   g) Are there historical (pre-CALFED) data that can be used?
   h) Are data being collected on the other factors (non-CALFED stressors and drivers) that affect this performance measure?
   i) Are the data geo-referenced and are/could they be combined with available GIS layers (see Attachment A) and used in analysis at the landscape scale?
7. Can the performance measure be used to detect patterns of change?
   a) Are the data from before the action was implemented adequate for meaningful comparison with post implementation data?

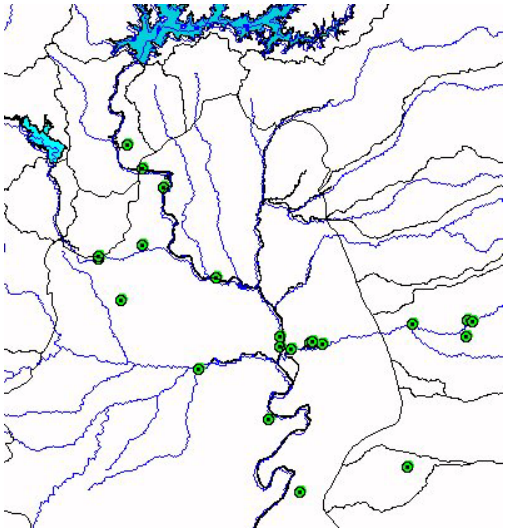
b) Is the performance measure focused enough so that measurement inaccuracies do not overwhelm the anticipated changes?
c) Is the measure being calculated at the appropriate spatial scale?
d) Over what time scale are changes anticipated?
e) What levels of change will be considered indicative of progress toward the goal?
f) Can the impact of CALFED actions on the measured change be isolated from the effects of other factors on the measure?
g) Are sufficient data being collected to identify potential adverse (or positive) consequential effects of the actions being taken?

8. Can the performance measure be explained to decision-makers and stakeholders in an understandable manner? Is there potential for decision-makers and stakeholders to unambiguously interpret patterns of change in the performance measure?

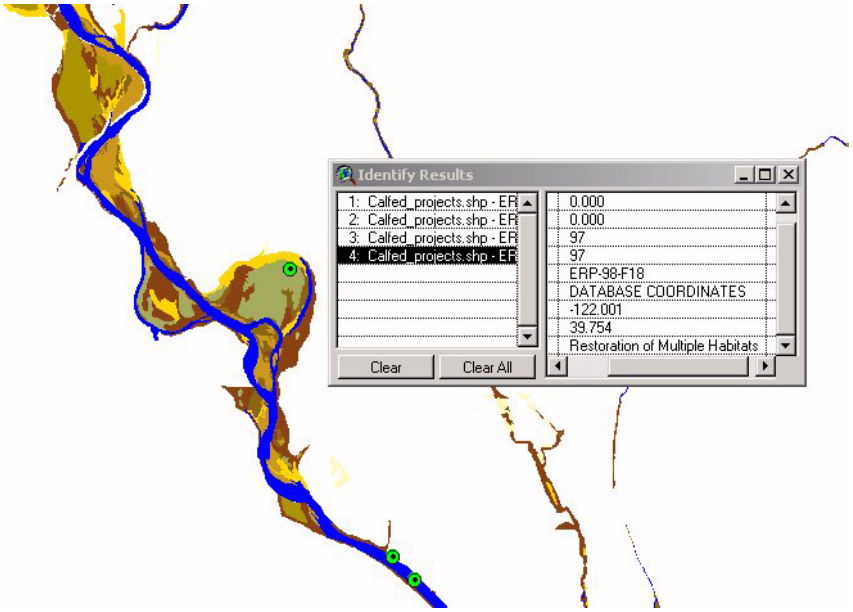
Attachment C-A. Selected GIS maps and imagery now available.

1. USGS topo (100K, 1/24K)
2. USGS ortho-photos 1/24K
3. CALFED ecoregions
4. CALFED & DFG eco-restoration projects
5. Watershed boundaries (CALWATER)
6. Streams (various levels)
7. Lower Sacramento River riparian vegetation
8. Lower San Joaquin River riparian vegetation
9. Delta Ecological Management units
10. Delta crop types (DWR yearly)
11. Levees (by type)
12. Delta bathymetry
13. Wetlands (National Wetlands Inv. / Ducks Unlimited)
14. New, High-resolution Digital Elevation (Delta) 2005
15. Delta Protection Commission boundaries
16. Estimation of degree of inundation
17. County, City boundaries
18. Roads

Examples of GIS maps and imagery



Restoration Projects (green circles) over streams)



Restoration Projects over Sacramento River riparian vegetation, with on-line data. In ArcInfo, or in DFG's new web-GIS(http://www.bios.dfg.ca.gov/), clicking on a green circle will link to the ERP database for the project description and reports, and in some cases, photos and field notes. DWR is developing a similar open-web interface. In this fashion, monitoring stations, outfalls, diversions, CALSIM nodes (i.e. any geo-referenced feature) can be integrated into a system of data assimilation and analysis and used for calculation of performance measures.

Attachment D

Modeling
ISB meeting of May 10, 2005

Findings

Integrative computer-based modeling is a tool that can be used to help solve some problems and to further our understanding of California's water resources. New modeling tools are often sophisticated and can inform the decision-making process.

The ISB's Modeling Team inquired whether experts could use modern modeling tools to analyze the following question in the context of the Delta Improvement Package (DIP): "Will increased pumping lead to management flexibility and better water quality and ecosystem function?" The ISB has found that the modeling needed to address this multifaceted question will require development of new integrated models. To develop such models in the context of evaluation of the DIP proposal to increase pumping capacity from 6,680 to 8,500 cfs provides an excellent opportunity to study and compare effects of varying pumping capacities.

The California Water and Environmental Modeling Forum is a non-profit, non-partisan organization whose mission is to increase the usefulness of models for analyzing California's water-related problems. The CWEMF, which was formed in 1994, carries out this mission by:

- facilitating an open exchange of information on California water issues;
- resolving technical disagreements in a non-adversarial setting; and
- ensuring that technical work continues to take into account the needs of stakeholders and decision makers.

The ISB's John Melack attended their 2005 Annual Conference and has found that CWEMF helps agencies use common data and common models. Additionally, the ISB has found that CWEMF is receptive to working collaboratively with the ISB to further modeling efforts.

Recommendations

The ISB recommends that:

- An independent rigorous peer review of the reformulated CalSimm II module for the San Joaquin basin be conducted jointly by the Science Program and CWEMF.
- The Science Program proceed with planning for a workshop to be held jointly with CWEMF in late Fall 2005 or early winter 2006 that focuses on the integration of hydrodynamic models with biological and water quality models. This workshop will facilitate a comparative and critical discussion

of the ability of the models to address a specific management question such as: "will increased pumping lead to management flexibility and better water quality and ecosystem function?" It is hoped that this workshop will encourage innovative approaches to increase our understanding of the system through modeling.

- The ISB encourages the development and use of community models that can be shared among agencies and other interested parties. In the context of this long-term goal, the ISB encourages an approach that builds upon the existing CWEMF recommendations to provide open access to models and to facilitate rigorous, independent peer review of models.

Attachment E
Subcommittee on ERP/EWA Integration
CBDA Independent Science Board
May 11, 2005

Members: Ken Cummins, David Freyberg, Helen Ingram,
Duncan Patten, Kenneth Rose (Chair)

Procedure

The subcommittee initially met during the September 2004 ISB meeting, where CBDA and agency staff offered to prepare written background materials. These background materials were then presented to the subcommittee at the November 2004 ISB meeting. Due to illness and travel complications of subcommittee members, the subcommittee was unable to meet during the February 2005 ISB meeting. The final meeting of the ISB subcommittee occurred during the May 2005 ISB meeting.

Roger Guinee of the US FWS (representing the EWA) and Dan Castleberry of the CBDA (representing the ERP) made oral presentations and provided a brief written report on the degree of integration between the ERP and EWA to the subcommittee at the November ISB meeting. Their written report was entitled "More Self-Conscious Integration of the Environmental Water Account with other Environmental Water Programs and Tools for Environmental Restoration." Campbell Ingram [representing the Environmental Water Program (EWP) of the ERP] also participated in the November subcommittee meeting.

Findings

The Subcommittee defined coordination as discussions (communication) among the parties to ensure all parties know what the other parties are doing. Integration was defined as the next step beyond coordination, so that communication among the parties results in altered decision-making. Integration allows for individual programs to make their own decisions; integration would ensure that these decisions are made to take advantage of opportunities for synergism between the two programs and to maximize the overall ecological benefits of actions. Integration can also have several downsides that generally arise from integration causing programs to become inter-twined. Downsides to integration can be reduced transparency of the decision-making process, distortion and shifting of the goals and responsibilities of individual programs, and reduced flexibility within individual programs.

It was clear to the subcommittee that there has been a high degree of coordination between the ERP and EWA programs. Communication between the leaders of the two programs was frequent and often, via direct conversations and regular group and team

meetings (e.g., the (b)(2) Interagency Team (B2IT); Data Assessment Team (DAT)). Some of the coordination occurs *de facto* because individuals are involved in multiple committees and teams. The degree of integration, however, seemed to occur on a more opportunistic basis (i.e., when situations presented themselves and the timing was right).

Recommendation

The Subcommittee recommends that a Task Force be constituted to evaluate the ecological benefits and the operational and other costs associated with additional integration among the four environmental water programs (EWA, ERP, (b)(2), and WAP). The evaluation by Task Force could include analyses of past actions to quantify synergistic effects of various level of integration. The activities of the Task Force should be done in close cooperation with agency and CBDA staff.

MEMORANDUM

From: Sam Luoma, David Freyberg

To: Independent Science Board

Subject: Water Management Research Questions

Date: February 22, 2004

Background

During the November 2004 meeting of the Independent Science Board (ISB), the Delta Improvements Package (DIP) was discussed. As one component of the DIP, DWR and the Bureau of Reclamation are developing a draft plan to increase the capacity for pumping of water from the south Delta (*8500 Plan*). The working hypothesis is that the increased flexibility allowed by increasing pumping capacity will simultaneously increase water supply reliability and allow for maintenance and improvement of ecosystems and water quality. The ISB raised several questions related to this issue including:

- What are the current diversions and the potential trends in diversions under the new regime?
- What would be the characteristics of the hydrographs at various monitoring points under different weather years under the proposed new pumping regime?
- What potential exists for water conservation to play a role in reducing pumping demand?
- What are and what would be the effects of pumping on habitat conditions throughout the system?

In January, The ISB sent a memo to the newly-formed Water Management Science Board (WMSB) at the request of WMSB Chair notifying them in general terms that the ISB would be crafting a specific request to the WMSB to address some of the issues outlined above.

While framing the more specific questions for the WMSB, we ended up creating a broader research agenda that covers a range of critical questions relative to DIP and the 8500 Plan. It is not expected that the ISM and other advisory boards, themselves, would conduct this research, but that the questions provide one aspect of the framework that guides the advice and evaluations the Boards provide for CALFED. Central to this is the question of whether and how CALFED is addressing these questions. It is recognized that there is great uncertainty embedded within these issue, but assessments and evaluations, at least, should explicitly state the major assumptions of the implementation, relative to those uncertainties.

Below is a draft of that more detailed request.

Research Agenda for the 8500 Plan

In the context of DIP and the 8500 Plan, the ISB recommends that the Bay-Delta Authority, with the assistance of the Independent Science Board, Water Management Science Board, ERP Science Board, and the Water Use Efficiency Subcommittee address the following points:

1) The scope of assessment and evaluation for the 8500 Plan should include both effects on hydrodynamics and ecological processes (and populations) *within the Delta* and *upstream effects* induced by changed reservoir operations.

2) There is a need to assess historical, current, and predicted future conditions throughout the watershed. Clarifying the state of knowledge is essential. What are the data on actual impacts of water management facilities and operations vs. projected impacts based on a small set of design flows? What do we know about impacts over a broad range of flow/diversion conditions? What are the uncertainties in our knowledge base? How do these uncertainties intersect the uncertainties of projected scenarios for future operations under the 8500 Plan?

3) The scope of assessing the impacts of changes induced by the DIP should be broad, going well beyond volumes diverted and alterations to the annual hydrograph. For example, the scope of temporal impacts should range over event hydrographs, seasonal patterns, to at least multi-year patterns of dry and wet years. Hydrologic and hydraulic impacts should include velocity distributions, turbulence and mixing, sediment erosion, transport, and deposition, the "zone of influence" in the Delta, habitat niches, etc. In other words, impact assessment should go well beyond traditional flow/hydraulic impacts to include characteristics of the system important to ecosystems, their protection and rehabilitation, e.g., habitat quality.

4) What will be the quantitative role/impact of water conservation? How do water conservation projects and programs (both ag and urban) contribute to supply reliability? To ecosystem protection and rehabilitation? Is there/can there be an active linkage between water supply reliability actions and water conservation actions?

5) From the perspective of water supply system design and operation, what are the opportunities for experimentation, both with water management actions that have the potential to increase water supply reliability without diverting more water and with water management actions that have the potential to contribute to ecosystem protection and rehabilitation? (WMSB)

6) What are the implications of developments in water markets on the DIP and 8500 Plan? What are the implications of developments in agricultural markets on the DIP and 8500 Plan?

7) What are the implications of technological developments, e.g., desalination technologies, large-scale computation, on the DIP and 8500 Plan?

8) How do developments in other water management institutions, e.g., water rights law, public trust doctrine, impact assessment of the DIP and 8500 Plan?

9) Given the centrality of terms such as "water supply reliability" and "flexibility", how is/should uncertainty be incorporated into the analyses and assessment of water management

science? What are the dominant sources of uncertainty? From an historical perspective, some apparently very important sources of uncertainty, e.g., population growth, structure and growth of the economy, climate change, often don't fit well within "design" uncertainty analyses. How should those sources of uncertainty be considered? How are "reliability" and "flexibility" being defined? How are they valued (how much are they worth)?