Agenda Item: 3 Attachment 1
Meeting Date: February 21, 2007

Independent Science Board
Performance Measures Liaisons Consolidated Comments

Water Quality: Bill Glaze and Antonio Baptista

Levees: Peter Goodwin, Jeff Mount, and Bob Twiss

Water Supply Reliability: Jack Keller, and Daene McKinney

Ecosystem: Paul Smith, Duncan Patten, and Judy Meyer

Water Quality
Bill Glaze

General Comments: The Subcommittee and the Water Quality Subgroup have made a valiant attempt to develop a process that will yield meaningful and useful indicators and performance measures in the face of resource limitations and possible drastic changes in the structure of the Bay-Delta system. The merging of drinking water and environmental water is a significant step forward.

Comments on the Water Quality Section of the Report

Indicators. The indicators listed beginning on page 4/80 are not labeled as such. Consistency of formatting with the previous section would have been helpful. Until one gets to the detailed report, one gets an impression that the chosen indicators hardly go beyond the rather meager list of indicators currently being used, particularly for water slated for export. The indicators not specifically included in the ROD including to protect ecosystems are limited in number and inadequately described in the executive summary. From the more detailed discussion in the body of the report it is clear that the sub-committee discussed more contaminants but choose to take a conservative approach in line with expected resources. The Executive Summary and the section on Key Messages need to be reconciled with the more detailed treatment in the main report.

The drinking water-related indicators reflect the simplest interpretation of the ROD, including as they do salinity/bromide, organic carbon, nutrients and pathogens. I am disappointed that the sub-group did not choose to take a higher road, regardless of the current lack of resources. The main report shows that the sub-group certainly appreciates that there are indicators other than the four listed above that may be important (for example, specific pesticide and herbicide residues, emerging contaminants such as endocrine disrupters, non-conventional disinfection byproducts, and emerging pathogens). The three “toxicity” indicators address this subject to a certain extent, but generic, group indicators based on traditional ecotoxicological methods have proven to be of limited value in deriving meaningful performance measures and source mitigation. We are at the point now where more molecular and species-specific indicators are needed and are becoming available. One example serves to illustrate the point: is it not possible that viruses and other non-conventional microorganisms play an important role in determining ecosystem health and the decline of specific species? Do we not need a comprehensive metagenomic analysis of the Bay-Delta as a beginning to a more complete understanding of the system? Other examples could be cited. In other words, I am afraid that the present document will not drive research that is needed to substantially further our understanding of the system and how water quality from the Delta affects public health.

The choice of mercury as a harmful water contaminant is a good choice, but the indicators should include more comprehensive monitoring (or existing data analysis) of mercury in the entire system including sources, transport and transformation (into

methyl mercury) and the construction/evaluation of models that describe these and the other processes indicated in three mercury bullets. Here the overlap with the ecosystem restoration group is significant but not clearly indicated in the document. Again, other species such as selenium were apparently considered but were relegated to latter Phases.

Finally, the detail in Attachment 2 illustrates how in depth were the deliberations of the Water Quality sub-group, how much combined knowledge exists in the group about the workings of CALFED and more generally, the Bay-Delta system in the largest sense of the term. Again, I feel that the document would have more impact had the group taken advantage of this knowledge and taken a bold and aggressive position regarding needed indicators and performance measures. While I appreciate the fact that arguments for more resources are necessary and that compromises in the plan will have to be made, I feel that this document, which will receive broad circulation, would be more effective if it laid out a bold, visionary plan for water quality monitoring with state-of-the-art methodologies that over the next decade would change the paradigm for water quality protection in the delta.

Other comments:

The term “disinfection by-products” needs to be precisely defined.
Ditto “pathogens”
Ditto “toxicity”, i.e. an operational definition as the term is used here.

Draft Memorandum

To: Dr. Jeff Mount

From: Peter Goodwin

Date: 2/12/2007

Re: CALFED Performance Indicators - Levees

Further to your request for suggestions on the performance measures related to levees.

Levees

The scale of the non-engineered levee problem is almost unprecedented and the consequences of a series of non-planned or non-anticipated failures could be a major risk to human life, ecosystem health and economic stability of the region. The CALFED program does have considerable expertise in staff with agencies and has also sought the advice of national experts such as Dr. Ray Seed (UC Berkeley). The kilo-inch mile (KIM) concept is a simple measure to track progress, and the reader assumes the width of material to be placed follows the standard design (but raising a levee by 5 feet over one mile takes more material than raising a levee one foot over 5 miles). The use of remote sensing of ground elevations by LiDAR is also an excellent way to determine low spots, slumping or other topographic changes in the levees. These are positive attributes to the levee management program but from the brief review material it was unclear how the science program (or other programs) were contributing to (1) investigation of potential failure mechanisms of the levee through overtopping or structural failure (2) research to minimize the costs of levee fixes (3) improving a real-time warning system and (4) identifying different levels of risk and priorities for levee improvement. This latter issue will be covered in DRMS. Some suggestions for the performance measures:

1. The work of Dr. Seed and others in Louisiana identified failure mechanisms that had not been anticipated and would not have been fixed by traditional levee upgrades (for example, the identification of very subtle thin layers of weak material in the levee set down in prior flood events). This is not a criticism of the engineers working in New Orleans, but a valuable illustration of the technical difficulties of working with levees in delta environments. Will the DRMS program include studies to investigate a full suite of potential failure mechanisms? Is there a possibility of developing a protocol of upgrading levees that will withstand all failure mechanisms except 'Process X' which was not foreseen? This is obviously a concern for IDWR but do they have the resources to conduct these studies?

2. The use of electromagnetic anomaly surveys to identify weak spots inside the levees is an excellent example of the use of technology to generate cost-effective management of a major threat. I am not intimately familiar with this technology – but have field studies been conducted to determine how comprehensive the results are in this environment? For example, are there some types of levee weakness or some locations (adjacent to pipes or abutments) that cannot be detected? The cost of supplementing the existing equipment with other parallel technologies would be modest compared to the consequences. The question of whether there are suitable supplementary technologies could be posed to the expert review panel being assembled for DRMS.

A recommendation for the levee performance measures is that agency staff and their external experts conduct an applied research study in parallel with current activities. The two objectives would be:

(1) Evaluate new technologies that could be mounted in parallel with the electromagnetic anomaly sensors capable of providing additional information on levee movement, water flux through the levee, pore pressures etc that would be used as part of an advanced warning system for levee failure or identifying areas to be fixed.

(2) Investigate other potential failure mechanisms not currently expected (Dr. Seed and DWR staff would be ideal leads in this type of study) through detailed assessment of a few study sites that are representative of different levees (depending on the results of analyses developed under the DRMS program).

Recommendation 1 could be used in conjunction with remote technologies to develop a real-time warning system. NASA is currently being encouraged by the global oceanographic science community and others to consider a satellite to measure water surface elevations as a priority for the future. CALFED may want to enter the debate to ensure that the satellite capabilities could support the type of data collection that would contribute to risk management in the Delta.

Suggestions for February ISB Meeting Agenda

One of the most critical areas where the ISB can support the overall CALFED effort is with the performance measures – as this is how the program will be judged in the future. This is a very difficult task and it is important to have all parties in general agreement with how the performance of the program will be assessed. It is an excellent idea to have an extended discussion in February on the Water Quality aspects. Future working sessions – or even workshops - could address the ecosystem performance measures. It appears there has been a significant investment of agency time and resources during the past five years that can be used and integrated into a comprehensive and fair set of measures. The ISB may be able to help prioritize these measures.

Levees
Jeff Mount

I appreciate the difficult task facing the levee indicators group, and the great deal of work that is being done outside of that group's efforts (DRMS). However, like most members of the ISB, it strikes me that this program is still a long way from developing the key indicators necessary for setting performance measures. We have a long way to go and progress appears to be very slow.

During this fall there has been a great deal of emphasis on the use of "KIM"s or Kilo-inch-mile as an important indicator for assessing levee reliability. I understand the logic behind this: if your levees do not meet a given standard for crown height and width, then they will have a higher probability of failure during high stage events. This, of course, only applies principally to overtopping. What worries me about this measure is the potential for misinterpretation. For example, a large island levee that is 3" below HMP or PL-84 standards will have a large KIM value, highlighting a problem. In contrast and equal island levee that is up to HMP or PL-84 standard elevations and width, but has one small sag in it that is, say 1' deep, will have a very low KIM. Yet the latter island is significantly more likely to fail by overtopping than the former, and the KIM will have missed this completely. Rather, this KIM is nothing more than a general measure of how close the islands are to PL-84 or HMP standards and how much material is going to be involved to bring it to that standard.

The KIM needs to be adjusted so that it can capture the negative excursions from the mean elevation of the levee crown. Sags in the levees are just as important as levee heights.

The KIM can also provide some measure of understanding of levee width, which is key to stability and necessary to reduce the effects of piping. But as the KIM is set up now, it aggregates the material needed to raise the levee height and to add to levee widths in order to maintain the proper slope. You will want to address this problem.

Ultimately, the key metric for overtopping and piping is whether or not the levees meet HMP or Pl-84 standards. That's the easiest and simplest first-order indicator for levee integrity. That said, those indicators are all tied to local hydrology, particularly the elevation of the so-called 100-year event. The hydrology for the Delta has not been upgraded since it was done following the 1986 floods. Inflows to the Delta have been large since then, particularly in 1997. It is highly likely that most of the Delta, regardless of improvements, will be out of compliance once the hydrology is redone. How will you accommodate this?

Underseepage, according the ACOE, is an under appreciated source of levee failures. Those who work in the Delta know this issue well, and it has bedeviled efforts to either fill islands or restore them, due to the underseepage impacts on adjacent islands. I see nothing in the current discussion of methods that will capture that. Kim's certainly don't, and your current focus for magnetic anomaly work probably won't get at it either.

The magnetic anomaly work is one approach for assessing levee interiors. But at this point, I am unclear how this would be converted into an important indicator. Perhaps in the next iteration we will hear more about this. Anomalies are just that, anomalies. Many different things can cause the anomalies to form, requiring investigation. This makes it hard to assess on a regional scale.

Of course, one of the most important predictors of levee failure is how well the local reclamation district has performed on O&M. Records are kept on this and inspections are made. Are you planning to make use of this information?

Finally, I don't really see how all this fits into the revised framework described by Lauren and others for the development of core indicators and performance measures. That is, I am seeing no movement in the material presented toward articulation of Administrative Indicators, Driver Indicators, and Outcome Indicators. Nor do I see any Conceptual Model that presumably links all of this together. Needless to say, more coordination and homework needs to be done.

To: Jeff Mount, ISB

November 13, 2006

From: Bob Twiss

Subject: Comments on Performance Measures for Delta Levee System Integrity.

Here are some suggestions.

Work with the proposed Kilo/Inch/Mile (KIM) idea presented by DFG et. al., but recognize that it relates to only one part of the threat, and only one tactical solution. This approach must be supplemented by other indicators of how well levees will perform under anticipated future states.

Problems with the KIM approach include:

Simply adding rock has its limits:

1. After a few inches buildup, the added weight can cause problems of subsidence and subsurface deformation.
2. The tactic of adding rock may be limited to only 1-3 inches of rise (a definitive figure to replace 1-3 inches would need to be set)
3. The Dutra rock quarry does not have enough reserve to treat all levees. Development of additional sources of rock may take years.
4. Adding rock to the top does not address seismic safety (and actually can reduce robustness)
5. Adding rock does not address ecosystem impacts or restoration.
6. Adding rock addresses overtopping, but not other key threats to levee integrity (foundation failures, burrowing animals, hydrostatic pressure, piping,)

KIM

Nonetheless, the Kilo/Inch/Mile approach could be used as a first step to:

1. Calculate the gap between current condition and the modest upgrades that could utilize this tactic.
2. Estimate the volume and cost of raising existing levees to meet the lowest projections for sea-level rise and higher flood peaks.
3. Compare current conditions to PL 84-99 (although KIM alone does not provide for reaching that standard; and that standard should not be relied upon for protection against anticipated future conditions.

Other Performance measures.

Other benchmarks need to be developed for achieving levels of protection that may be needed to accomplish known goals for the Delta and those that are likely to arise in the Delta Vision and Strategic Plan (e.g.: salinity control, water supply routing, infrastructure protection, etc.). These standards of protection can be characterized by class archetypes (as is done for naval vessels, where **class** denotes a complex of features such as size and thickness of armor):

The key performance measure between the **Current State vs. Targeted levels of protection**.

> The current state can be shown in relation to targeted levels of protection that will emerge as the Delta Vision/Strategic Plan process produces land use scenarios and recommendations. Land use types will presume (or mandate) certain levels and types of long-term protection. For example:

1. **Non-Project class**. Current non-project levees presumably could be specified for locations and land uses that can withstand flooding now, and that in the future cannot be relied upon for protection.
2. **PL 84-99.** This class should not be used. The ISB, DRMS, or other entity should write the rationale for why this class fails to meet long-range planning and protection needs for the Delta, and why continued use of this formula can be highly misleading and dangerous to public safety.
3. **Revised PL 84-99** or similar class. The revised standards would recognize increased flood height and frequency in climate-change and sea-level rise forecasts.
4. **Double-armor class** levees may be necessary for protection against wave action in polders that are intentionally flooded, or are allowed to remain flooded by design or in response to multiple-island failures.
5. **Twitchell class** levees for long-term modified agriculture, ecosystem restoration, or protection of channel configuration. Twitchell Island class levees are high enough to withstand sea-level and flood rise, are set back, have new foundations and ecosystem measures; but do not have internal armoring or seismic engineering.
6. **Seismic class** levees would be needed for urban and industrial land uses to protect life and high-value property. This class of levee does not exist in California, but engineering characteristics (and cost estimates) for a class archetype could be specified.

Management of the levee system for the Delta as a whole could be planned with conceptual reference to the framework sketched in the attached spreadsheet.

Measure of performance = gap between current state and level of protection for sea-level, flood, and seismic forces								
Level of protection	**Miles**		**Volume of material**	**$/mi (millions)**	**Capital investment**	**Time est.**		
			Kilo Inch Mile		(in millions)			
Current state	0		10 yr av per yr	?		yr by yr		
Partial upgrades								
PL84-99 "100yr" / 40yr?	550			2.5				
PL84-99 + 6"				?				
PL84-99 + 12".								
PL84-99 + 24"								
Double-side armor				2				
Replace levee, incl foundation								
Twitchell-type setback				8				
Seismic retrofit				20				
Example:								
Bethel Isl. Seismic retro	12			20	240	10		
Twiss 13 Nov 06								

PHASE 1 REPORT: CORE INDICATORS AND PLAN
PRELIMINARY PLAN – SEPT. 7, 2006

Comments on Water Supply Reliability

Daene C. McKinney
ISB Member
November 17, 2006

INITIAL NOTE: These comments are offered based on very limited information and incomplete knowledge of the development of the performance measurements process and the role of the ISB in this process.

FRAMEWORK

The 10-Year Action Plan gives responsibility to the CALFED implementing agencies to develop performance measures.

The framework for performance measurement and monitoring uses three levels of indicators: administrative; drivers; and outcomes. The framework puts emphasis on conceptual models that describe the rationale and scientific basis linking drivers and outcomes. The framework also emphasizes indicators and performance measures, with associated conceptual models as a tool for integrating science into decision making, evaluating the implementation, and providing information for decision-making and adaptive management of the system.

Main tasks in Phase 1:

1. Identify a list of the primary performance objectives and targets for the program

   STATUS (as far as can be determined form the report): some were identified, some were passed off to other programs, some were postponed to the future

2. Agree on a theoretical framework and approach for developing and communicating indicators and performance measures

   STATUS (as far as can be determined form the report): Not present in the report

3. Develop a process with clear roles and responsibilities and appropriate review and input for developing and reporting on indicators and performance measures

   STATUS (as far as can be determined form the report): Not present in the report

4. Choose a core set of initial indicators related to the four program objectives

STATUS (as far as can be determined form the report): some were identified, some were passed off to other programs, some were postponed to the future

5. Conduct an information survey about the core indicators – including conceptual models, identifying drivers, and documenting data availability and quality

   STATUS (as far as can be determined form the report): Summarily or not present in the report

6. Estimate resources needed to complete the data compilation, analysis and reporting for the core set of indicators (OK)

   STATUS (as far as can be determined form the report): OK, but not justified.

7. Develop a tentative plan and schedule to complete development of the core indicators, monitoring, data compilation, analysis and reporting

   STATUS (as far as can be determined form the report): Not present in the report

In the Phase 1 process, a scientific and monitoring information "inventory" for outcome indicators was to be undertaken. Areas should have been evaluated for information availability ranked from 0 (no information available) to 4 (information is fairly complete):

- Monitoring data for the outcome indicator
- Conceptual models that list the drivers affecting that outcome and the linkages between the drivers and outcome
- Quantitative models that describe the linkages between drivers and outcomes
- Monitoring data for the driver indicators

  STATUS (as far as can be determined form the report): Summarily or not present in the report

INDICATORS AND PERFORMANCE MEASURES

Indicators and performance measures translate program goals and objectives into measurable benchmarks of program success.

Indicators are a group of measurements used to evaluate the state of the system and provide better understanding about how the system is working.

Performance measures are indicators that are used to evaluate progress towards program goals.

Indicators are defined on three levels:

1. **Administrative indicators** track how resources are used to address a problem by tracking funds and numbers of projects.

2. **Driver indicators** track actions that have been implemented, as well as other uncontrollable factors that may be affecting an outcome.

3. **Outcome indicators** indicate the state of the system related to program goals and objectives, including environmental outcomes such as species population levels or water quality measurements.

CONCEPTUAL MODELS

Conceptual models are used to identify the drivers related to each outcome, including actions that have been implemented and uncontrollable factors in the environment.

Key Messages from Phase 1 report:

> "effort of federal and state CALFED implementing agencies "

QUESTION: Why was there no input from stakeholders, interest groups, citizens, contractors, etc?

QUESTION: Staff resources for various analysis and monitoring functions are called for. What, specifically, are these resource requirements and how likely are the analysts and monitors to receive these resources?

QUESTION: Since the performance measures and indicators are being developed by the implementing agencies, who will perform the analysis and monitoring referred to? The implementing agencies, who are developing the indicators and measures of their own success CAN NOT monitor their own fulfillment of those goals. Certainly a self-assessment can be done and this is valuable, but the main function of monitoring MUST be done by an independent, outside body or panel.

RECOMMENDATION: Since the ISB is being asked to provide the review, assessment and approval (including ongoing review after the development of the performance measures and indicators) of the performance of the Implementing Agencies relative to the performance measures defined in this process, it is critical that the ISB provide detailed inputs to the development process. To date there has been little interaction or input by the ISB in this process and everything has been at the level of short briefings and incomplete draft reports. It seems reasonable to expect that there should be ISB representation in the various subcommittees that are developing the performance measures and indicators.

WATER SUPPLY RELIABILITY

Program goal

"reduce the mismatch between water supplies and uses dependent on the Bay-Delta system."

Outcome indicators

1. AF of water for water quality and fish restoration
2. AF of water delivered from the system (10 year average).
3. TAF/year of reductions in deliveries.

Challenges

"defining current and projected beneficial uses"

Measurement of deliveries for municipal and industrial and agricultural (MIA) uses is possible. Measuring the maintenance of fish and wildlife and preservation of water quality is much more difficult.

MIA use estimates must be used in conjunction with a broader range of information, such as

1. Other sources of water supply
2. Changes in water use infrastructure
3. Changes in water use practices,
4. Water quality at various locations and for different uses, and
5. Long-term health of the affected ecosystem.

QUESTION: About ½ of the use categories may be adequately estimated (1-3). Why is there no discussion of the state of measuring categories 1-3? What are the measures of these categories? What work is going on to bring the other categories (4-5) up to the level of proficiency as the traditional uses?

QUESTION: What is meant by "other sources"? Alternative sources? Groundwater? Inter-basin transfers? Desal?

QUESTION: What is meant by "changes in … infrastructure"? New storage? Conjunctive use?

QUESTION: What is meant by "water use practices"? Water conservations? Irrigation system efficiency improvements?

NOTE: Water quality and ecosystem health appear to be addressed by other groups and agencies, whereas the sources, infrastructure, and practices seem to be the concern of the water supply reliability group.

Identified needs (from the report):

- Better scientific understanding about the relationship between the availability and movement of water and a healthy ecosystem.

- The evolving concerns about exotic species, climate change and the growing number of water quality constituents of concern.

- Water supply reliability performance measures must be tied to those for ecosystem restoration and water quality improvement.

QUESTION: There is a tendency to tackle the traditional aspects of supply-side water planning and to pass the other aspects off to other groups. What indicators of proactive measures are being developed to integrate the traditional and other aspects in the water supply reliability work?

Recommendation (from the report):

> "CALFED should focus on the Delta aspects of improving Statewide Water Management Systems to make Delta water conveyance more sustainable and reliable. Beyond the CALFED Program, State and federal agencies should continue to address the other aspects of water management, such as alternative water supply sources and demand management that directly affect local, regional, and statewide water supply reliability."

QUESTION: So how does this recommendation relate to the earlier observation that estimates of MIA uses must be considered *in conjunction with* a broader range of information? This "broader range of information" includes exactly the things that are being called "beyond the scope". On the one hand this it is claimed that the information is needed; on the other hand it is claimed to be beyond the scope. It doesn't seem like you can have it both ways.

Recommendation (from the report):

> "CALFED Program implementing agencies should focus on water deliveries from the Bay-Delta system for municipal and industrial and agricultural purposes as one important input to statewide water supply reliability."

QUESTION: Is this a statement of maximizing water delivery subject to the constraints of meeting specified levels of the "other" considerations of water quality and ecosystem integrity? If so, is this the appropriate perspective to take? Have alternative perspectives been considered, such as multi-objective analysis to balance the several objectives and identify the tradeoffs between them? An interesting alternative is well stated in the following paragraph: "a healthy, reliable and sustainable Delta ecological system that can also convey stable water deliveries."

Strategic Objective 1. Enhance Long-Term Stability of Delta Water Supplies

***Performance Objective 1a*:** Provide water supply to improve delta water quality and contribute to fish restoration efforts.

Indicators

- Water available for water quality and fish restoration
- Progress in meeting ERP and WQ program goals
- To be coordinated with the ERP and WQ programs

***Performance Objective 1b*:** Maximize Sustainable Delta Deliveries.

Indicators

- Average annual water delivery.

Targets

- Benefits provided through implementation of activities to enhance delivery capability.

QUESTION: What are "activities to enhance delivery capability"?

***Performance Objective 1c*:** Minimize unanticipated and uncompensated reductions in scheduled delta water deliveries (delivery stability).

Indicators

- Unanticipated and uncompensated reductions in scheduled deliveries.

Targets

- No unanticipated and uncompensated reductions in scheduled deliveries.

QUESTION: So are "compensated" reductions acceptable and to be allowed?

QUESTION: The target implies 100% reliability in meeting scheduled deliveries. Clearly this is impossible and planners and customers would be skeptical of a statement of this kind. Perhaps some modified language could be considered here, such as "*Minimize* Unanticipated …"

Strategic Objective 2. End User Supply Reliability

This Objective is administered through the California Water Plan update process and reported to the CALFED Program.

Indicators

- Indicators and targets will be developed in cooperation with local and regional agencies, in consideration of statewide and regional water management objectives.

QUESTION: Will these indicators be developed and approved by the CALFED Program or as another activity of the implementing agencies?

APPENDIX: WATER SUPPLY RELIABILITY

Data inventory

"The ongoing Common Assumption effort has prioritized and will continue to identify data gaps, collection of data and use of surrogate data for the Storage Planning Studies. This information and plan will be made available to agencies and the public as necessary. See the current plan attached."

NOTE: More information on the "Common Assumptions" program is needed.

Outcome indicators

- WSR -1: Water supply available for and dedicated to Bay–Delta system for fish restoration and water quality improvements.

- WSR -2: Delta system export capability – export demand (reported in percent of export demand supplied)

Conceptual or quantitative models related to indicators

"A first draft of a conceptual model and the cause and effects of drivers and outcomes is depicted on the attached Figures 1 and 2."

NOTE: Figure 1 available, Figure 2 not supplied

"Further work will be required to define these relationships more closely using the CALSIM, DSM2 and related peer reviewed mathematical models that predict Bay-Delta system supply and demand. The ongoing Common Assumptions effort to standardize and collaborate on modeling assumptions strives to provide a commonly accepted and fully coordinated amongst the Calfed Agencies approach to modeling state wide hydrology and hydraulic capabilities of the state and federal water systems dependent on the Bay-Delta system."

QUESTION: What work is going on to "define these relationships more closely"?

NOTE: Information on the "Common Assumptions" program is needed.

Data and information gaps

NOTE: No response to this question

NOTE: All figures and tables missing (except Figure 1).

RECOMMENDATIONS AND CONCLUSIONS

General comments:

The effort to define the performance indicators and measures for water supply reliability is, if one considers the materials presented for this meeting, in its infancy. So far, in this effort, there is no clear definition of what is meant by "water supply reliability" and there are no indicators or measures suggested to deal with the issue. The indicators that have been mentioned do not deal with the issue of reliability and are simple measures of volumes of water delivered. No temporal or spatial indicators have been mentioned or discussed. No indicators that deal with the various types of delivery or service are mentioned. No indicators of the affects of enhancements to water supply through increased surface water or ground water storage are mentioned. The interconnections between volumetric water deliveries and other aspects of delta management are not addressed, such as water quality or ecosystem health and integrity.

Recommendations:

Given the report that was presented to the ISB, it is clear that much more work remains to be done to define performance measures and indicators of water supply reliability. The nature of the reliability of water supply has not been defined in the report, nor is any concept of reliability hinted at. Without this definition, the measures and indicators to address the success in providing a reliable source of water can not be developed. The measures and indicators presented in the report do not address the question of water supply reliability and much more work needs to be done on these. Some specific recommendations are made below.

- Develop and agree on a definition of "water supply reliability".

  This definition should include considerations of the traditional aspects of delivery of water to municipal, agricultural and industrial customers and the other aspects of water quality and ecosystem health and integrity.

Water is supplied from the delta system for various services. These different services need different definitions of reliability.

Reliability definitions should consider the different time scales of water supply from the delta system. These different time scales may require different definitions of reliability.

- Develop and agree on performance measures and associated indicators that can be used to measure water supply reliability in light of the above definition.

  These measures and indicators should take into account both the traditional aspects of delivery of water to MIA customers and the other aspects of water quality and ecosystem health and integrity as well as considerations of levee integrity.

  These measures and indicators should be both deterministic and stochastic in nature in order to capture the variability and uncertainty in water supply due to climatic variability and future development.

  These measures and indicators should be both quantitative and qualitative in nature in order to deal with the fact that many of the linkages between various aspects of water supply including water quality and ecosystem health and integrity.

  Forecasts of future water supply reliability should be considered as well as analyzing historical data on measures and indicators.

  Financial aspects of water supply reliability should be considered alongside of the physical, biological, and chemical aspects. The financial aspects may indicate aspects of reliability that are not evident from the other aspects.

  Some measures and indicators should indicate the “state” of the water supply systems and its affect on reliability, and some indicators should indicate the “outcome” of the water supply systems and their affect on reliability.

  Water is supplied from the delta system for various services. These services should be taken into account in the development of measures and indicators, since the different services may have different reliability definitions.

  Water supply from the delta system occurs over different time scales, including daily, weekly and monthly. These different time scales should be considered in the development of indicators of reliability.

  Different spatial scales affect water supply from the delta system and these scale affects must be take into account in the measures and indicators.

- Develop and agree on a conceptual model of “water supply reliability” that promotes an understanding of the reliability and how the performance measures and indicators are related to it. This conceptual model should be more than a diagram of the inputs and outputs of CALSIM-II. It should include indications of the interactions that affect reliability of water supply.

- Include ISB representation in the various subcommittees that are developing the performance measures and indicators. One member from the ISB should be assigned to each of the subcommittees in order to develop a better understanding of the process and the developed performance measures and indicators.

Ecosystem
Paul Smith, PhD

This is in response the CalFED Science program phase 1 document on Performance Indicators.

I have two categories of comment: one on presentation and another on the Ecosystem Indicators subpanel.

Recommendations for Overall Document Formatting

While the document is big with water quality with a short levee section and almost nothing on Ecosystem by the time the report is balanced it will be too big for the readership. To solve this, I believe that the performance plan should come in three versions: an executive summary [no more than 4 pages], the decision document [no more than 30 pages] with references to the full length implementation document.

Specific Recommendations to the Ecosystem Indicators Group

With the ecosystem emphasis, I see diversity as the keystone of the Delta. The early draft seems to put population abundance at the top. I think the habitat is so materially constrained that abundance recovery is a long way off. But one can ensure that the nugget populations are maintained at some level above genetic or extinction risk.

Index numbers and proportional changes are quite useful for studies of populations: however, in an ecosystem sense, in which physical and biological interactions are paramount, there is much to be gained by getting absolute numbers on the various populations. This is particularly worthwhile when surveys with varying samplers are used for different life stages of several species. The results of all surveys need to be expressed as absolute standard units. As a beginning, the standing abundance needs to be quantitative on a delta wide basis. Also the fraction of the delta which is habitat should be expressed in square or cubic kilometer terms. Eventually, the standing abundance of organisms should be expressed in terms of productivity by estimating the growth and mortality rates of each species.

Quantification should begin, as the highest priority, on the endangered species and stocks within the Delta. Special efforts should also begin on species of concern, such as those which are of sport fishing interest. Lastly, the early documents should be consulted for an estimate of quasi-baseline conditions, such as the Fish Bulletins [DFG} by Kelley, 1956 and Turner, 1956 prepared for impact studies of the peripheral canal.