CALFED BAY-DELTA PROGRAM

CALFED Bay-Delta Program
Indicators and Performance Measures

Phase 1 Report: Core Indicators and Plan

PRELIMINARY DRAFT —September 7, 2006

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Executive Summary

Purpose

The reviews of the CALFED Bay-Delta Program by the Little Hoover Commission and the Department of Finance emphasized the need for performance measures to report on progress towards goals. The 10-Year Action Plan gives responsibility to the CALFED implementing agencies to develop performance measures with guidance from the CALFED Science Program.

Indicators and performance measures are used to translate program goals and objectives into measurable benchmarks of program success. Indicators will be used by the CALFED Bay-Delta Program to help understand cause and effect relationships between actions and outcomes, track progress toward program goals, inform decisions to be made at the end of Stage 1 (end of 2007), and assess program progress and performance, such as the federal PART process.

A Phased Approach to Indicator and Performance Measure Development

In response to the 10-Year Action Plan, the CALFED agencies formed a subcommittee to direct the development of indicators and performance measures related to the Program objectives and actions. The subcommittee also formed four subgroups, one for each of the four CALFED objectives: water supply reliability, water quality, ecosystem restoration, and levee system integrity. In addition, a technical workgroup was formed to oversee the integration of the various subgroup efforts.

Working collaboratively, the agencies are using a phased approach to develop indicators and performance measures. In each phase, an independent science review will be completed for all products.

Phase 1 will identify primary program performance objectives, select core indicators, determine the availability and comprehensiveness of monitoring data and conceptual modules, present a schedule and plan of action to complete the work, and identify the resources needed.

Phase 2 will evaluate and develop a web-based communications product on the core set of indicators.

Phase 3 will revise the web-based product and will develop the information for publication.

Phase 4 will develop a more complete set of indicators.

Key Messages of the Phase 1 Report

This draft document, ***Phase 1 Report: Core Indicators and Plan***, summarizes information about the Phase 1 activities. Further detail and documentation is provided in an appendix to the report. As the subcommittee developed this product, several overarching key messages were identified:

- An approach for developing and using indicators and performance measures has been refined as the result of a collaborative effort of federal and state CALFED implementing agencies

- Monitoring of indicators and analysis of monitoring data are key to the process

- The development of indicators and performance measures is ongoing, based on a process of adaptive management. Additional indicators and performance measures will be developed in future phases

- Additional resources will be needed to analyze and report on existing monitoring data, identify gaps, and develop and implement additional monitoring programs

- Without additional staff resources at the implementing agencies to work on indicators and performance measures, only a few outcome indicators or performance measures related to water quality and water supply reliability will be monitored and reported on over the next couple years.

In addition to these overarching themes, each subgroup identified key messages specific to their program objective (see Key Messages from Subgroups in the Phase 1 Report).

Core outcome indicators for the four Program objectives

The core outcome indicators that are identified in the Phase 1 report and chosen to be developed and reported on during Phase 2, if resources are available, are:

Water supply reliability:

- Indicator: Acre-feet of water made available and dedicated for Bay-Delta system water quality and fish restoration improvements
- Indicator: Ten year moving average of annual water delivered from the Bay-Delta system in Acre-feet. (Or some other instructive measure of actual water deliveries that accounts for the variation of annual deliveries from year to year based on hydrologic conditions and changing patterns of demand.)
- Indicator: TAF/year of unanticipated and uncompensated reductions in scheduled deliveries.

Water quality:

- Water quality at the five Delta intakes (organic carbon, salinity/bromide, nutrients, pathogens)
- Water quality at the tap of Delta source providers (disinfection byproducts, salinity, taste and odor, disinfection levels and type)
- Toxicity: Indications through Toxicity Identification Evaluations (TIE) that identify the sources of toxicity
- Toxicity: No likely significant toxicity to aquatic test organisms in water and sediment.
- Toxicity: Establish whether contaminants are significant factor in the decline of pelagic organisms, and if so, identify sources
- Mercury: Measure mercury tissue concentrations of biosentinel species (birds, small fish, invertabrates)
- Mercury: Measure mercury tissue concentrations of fish consumed by humans
- Mercury: Develop a metric to measure effectiveness of outreach efforts to reduce human exposure to mercury from consumption of contaminated sport fish

Levee System Integrity:

- Resistance to overtopping: KIM (Kilo-inch Mile) is a measure of how much material is needed for the levees to meet PL 84-99 standards or other relevant standards
- Levee structural integrity: Number of anomalies detected and repaired. Electromagnetic surveys will be done to detect anomalies and potential levee weak spots

Ecosystem Restoration: Core indicators to be determined in the future.

KEY MESSAGES FROM SUBGROUPS

Water Supply Reliability Performance Measures

Historically, the CALFED Program has defined its highest-level goal for water supply reliability to be to "reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system." While this is an apt description of the intent of the CALFED Program, there are many challenges in defining performance measures that can be used to adequately describe progress towards achieving this broad goal.

One primary challenge is to define the current and projected beneficial uses dependent on the Bay-Delta system. At this time, we cannot measure current beneficial uses precisely, and due to their dynamic nature, predicting beneficial uses in the future is even more difficult. Many laypeople interested in the CALFED Program may believe that the term "beneficial use" refers to more direct application of water to satisfy human wants in categories such as municipal and domestic, industrial, and agricultural uses of water. Of course, "beneficial use" also refers to the broader uses of water that provide public benefit, such as providing good conditions for fish and wildlife, maintaining freshwater in water bodies, recreation, and hydropower. (The State Water Resources Control Board has identified 24 categories of beneficial uses of water.)

While it is challenging to precisely quantify the current and projected beneficial uses of water in the classical categories of municipal and industrial and agricultural uses, we have much more experience approximating future use for these categories than quantifying the projected beneficial uses of water for other categories of use, such as maintaining fish and wildlife and preserving water quality. Recent experience with the Pelagic Organism Decline clearly shows the need for better scientific understanding about the relationship between the availability and movement of water and a healthy ecosystem. Moreover, considering ongoing changes in the Bay-Delta system due to exotic species, climate change and the growing number of water quality constituents of concern, any quantifiable projection of beneficial uses dependent on the Bay Delta System will continue to evolve for the foreseeable future.

Given these challenges, any comprehensive performance measures for the water supply reliability goal of the CALFED Program must be tied to performance measures for both the ecosystem restoration goals and the water quality improvement goals of the Program. While it is possible to measure deliveries of Bay-Delta water supplies for municipal and industrial and agricultural uses, this measure provides an indirect and limited indication of how successful the CALFED Program is in producing the intended benefits. If this delivery indicator is not used in conjunction with a much broader range of information, little can be learned about the success of the program with regard to "current and beneficial uses dependent on the Bay-Delta system." Examples of other information that must be considered to evaluate success include application of other sources of water supplies, changes in water use infrastructure or water use practices

that improves water use efficiency, water quality at various locations and for different uses, and some meaningful indication of the long-term health of the affected ecosystem.

Unless advances in scientific understanding prove otherwise, the best indicators of any mismatch between Bay-Delta supplies and beneficial uses related to ecosystem restoration and maintaining water quality will be the overall success of those programs as measured by the performance measures developed for those programs.

To develop indicators of water supply reliability for the subset of municipal, industrial and agricultural uses, two primary recommendations are offered, as follows:

1. To date, CALFED has attempted to evaluate the total portfolio of available water supplies and demands for all Delta Water Users with the goal being to produce an acceptable balance between the two. Upon consideration of the CALFED ROD and supporting documents, it appears that this approach may over reach the CALFED mission and authority, would be unmanageable within the context of the CALFED Program, and would divert the focus of CALFED agencies from addressing specific Bay-Delta beneficial use needs.

   Part of the outcome of the review and refocusing effort of CALFED in 2005 was recognition that CALFED's mission was too large and that the Program should be re-scoped to provide more direct attention to Delta issues. To that end, CALFED should focus on the Delta aspects of improving Statewide Water Management Systems to make Delta water conveyance more sustainable and reliable. As part of their broader missions 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. The California Water Plan update process should serve as a forum for agencies to continue coordination, seek public input, and provide transparency in policy development and implementation.

   Through the California Water Plan update process, DWR and other agencies will compile and integrate regional goals set through emerging Integrated Regional Water Management planning processes. Based on this work, DWR and other agencies will evaluate progress in improving statewide water resources management and develop and articulate State water policy. CALFED water management goals and performance measures should be informed by these broader goals set by the California Water Plan, and vice versa. The Delta Vision and Delta Risk Management Strategy development processes will also inform the California Water Plan update process.

2. As part of the core mission of the 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. Consider changes in those deliveries and predictability of

deliveries as indicators (using probabilistic measures of deliveries over time that can accommodate the inherent variability of conditions in California and the dynamic nature of demand to produce meaningful comparisons), and evaluate these indicators together with performance measures for ecosystem restoration and water quality, as an overall performance measure for the CALFED water supply reliability goal.

Recommended Approach: Refine and more clearly articulate the CALFED Program goal for Water Supply Reliability

The underlying commitment of CALFED is that sustainable progress will be made on all of the Program objectives through a balanced set of actions. The goal for the CALFED Water Supply Reliability program objective should be refined in such a way that accomplishments can be measured and that expectations are reasonable given the refocused CALFED strategy.

Below are two proposed strategic objectives that describe how WSR accomplishments should be measured as they relate to 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
The stability of water supplies for uses both within and exported from the Bay-Delta system is linked to the sustainability of the Delta ecosystem and Delta water quality for both aquatic species and municipal, industrial and agricultural uses.

Performance Objective 1a: Provide water supply in sufficient quantity and timing to improve Delta Water quality and contribute to fish restoration efforts. Water supplies for these purposes will be provided subject to the terms included in the Bay-Delta Water Quality Control Plan, ESA Biological Opinions, HCP and NCCP agreements, OCAP, EWA, and any other relevant regulations or agreements among CALFED implementing agencies. These regulations and agreements should evolve based upon best available scientific understanding of the water supply needs to provide for water quality improvement and ecosystem restoration in the Bay-Delta system.

- Indicator: Acre-feet of water made available and dedicated for Bay-Delta system water quality and fish restoration improvements
- Indicator: Progress in meeting ERP and WQ program goals as measured by established performance measures for those programs.
- Targets: To be coordinated with the ERP and WQ programs.

Performance Objective 1b: Maximize Sustainable Delta Deliveries. As part of a balanced CALFED Program, CALFED agencies should seek to maximize long-term, sustainable water deliveries from the Bay-Delta system, while providing

for all other beneficial uses, including restoring ecosystem health and improving water quality.

- Indicator: Ten year moving average of annual water delivered from the Bay-Delta system in Acre-feet. (Or some other instructive measure of actual water deliveries that accounts for the variation of annual deliveries from year to year based on hydrologic conditions and changing patterns of demand.)
- Targets: Targets should reflect the benefits that could be provided through the implementation of activities in the CALFED ROD to enhance delivery capability and must be evaluated and updated regularly and reflect currently institutionalized constraints to deliveries, including updates to the Bay-Delta Water Quality Control Plan, ESA Biological Opinions, HCP and NCCP agreements, OCAP, and others. These constraints should evolve based upon best available scientific understanding and established needs for other beneficial uses of the Bay-Delta system including ecosystem health and water quality. .

Performance Objective 1c: Minimize unanticipated and uncompensated reductions in scheduled Delta water deliveries. One important component of water supply reliability is the degree of confidence that a scheduled quantity of water will be delivered during the time planned (referred to here as delivery stability). Delivery stability can be diminished by conditions that arise in the Delta that reduce or prevent delivery of scheduled water. The delivery stability will be measured as the amount of unanticipated and uncompensated reductions in scheduled deliveries via the SWP and CVP pumps caused by conditions within the Delta that prevent those deliveries.

- Indicator: TAF/year of unanticipated and uncompensated reductions in scheduled deliveries.
- Performance target: No unanticipated and uncompensated reductions in scheduled deliveries.

Strategic Objective 2. End User Supply Reliability (To be administered by DWR and other agencies through the California Water Plan update process and reported to the CALFED Program)

Long-term, sustainable, water supply reliability is best measured at the end user, capturing the balance of supply and demand considering all sources of supply, demand management, and other water management strategies. As discussed above, DWR and other State agencies are encouraging the development of Integrated Regional Water Management Plans throughout California, as described in the 2005 California Water Plan Update. The water management goals and actions resulting from IRWM planning will be assessed on a statewide basis by DWR and other agencies through future California Water Plan Update processes. Specific indicators and targets will be

developed in cooperation with local and regional agencies, in consideration of statewide and regional water management objectives.

Recommended Next Steps

- Coordinate with Ecosystem Restoration and Water Quality Program agencies to ensure that initial targets are established for water supply volume, flows and timing to support CALFED ecosystem and water quality goals. It should be made clear that these targets may change in the future as on-going and planned research activities are completed.

- Coordinate with the California Water Plan update, Delta Vision, and DRMS processes to include Delta Risk management and Delta sustainability information.

- Bring the performance measures proposal to the BDPAC Water Supply Subcommittee to allow it to provide recommendations to the BDPAC on how to proceed.

Resources Needed

The efforts related to the further development of water supply reliability performance goals and indicators must be integrated with other efforts including the California Water Plan update process.

Specific effort to develop indicators and targets for Strategic Objective 1, Enhance Long-Term Stability of Delta Water Supplies, will be met using existing staff within DWR and Reclamation. However, this overall effort could exceed $400,000 per year—approximately one FTE from DWR and one from Reclamation and support from Program staff from the following program areas: Conveyance, Surface Storage, Transfers, and the Environmental Water Account.

Further engagement and cooperation with local and regional agencies will be needed to develop indicators, targets, and the data needed for accurate analysis under Strategic Objective 2: End User Supply Reliability. Resource needs are under development but unknown at this time.

For the Water Supply Reliability program to complete this effort, resources may need to be dedicated within the Ecosystem Restoration and Water Quality subgroups to develop science based environmental water demand targets for tributaries to the Delta, in Delta, and Delta out flow. It is likely that a significant amount of the environmental water demand targets will be developed in ongoing efforts, (e.g. Bay-Delta Conservation Plan); however, this information may not be available in the near future and interim targets for environmental demands may need to be developed. Ultimately, resource

allocation decisions for these purposes would be made by ERP and WQ program agencies.

Water Quality Performance Measures

Core outcome indicators and performance measures should be developed for a range of beneficial uses, focusing on water quality issues which have particular relevance to Program objectives in the Delta. The topics selected for this first phase of work on indicators, are drinking water quality, toxicity, and mercury. Because of the importance of these topics across CALFED Program activities – for instance, habitat restoration, POD investigations, and quality of Delta drinking water supply -- further work on these indicators and performance measures will require enhanced collaboration of a number of agencies.

Drinking Water**:**

- Along with the Central Valley Water Board and CDHS, the CALFED Water Quality Program has been working on conceptual models and comprehensive data assessments for key constituents affecting drinking water which will support CALFED evaluation of Delta conveyance alternatives, and will contribute to a Central Valley drinking water policy.
- The conceptual model and assessment work provide a substantial foundation for performance measures of water quality at the Delta intakes and "at the tap."
- This work takes into account environmental justice issues regarding drinking water quality, cost of adequate drinking water treatment, and potential limitations in affordable treatment processes.
- To complete the data assessment, prioritize additional data needs, and develop performance measures using existing information, additional staff (SWRCB and CDHS) are required.

Toxicity:

- Toxicity, an indicator of ecosystem water quality, is being examined as a factor in the "Pelagic Organism Decline" (POD) within the Delta.
- Data for individual toxicity drivers, such as certain pesticides, exist, but in many cases the specific causes of toxicity have not been identified. Work for the POD will investigate toxicity through water quality testing and biomarker analysis to improve assessment of impacts on aquatic ecosystem populations.
- Additional staff (at the Central Valley Water Board and California Department of Fish and Game) will be needed for next steps in developing toxicity indicators: identifying data gaps, expanding monitoring, and conducting data retrieval and evaluation.

Mercury:

- Mercury contamination occurs throughout the Bay-Delta system and is an important issue for health of aquatic species and wildlife, and a potential human health concern. Environmental justice considerations relate to the possibility that

high rates of fish consumption disproportionately expose certain ethnic and socioeconomic groups to mercury in fish.

- Information about mercury cycling, transport, transformation, bioaccumulation, speciation, and food web interactions is being generated from a number of CALFED grant-funded projects which are scheduled to conclude by 2008. Further, the San Francisco Bay and Central Valley Water Boards are developing TMDLs for mercury. All of these activities provide an information and conceptual basis for core indicators and performance measures.
- Funding and staffing are needed to support a large scale synthesis of current project work and to develop appropriate next steps, including progress on performance measures and a strategy for mercury monitoring.
- Resource agency staffs (DFG, USFWS, NOAA) have an important role in discussion and defining environmental water quality and appropriate performance measures. Funding should be secured to support their participation in addition to funding to support implementing agency staff (SWRCB, CVRWQCB, and DHS).

Levee System Integrity Program

Levee system integrity in the Delta has significant cross-over to other critical CALFED programs: Water Supply Reliability, Water Quality, Conveyance, and Ecosystem Restoration. The State's water supply for 23 million Californians depends on the integrity of the Delta levee system for conveyance, to prevent salt water intrusion and associated water quality problems (salinity and bromides) at the source. In addition, the Levee System Integrity Program (LSIP) has been integral in advancing Ecosystem Restoration programs on over 2600 acres in the Delta.

Potential performance measures and core outcome indicators are under consideration or initial development for the commitments identified in the CALFED ROD: Base Level Protection (including beneficial reuse of dredged materials), Subsidence Control, Emergency Management Response, and Levee Risk Assessment. The following is a brief description of the performance measures under consideration.

1. Provide Base Level Protection

- Base level is associated with bringing levee cross sections to the PL 84-99 standard, which can be simply represented in miles. However, there are additional factors that are needed to demonstrate progress towards this standard or improvements beyond the PL 84-99 standard.

- Foundation preparation is essential prior to the start on any levee rehabilitation project. It is well understood that the Delta levees, for the most part, are very fragile and simply raising the levee crest elevation is not adequate to improve the integrity of the system. Therefore, the levee footprint or base must be significantly expanded on the landside. Berms need to be placed on this footprint

and the foundation must be allowed to consolidate and strengthen before the levee crest elevation can be raised. Indicators for foundation preparation can be measured in acres of the levee footprint beyond the base condition and the number of cubic yards of material placed on the landside of the levee to improve the levee cross section. Additionally, as part of the Delta Long Term Management Strategy, the Department is involved with beneficial reuse of dredged material from channel bottoms. Beneficial reuse of dredged material for levee rehabilitation can be measured in cubic yards of material placed per year.

- Resistance to overtopping can be measured by the amount of material needed (or placed) on the levee crown to raise the crest elevation to a specific standard (PL 84-99, HMP, etc.). The KIM (Kilo-Inch Mile) is a simplified volumetric number that sums up the material to raise the levee crest by one inch multiplied by the miles of levee in which the material is needed. The KIM also contains a decay factor that accounts for levee settling over time.

2. Subsidence Control

- The Delta covers 738,000 acres with most of the land being below sea level. Delta soils consist primarily of peat which subsides from oxidation. Peat soils can also be lost to wind erosion and tends to develop cracks and fissures. Because of this, subsidence is a major concern. With the land elevation continuing to drop (and sea level on the rise), additional pressure is exerted on the levee system weakening them over time and creating stability concerns. The water surface elevation is often over 20 feet higher than the land surface elevation. In order to control Delta subsidence, studies have identified several best management practices (BMPs) including shallow island flooding, changes in land use, and a combination thereof. Performance measures can be developed to track the number of acres on which BMPs have been implemented.

3. Emergency Management Response

- The Department has been involved in several flood emergencies within the past couple of years and has been proactive in preparing staff and local agencies for the flood season. The Department uses the Standardized Emergency Management System (SEMS) for the coordination, planning, and response to all flood and non-flood emergencies. The Incident Command System (ICS) is a key component of SEMS at the field level. The Department has successfully applied ICS during flood emergencies, and will continue to train staff to effectively employ the system. A performance measure for emergency response can be developed by tracking the number of personnel trained in emergency response.

- The Department stockpiles flood fight materials at warehouses and storage containers throughout the Delta. Pre-positioning these materials allows the Department and local agencies quick access to materials needed to fight floods. Our stock piles of emergency response materials are currently tracked in-house on an annual basis.

- The Department entered into a Memorandum of Understanding with the California Department of Forestry and Fire Protection (CDF) to provide each other support during fires and flood fights. This agreement allows the Department to assist CDF during fires and CDF to assist the Department during flood emergencies. CDF is very experienced in the SEMS/ICS system and has provided training to Department staff both prior to and during flood events.

- The Department is working with the local agencies and districts on preparing emergency response plans for their areas. These plans are essential in preparing for the flood season and tracking the number of local agencies with Emergency Response plans is an excellent indicator of performance.

- The Department is working with the local agencies and districts on preparing Flood Contingency Maps, which provide useful background information,

topographical information, relief cut locations, supply delivery locations, etc. These maps proved very useful during the recent flood fight in San Joaquin County in April 2006. The Department is providing both technical and financial assistance in the development of these maps and the number of Flood Contingency Maps developed could be tracked to measure performance.

4. Levee Risk Assessment

- The Department is in the process of conducting a comprehensive Delta Risk Management Strategy (DRMS) study, which will evaluate the risk and consequences to the State (e.g., water export disruption and economic impact) and the Delta (e.g., levees, infrastructure, and ecosystem) associated with the failure of Delta levees and other assets considering their exposure to all hazards (seismic, flood, subsidence, seepage, sea level rise, etc.) under present as well as foreseeable future conditions. The evaluation is to assess the total risk as well as a deaggregation of the risk for individual islands.

- The Electromagnetic Anomaly work agreement will provide funding for local districts to assess the interior levee structure. This concept is designed to identify internal levee abnormalities, including beaver dens and abandoned pipes. The results of these analyses will allow the local districts to address the priority stability issues to prevent levee failure. Results of these studies could be compiled and tracked on an on-going basis.

Resources Needed:

Resource needs for LSIP performance measures include baseline staffing for developing and refining performance measures and subsequent data analyses and tracking. In addition, Delta surveys using LIDAR (LIght Detection And Ranging) are a necessary component to measuring progress towards achieving PL84-99 standards and measuring on the ground achievements made by Special Projects and is essential for the KIM metric. As a preliminary estimate, the program would need at least three positions for performance measure development and tracking. LIDAR surveys would be conducted Delta-wide approximately every three years at a cost of $1million.

Ecosystem Restoration

- Since its inception, the ERP has acknowledged the need to establish ecosystem indicators and performance measures, and much work has been conducted in these areas during the past several years.

- During Stage 1 implementation, the ERP has relied on “milestones” to track program progress. The milestones were identified in the CALFED programmatic biological opinions and Natural Community Conservation Plan (NCCP)

determination, and comprise actions and objectives intended to benefit species covered in the biological opinions and NCCP determination. An assessment of milestones progress was completed by the ERP in 2004, and another assessment is planned for the end of Stage 1.

- The ERP implementing agencies (DFG, FWS, and NMFS) recognize the need to continue development of science-based performance measures and are committed to the effort. The framework proposed by the CALFED Science Program appears suitable for developing a sound foundation for ecosystem performance measures.

- The ERP implementing agencies have participated in Subcommittee and Science Program meetings to coordinate work on performance measures, but development of ecosystem performance measures is encumbered by insufficient staffing and funding.

- Development of ecosystem performance measures is complicated by several uncompleted, near-term evaluations that will inform development of performance measures. These include the end of Stage 1 milestones assessment, review of the current Conservation Agreement and CALFED regulatory documents, assessment of present ecological conditions of the Bay-Delta watershed, development of the Bay-Delta Conservation Plan (BDCP), and development of conceptual models for the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP).

- The Comprehensive Monitoring, Assessment, and Research Program (CMARP) Phase 3 and the Interagency Ecological Program (IEP) also are working on conceptual models, monitoring indicators and performance measures. These programs and DRERIP need to confer on respective goals and objectives and coordinate efforts to most efficiently address the range of environmental indicators and performance measures needed and avoid duplication of effort.

- Success of this effort hinges on an interactive melding of three elements; conceptual models, indicators based on those models, and a comprehensive monitoring strategy. The definition of success includes accomplishing the assignment and implementing it.

<u>Recommended Next Steps</u>

- The ERP implementing agencies are preparing a “concept paper,” to be completed by the end of summer, which will describe how the ERP will conduct end of Stage 1 evaluations and guide development of a conservation strategy for Stage 2. The concept paper also will include a process outline for development of performance measures based on conceptual models in the context of a comprehensive monitoring strategy.

- The concept paper also will describe processes for comprehensive monitoring, coordination of Endangered Species Act re-consultation for the Bureau of Reclamation's Central Valley Project Operations Criteria and Plan (OCAP), and public participation.

- The ERP implementing agencies plan to form a conservation strategy team. The conservation strategy team will be responsible for conservation planning, development of conceptual models to support review of potential environmental actions under the ERP and BDCP, and development of performance measures for ERP and BDCP goals and actions.

- A new action is included in the Year 7 Program Plan titled "Coordinated Monitoring and Indicator/Performance Measure Strategy Project," that describes Year 7 funding of $2M. Under this project, an interagency team will develop a coordinated monitoring and indicator/performance measure strategy for the ERP and begin implementation of that strategy.

Resources Needed

- It is difficult to accurately estimate staffing needs, budget, and schedule at this time. Once the ERP implementing agencies have further addressed near-term issues via the concept paper, it will be possible to better provide these estimates.

- For purposes of planning, preliminary estimates are that the equivalent of 6 to 10 full time staff will be needed to develop initial performance measures over the next 18 months, at a cost of $1.16M to $1.93M. An additional $320k to $540k is estimated for technical assistance contracts.

CHAPTER 1: First Phase of Developing System-wide Indicators and Performance Measures for CALFED Program Objectives

Indicators and performance measures can be used by the CALFED program to measure changes in the environment or outcomes that are related to the programs goals and objectives. Indicators can help managers understand the factors affecting outcomes, effectiveness of management actions, and overall progress towards goals. Indicators and performance measures are a critical component of adaptive management that provides information to managers about which factors are affecting the outcome, and how management actions might be improved. Developing and monitoring robust, science-based indicators and performance measures is critical to continued program success.

Ideally, performance measures should be developed during the planning process – clearly articulating quantifiable goals and objectives for the program. For some of the program objectives, the Record of Decision has not clearly described goals and objectives nor defined quantifiable performance goals and targets for the program. This has made it difficult for CALFED implementing agencies and stakeholders to agree on how accomplishments towards goals and objectives should be measured. Agreement on appropriate program-level measures will not be easy, but it will be essential for CALFED agencies to effectively demonstrate past and future progress towards the mission of the Program.

Indicators are a broad set 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.

The CALFED agencies recently formed a subcommittee to direct development of indicators and performance measures related to the Program objectives and actions. The development and reporting on indicators and performance measures will occur in phases. This document provides a plan and tentative schedule for development and reporting on a core set of indicators by summer 2007. A more comprehensive set of indicators and performance measures will be developed in 2007-2008.

This document summarizes the first phase of renewed efforts for performance measure and indicator development for the CALFED program. The approach is an evolution of previous efforts, and will be refined as the process moves forward. The main tasks in Phase 1 are:

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

- Agree on a theoretical framework and approach for developing and communicating indicators and performance measures
- Develop a process with clear roles and responsibilities and appropriate review and input for developing and reporting on indicators and performance measures.
- Choose a core set of initial indicators related to the four program objectives
- Conduct an information survey about the core indicators – including conceptual models, identifying drivers, and documenting data availability and quality
- Estimate resources needed to complete the data compilation, analysis and reporting for the core set of indicators
- Develop a tentative plan and schedule to complete development of the core indicators, monitoring, data compilation, analysis and reporting.

The chapters of this report contain the summarized information from these Phase 1 activities. Additional details and documentation are provided in the appendix.

The recent review of the CALFED Bay-Delta Program and the 10-year Action Plan highlights the need for measuring Program performance and to assess the success of the implementing agencies in fulfilling the Program's mission and goals. The 10-Year Action Plan also emphasizes that the goal is not only to gauge progress towards goals, but also to do science-based adaptive management and when appropriate, change the course of action to improve Program results. The 10-year Action Plan states that the CALFED implementing agencies will measure and report on Program performance for:

- The four overall CALFED objectives
- Specific program element goals, and
- Individual project actions

Performance measurement will provide important information for the CALFED agencies to use in directing strategic planning.

In past years, program elements and projects have developed performance measures with varying levels of success. In this past year, the implementing agencies and CBDA staff have begun a outcome-based approach that will develop system-wide indicators and performance measures related to the mission of the program and the four program objectives. These indicators will be used to evaluate the overall progress of the CALFED program. The framework for developing indicators describes three levels of indicators:

1. **Administrative indicators** track how resources are used to address a problem by tracking funds and numbers of projects.
2. **Driver indicators** track "on-the-ground" management actions that have been implemented, as well as other uncontrollable factors that may be affecting an outcome.

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

The outcome-based approach will begin with looking at the program goals and objectives and choosing appropriate outcome indicators to determine progress towards goals. Then conceptual models will be used to identify the drivers related to each outcome objective, including management actions that have been implemented and uncontrollable factors in the environment.

Work on indicators will be iterative, starting with a small set of core indicators and taking them through development, analysis and reporting. Guided by external, independent science review, this work will be assessed and a larger and more comprehensive set of indicators will be prepared. Given the complexity and scope of the program, the initial set of core indicators will provide an incomplete picture of the state of the system, but it is necessary to prioritize based on the limited resources for monitoring, data compilation and analysis and reporting.

As we have seen with the Pelagic Organism Decline, it is not sufficient just to monitor the outcome of interest, but also the need to understand why we are getting that outcome. The framework for indicators and performance measures emphasizes the need to also monitor the factors—or "drivers"-- that are influencing the outcome. These factors may be management actions implemented by the agencies, other man-made factors, or factors that we have no control over, such as weather. In a complex system such as this, with multiple drivers influencing the outcome, there is uncertainty and unpredictability in our knowledge of which drivers or interaction of drivers have the most influence on the outcome. Therefore, our framework emphasizes the need for conceptual or quantitative models to document our current understanding of the system. Explicit conceptual models assist multi-disciplinary review and decrease the probability of faulty reasoning or unintended consequences. Conceptual models can become the repository of the most current science and be continually updated with new research and monitoring information. Strategic planning, with an adaptive management component, can use conceptual or quantitative models as tools to prioritize management actions, recognize critical information gaps, direct research and monitoring to increase our understanding of the system, and revise actions based on new information.

CHAPTER 2: An Approach for CALFED agencies to collaborate on development of system-wide indicators, incorporating stakeholder input and scientific review

Roles and Responsibilities:

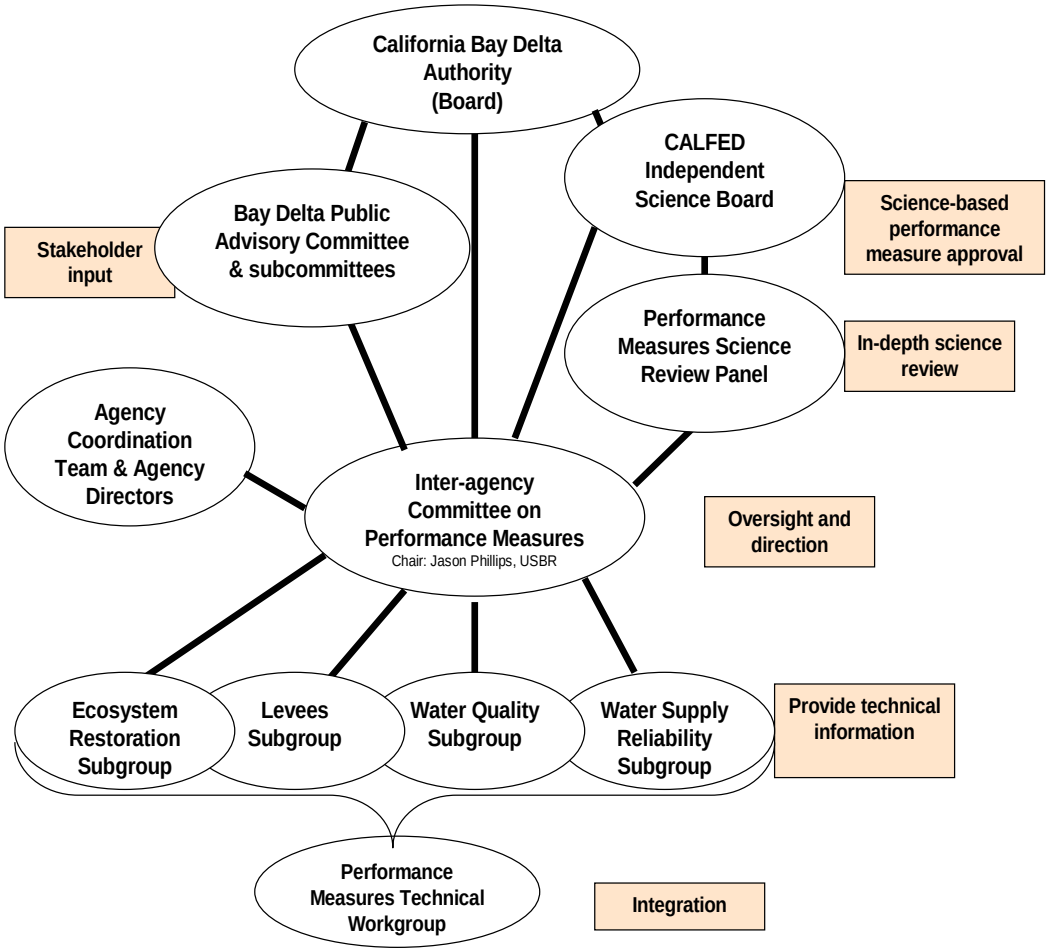
The 10-Year Action Plan describes the roles and responsibilities for the agencies involved in the CALFED program:

> ***Establish results-oriented performance measures****. The implementing agencies will be responsible for developing performance measures, monitoring, and report under the guidance of the CALFED Science Program. The Science Program will facilitate cross-program integration and independent science review of performance measures, data and reporting. Performance measures will be used to assess progress toward Program goals and to inform adaptive management of the system. The implementing agencies and Science Program will work together to develop a unified plan for development of performance measures, communication products and appropriate budget needed to fulfill monitoring and report for performance measures. The development and implementation of performance measures is resource intensive and will require the cooperation of local agencies who may be engaged in implementing some of the CALFED actions. New funding sources must be identified to make significant progress in developing and implementing quantifiable performance measures.*
>
> ***Establish accountability throughout the organization****. Administrators, managers and employees are responsible for not just activities and programs, but for results.*
>
> ***Collect, analyze and use data.*** *…The information collection process should be part of Program staffing and budgets and include not only performance data, but also feedback from outside stakeholders to assure any concerns they may have are addressed. …Data collection and analysis is important, but the goal is to use the information to gauge progress, change the course of actions, when appropriate, and improve Program results*
>
> ***Prepare an annual report.*** *The CALFED Leadership Council should report annually to the general public, the Governor, the state Legislature and the U.S. Congress on the status and accomplishments of the Program and the adequacy of science-based adaptive management in guiding the CALFED program.*
>
> ***Continuously review business processes.*** *An effective business process review program that is most likely to generate ongoing performance improvements should be an integral part of the operation of each program or department.*
> (page 23-25, 10-Year Action Plan)

The CALFED Leadership Council (CLC) created an interagency subcommittee to begin work on developing and coordinating performance measures. Jason Phillips is the chair of this committee, and many CALFED implementing agencies are participating in this effort. Since there is a lot of detailed technical work to be done and coordinated among the agencies, the subcommittee formed four subgroups to focus on the technical details – each is led by a representative from the subcommittee. The four subgroups are focused on each of the four CALFED Program objectives: Water Supply Reliability, Water Quality, Ecosystem Restoration, and Levee System Integrity. A Performance Measures Technical Workgroup, facilitated by the Science program, provides a forum to integrate workgroup efforts.

The diagram below describes the different groups and their role in this effort.

Flow of information between groups



The groups will evaluate where there are linkages with environmental justice concerns, working landscapes, and watershed management. The CLC also formed a subcommittee to address environmental justice issues, and they may develop program-wide performance

measures related to environmental justice. A separate group may be formed to develop Program performance measures related to outreach and communication that cut across all of the program objectives and program elements.

Table 1: Implementing agencies for the CALFED Bay-Delta Program, organized by program objective

Program Objective	CALFED Implementing Agencies	Participation in subcommittee and subgroups
Water Quality	CA Department of Health Services	✓
	State Water Resources Control Board & Central Valley Regional Water Quality Control Board	✓ ✓
	US Environmental Protection Agency	✓
Ecosystem Restoration	CA Department of Fish and Game	✓
	US Fish and Wildlife Service	✓
	NOAA Fisheries / National Marine Fisheries Service	✓
Levee System Integrity	CA Department of Water Resources	✓
	US Army Corps of Engineers	✓
	CA Department of Fish and Game	✓
Water Supply Reliability	CA Department of Water Resources	✓
	US Bureau of Reclamation	✓

Phases and Products:

Performance measures are being developed in phases, beginning with a small set of indicators closely related to the CALFED performance objectives presented in this report. For these core indicators data and information will be collected, analyzed and summarized in integrated communication products for both technical and non-technical audiences. After a core set is developed and implemented, a more comprehensive set will be developed. Independent science review and stakeholder input will be an integral part of the process. The first 4 phases are briefly summarized below followed by a description of the product of each phase in parentheses.

> **Phase 1:** Identify primary program performance objectives, select example core indicators and develop plan. (Product: Phase 1 Report: Core indicators and plan)

Phase 2: Implement plan to develop core indicators: Report detailed information on web. (Product: draft web-based communication product for technical audience)

Phase 3: Review and revise core indicator information; Develop summary publication (Product: Summary publication for non-technical audience)

Phase 4: Identify additional priority indicators and plan for development. (Product: Report with additional indicators and plan)

As mentioned in the 10-Year Action Plan, it is resource intensive to develop, analyze and report on meaningful indicators. It is also recognized that there are a lot of monitoring, research and other activities that could provide valuable information for the effort to develop, analyze and report on indicators. The first phase will include an information inventory for the core indicators. This will entail assessing what information is already available, how this could coordinate with other efforts, identifying priority data gaps and resource needs to complete the monitoring, data analysis and synthesis needed to complete this effort. This report is a product and summary of information gathered during Phase 1. An independent Science Review Panel will review and provide feedback on this Phase 1 report.

Phases 2 and 3 will implement the plan that is developed in Phase 1, if resources are available. During Phase 2, the subgroups assisted by other agency staff will collect monitoring data, analyze the data, compile other information such as conceptual models, and prepare it to be presented on a web site. It is envisioned that the website would be used to organize and summarize all of the technical information related to the indicators and provide links to more detailed documents and references. This draft web compilation would be reviewed by an independent science panel at the end of Phase 2. Phase 3 would include any needed revisions to the web-based information and a summarization that would be included in a publication targeted for a non-technical audience.

Phase 4 will begin the cycle again – revising and adding indicators to form a more complete set of indicators. This allows us to move forward more quickly and develop indicators and performance measures in an adaptive way – refining our tools as we learn from going through the process. During Phase 4, the groups will also receive feedback from the independent science panel and stakeholders on the highest priority areas for additional information. The product of Phase 4 will be a revised list of indicators, an information inventory and plan for completing them.

Science review

The Science program will convene an independent science review panel to provide feedback to the groups and agencies working on the product. The purpose of the independent science panel will be to review the scientific basis of the indicators being used for the performance objectives, review the data and conclusions being presented

as outcomes, and to provide constructive feedback on how to improve the indicators and their use in the adaptive management process.

The science panel will have four to six members with a broad range of expertise that reflects the scope of the CALFED Bay-Delta program. Although the panel has not yet been identified, it is expected that there will be some overlap with members of the CALFED Independent Science Board. We expect to have the same science panel review products from the four phases that are outlined here.

- At the end of the first phase, the panel will review the framework, the general approach, and the core indicators that have been selected.
- At the end of Phase 2, the panel will review the draft web-based communication product with the indicator data and supporting technical information.
- Feedback from the review panel will be addressed during Phase 3 to create a final web-based communication product. At the end of Phase 3, the review panel will review the summarized information for publication and also provide feedback on priority areas for refinement in future phases.

The independent Science Review Panel for Performance Measures will present their findings to the CALFED Independent Science Board as well as the agency staff working on indicators and performance measures. The charge for the CALFED Independent Science Board is as follows:

> "Approve performance measures. Evaluate and provide final approval of performance measures for the Bay-Delta Program, assuring scientific rigor and balanced interpretation of each measure and its updates." (*Charge to Reconstituted Independent Science Board of the California Bay Delta Authority*)

There will be up to two members of the Independent Science Board that also participate on the Science Review Panel for Performance Measures, to provide overlap and continuity between the two groups of scientists. Frequent updates will be provided to the Independent Science Board during development of indicators and performance measures for the CALFED program.

Stakeholder review:

Draft documents are made available for public review and comment on the Science program website: http://science.calwater.ca.gov/monitoring/monitoring.shtml#

Stakeholder participation and feedback for phase 1 will be primarily through the Bay Delta Public Advisory Committee (BDPAC) and its subcommittees. Draft products for each of the phases will be made available on the website for review, and will also be presented at regularly scheduled meetings of relevant BDPAC subcommittees and the BDPAC itself. Status updates may be presented while draft products are under review.

Agency review:

It is expected that this Phase 1 report will be presented to the subcommittees and BDPAC in the late summer of 2006, with possible presentation to the California Bay Delta Authority in October 2006. This schedule may be revised as we receive feedback and input from these groups.

A tentative schedule for review of the draft Phase 1 report by CALFED groups:

- Agency Coordination Team (ACT) end of June 2006
- BDPAC subcommittees September-December 2006
- BDPAC September 2006
- Independent Science Board November 2006
- CBDA October 2006

Chapter 3: Theoretical framework for developing and using indicators for science, management and adaptive management

Introduction:

This theoretical framework is a revision and evolution of the previous theoretical framework developed by the Science program. The revisions were based on feedback from many different participants both inside and outside of the CALFED agencies. The framework (Figure, p. 17) uses three levels of indicators: administrative indicators; drivers, which include uncontrollable factors as well as outputs of management actions; and outcomes. The revised framework puts emphasis on documenting the conceptual models that describe the rationale and scientific basis that links the drivers and the outcomes. The revised framework also emphasizes indicators and performance measures, with associated conceptual models as a valuable tool for integrating science into decision making, evaluating the effectiveness of implementation, and providing valuable information for policy decision-making and adaptive management of the system. A more complete description of the framework, including a glossary of terms is available on the CALFED website at:
http://science.calwater.ca.gov/monitoring/monitoring_framework.shtml

Overview of Framework:

Indicators and performance measures are used to translate program goals and objectives into measurable benchmarks of program success. Indicators can also be used to help understand how actions cause results in the environment. This framework provides general background information for how indicators can be used to inform science, management and adaptive management. The framework also includes information so that indicator development and assessment will be more useful for decisions to be made at the end of Stage 1, and for formal program assessments such as the federal Program Assessment Rating Tool (PART) process.

Purpose:

Indicators will be used by the CALFED Bay Delta Program to:

- Help understand cause and effect relationships between actions and outcomes
- Track progress towards program goals
- Inform decisions to be made at the end of Stage 1 (end of 2007)
- Assess the program progress and performance, such as the federal PART process

Indicators could be used to help answer questions such as:

- Is CALFED meeting program goals?
- Is the progress towards meeting performance goals balanced among the 4 program objectives?
- Is the system working the way that was expected? (e.g. are the outcomes of actions what were expected?)
- Is CALFED taking the right actions – and the highest priority actions?
- Are their other factors influencing the system that can't be controlled, or hadn't been considered?

To effectively manage the system and help understand cause and effect relationships, indicators should be closely linked to conceptual models that describe and document our current scientific knowledge of how drivers and outcomes are related. A more comprehensive set of indicators at different scales is needed for this purpose. Given the limited resources and the complexity of the issues, a lot of thought will need to go into the selection of these indicators to better understand the underlying mechanisms at work in the region, and to provide support for diagnostic capabilities. This more comprehensive and detailed set of indicators (often at different scales) are intended for a technical audience and will assist in making management decisions and doing adaptive management.

A subset of indicators can be used to assess progress and answer questions directly related to the goals and objectives of the program. This smaller set of indicators should be derived from the more technically detailed indicators and include discussion of the factors that are most likely affecting the outcome of the system. For example, adult salmon escapement may be used as an indicator to report progress towards recovering salmon populations. To understand the "why" behind this outcome, a much broader suite of indicators is needed, such as proportion of hatchery escapement, age structure of spawning adults, conditions during spawning, rearing and migration, ocean conditions, abundance of juveniles, ocean and inland harvest.

Projects that are in the planning phase can develop predicted outcome indicators that describe how a project might contribute to program goals. Predicted outcome measures are the result of modeling efforts and can be used by decision makers to evaluate different management options to achieve goals. If a project is chosen for implementation, the monitored outcomes can be compared to previously predicted outcomes.

The terms "performance measures" and "indicators" have often been used interchangeably – but this can be misleading. Indicators are a larger group of measurements that help us understand how the system is working. Performance measures are a subset of indicators that can be used to measure the performance of a particular project, program or agency. One difficulty in choosing performance measures is that an outcome of particular interest (for example, returning salmon populations) may be affected by many different factors: some that may be influenced by management actions, and some that may not.

Evaluating outcomes using indicators and performance measures should be part of a periodic program assessment. The federal government uses the Program Assessment Rating Tool (PART) as a process for evaluating program effectiveness. This framework is compatible with the PART approach, but has a broader focus. This framework emphasizes the need for documenting the scientific basis for making decisions, and using indicators to reduce uncertainty and improve our scientific understanding through adaptive management. A program assessment should also evaluate the broader process of adaptive management. Adaptive management includes incorporating the

latest science into management decisions, evaluating the effectiveness of management actions, and adjusting planning and policy based on new information.

Basic framework: levels of indicators and how they can be used:
Below is a description of some general levels of indicators, and a conceptual model of how indicators relate to management, science and adaptive management. This basic framework or approach can be used by the program elements in the development of appropriate indicators.

Levels of indicators:
The basic framework includes three general levels of indicators:

1: **Administrative indicators**. These describe what resources (funds, programs, projects) are being implemented (or plan to be implemented). These may also be called "input measures" or "input indicators".
Example: Dollars spent, number of projects implemented

2: **Driver indicators** (can also be called "pressures," "management actions" and "other factors"). These indicators describe the factors that may be influencing outcomes. There are two types of driver indicators: 1. **Outputs** which are on-the-ground implementation of management actions, such as acres of habitat restored and 2. **Uncontrollable factors** which are often natural phenomena not caused by the management actions of the program such as weather and hydrologic fluctuations.

3. **Outcome indicators** (can also be called "response," "ecosystem status or state" or "results" indicators). This class of indicators describe measurements related to the ultimate outcome of the drivers – and should be closely related to the goals and objectives of the program. Examples: For water quality, indicators may include measures of public health protection for tap water and cost of treatment. For water supply reliability, indicators may be related to the ability of supply to meet demand. For ecosystem restoration, indicators can be population level of key species, diversity indices, or other indicators of ecosystem status and processes. Quantitative models may provide predicted outcome indicators that can be used to evaluate future management options.

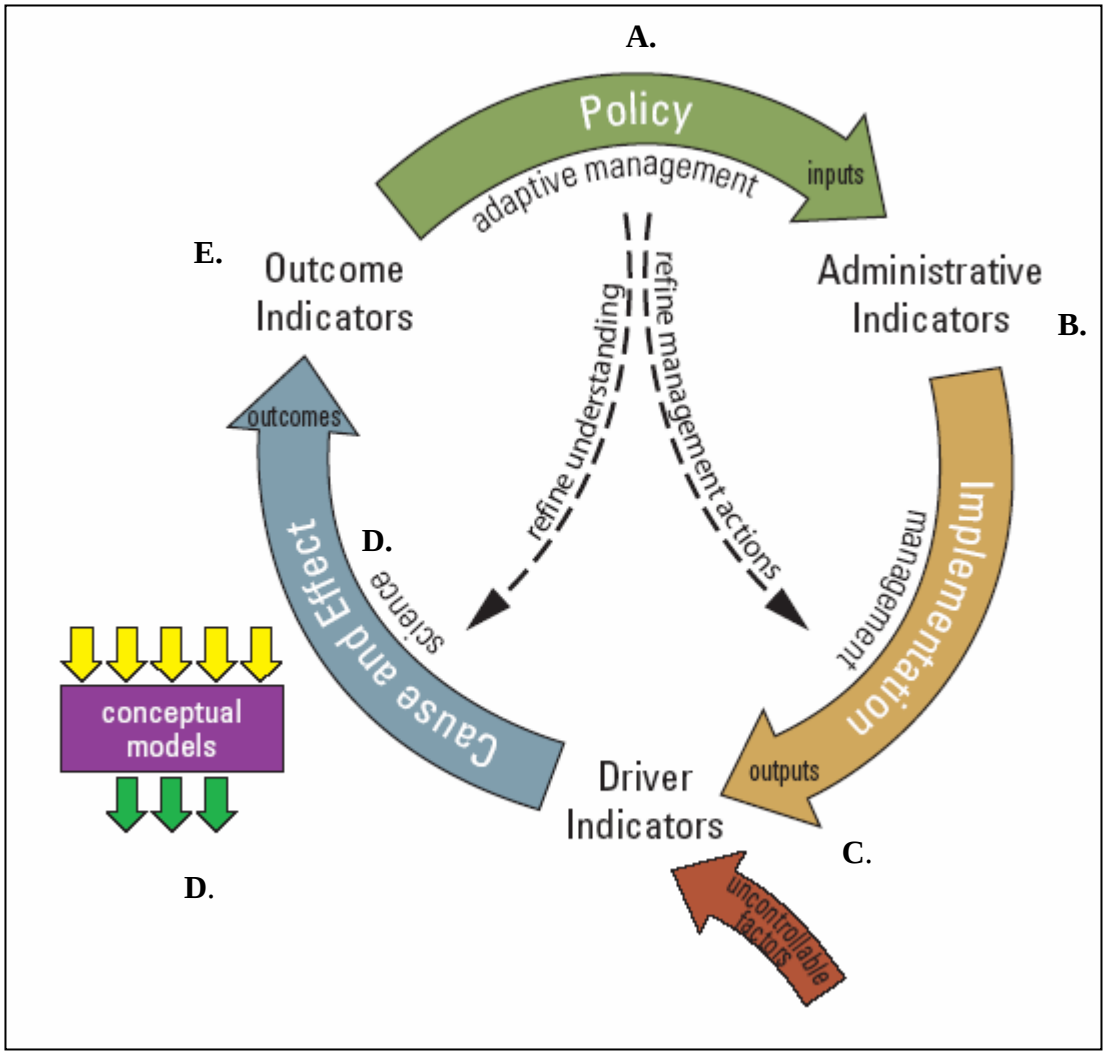
These categories are flexible so that the framework can be more easily adapted to the different program elements within CALFED. The distinctions between the categories are not rigid. In some cases, an outcome indicator for one purpose may become a driver indicator for another purpose.

The PART process also recommends the development of efficiency measures. Efficiency measures reflect how well the program implements activities and achieves results while avoiding wasted resources, effort, time and/or money. An efficiency measure is the ratio of the outcome or output to the input of any program. For example, an outcome efficiency measure could be cost per acre of wetland habitat restored or cost per acre-foot of water conserved through implementation of water use efficiency

measures. Other potential efficiency measures could be length of time to get contracts signed or number of projects successfully completed on time and on budget.

How indicators can be used to link science, management and adaptive management

Indicators can be an integral part of informing policy decision making, tracking implementation, and helping to improve our understanding of how the system works. Indicators can also be used during the project planning and evaluation phase to predict expected outcomes of different management actions. The predicted outcomes can then be used as performance goals (targets) if the project is implemented.



The diagram above describes the relationship between the three different levels of indicators and the activities of managing a complex system in the environment.

A. Policy decisions are made based on a desired outcome, as described in the goals and objectives of the program.

B. Administrative indicators (often called "inputs") can be used to track the financial resources allocated to address the problem, documenting how funds are spent. Management oversees implementation of the policy decisions – essentially turning financial resources into on the ground actions.

C. These actions may result in physical changes to the environment, such as levee maintenance or habitat restoration. **Driver indicators** are used to track these physical changes due to management actions (often called "outputs"). However, there may also be other uncontrollable factors in the environment that also affect an outcome of interest. Driver indicators can also track the uncontrollable factors so that we can better understand how these multiple drivers interact and affect an

outcome of interest. For example, enhancing urban water use efficiency is a management action related to reducing demands on water supplies. The amount and form of precipitation in California is an uncontrollable factor that also affects an outcome of water supply reliability. Both precipitation and water use efficiency may be used as driver indicators for the outcome of water supply reliability.

D. Science can help explain and document the relationships between drivers and outcomes, which are often quite complicated. Most management actions are taken with the intention of a specific outcome in the environment.

Conceptual models and quantitative models can be used to develop, refine and document a common understanding of the system, including assumptions about intended outcomes from actions. Conceptual models can provide a basis for incorporating new information and continually improving our knowledge of the system. Scientific research and monitoring of indicators play a critical role in understanding cause and effect relationships.

E. Outcome indicators need to be closely related to the goals and objectives of the program to help inform progress toward goals. Outcome indicators can also be used to evaluate the effectiveness of management actions and help refine our understanding of how the system works, or in other words – can be used to inform adaptive management.

CHAPTER 4: Program Goals and Objectives, Selection and information inventory of core indicators

This chapter describes the core indicators that were selected by each one of the subgroups: water supply reliability, water quality, levee system integrity, and ecosystem restoration. The intent for chapter 4 was for the groups to review program documents and select a few key objectives to select and develop indicators for. To the extent possible, the subgroups were to document the exact wording of the selected objectives and also document any narrative or quantitative performance goals and targets that were in the CALFED Record of Decision and associated documents. If no specific goals and targets were found in the program documents, that should be identified – but new goals and targets are not to be identified as a part of this process.

After selecting the program objectives to focus on, the subgroups were to select measurable indicators that could be used to assess progress towards those goals. Each group was directed to assemble a table that described the goal, objective, measurable performance goals and objectives from the documents, and the suggested outcome indicator to use in evaluating progress towards goals.

Recognizing that there already exists a great deal of scientific and monitoring information that could be utilized for this process, each group was instructed to do and "information inventory" about the outcome indicator selected. There were four general areas to evaluate the information availability:

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

Information availability for each of these topics was ranked from 0 (no information available) to 4 (information is fairly complete). This effort helped identify critical information gaps for the completion of evaluating indicators and performance measures. It also helped identify the staff resources that might be needed to compile and evaluate existing data so that it could be reported system-wide.

It was a significant amount of work to review documents, select indicators and do the information inventory. Not all of the subgroups had sufficient agency resources to complete this in the short timeframe of developing this report. In some cases, such as Ecosystem Restoration Program, the agencies need more staff and resources to focus on this work, and also to coordinate and build upon other efforts already under way in their agencies. The information developed by the subgroups is summarized in this chapter with more detailed explanations available in the appendix.

WATER SUPPLY RELIABILITY

Although no clear, agreed upon definitions or targets for water supply reliability have been formally established, several statements in the CALFED Programmatic Environmental Impact Statement and Environmental Impact Reports (PEIS/R) and Record of Decision (ROD) provide insights to the expectations in terms of water supply reliability accomplishments. This section presents information from CALFED documents relevant in defining goals and core outcome indicators for water supply reliability. A summary is provided in WSR **Table 1**.

CALFED PEIS/R Purpose and Need Statement – Water Supply Reliability

The CALFED PEIS/R states, "The goal for water supply reliability is to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system. This can be accomplished by addressing objectives that collectively reduce the conflict among beneficial water uses, improve the ability to transport water through the Bay-Delta system, and reduce the uncertainty of supplies from the Bay-Delta system. These objectives in summary form are:

1. Maintain an adequate water supply to meet expected in-Delta beneficial use needs.
2. Improve export water supplies to help meet beneficial use needs.
3. Improve the adequacy of Bay-Delta water to meet Delta outflow needs.
4. Reduce the vulnerability of Bay-Delta levees.
5. Improve the predictability of the water supply available from the Bay-Delta system for beneficial use needs."

WSR Table 1 - Water Supply Reliability Objectives Described in the CALFED Programmatic EIS/EIR and Associated Documents

Water Supply Reliability Primary objective	Water Supply Reliability Main Sub-Objectives	Water Supply Reliability Sub-Objectives	Sub-objective Description	Time frame	Uses
Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system	Reduce the conflict among beneficial water users and improve the ability to transport water through the Bay-Delta system[1]	Maintain adequate Bay-Delta system supplies to meet expected existing and future) in-Delta beneficial use needs	Adequacy of a water supply reflects the degree to which supplies and demands are matched. CALFED documents recognize a mismatch between Bay-Delta water supply quantities and current demand patterns. With a growing population and evolving recognition of water needs to sustain biological resources of the Bay-Delta, it has become clear that water supplies are not adequate to meet existing and projected demands, particularly in times of drought. Mismatches between supply and demand generally result in problems for water users and the environment.	Short-term	Agricultural
					Environmental
				Long-term	Agricultural
					M&I
					Environmental
		Improve Bay-Delta system export water supply and timing to help meet reasonable existing and future beneficial use needs	Different end users have different needs and uses of water. Because problems for some users may not be problems for other s, each water user type must be considered separately. For example, urban and agricultural water users prefer supplies that are relatively consistent, year after year. By contrast, the environment requires variations in flows from year to year. Too many high flows or low flows can be undesirable. Each of these beneficial uses requires water of adequate quality, which differs for each use.	Short-term	Agricultural
					M&I
					Environmental
				Long-term	Agricultural
					M&I
					Environmental
		Improve the adequacy of Bay-Delta water to meet expected needs for Delta outflow	See Ecosystem Water Quality and Drinking Water Quality sections	Short-term	--
				Long-term	
	Reduce the uncertainty of Bay-Delta system water supplies to help meet short- and long-term needs	Improve the reliability of the Bay-Delta system by reducing the vulnerability of the levees	Delta levees, combined with fresh water inflow, repel brackish water from the Bay. In general, these levees are fragile and vulnerable to failure, thus increasing the vulnerability of water supplies dependent upon the Delta. (See Levees Section) DRMS is a program aimed at assessing the delta levee vulnerability.	--	--
		Improve the predictability of the water supply available from the Bay-Delta system from season to season and from year to year for beneficial use needs	The predictability of a supply is the degree to which future supply or supply patterns can be predicted. A low degree of predictability can lead to decisions that result in over- or under-investments in water supply production or unacceptable shortages. The availability and quality of Delta water supply is influenced by California's highly variable rain and snowmelt runoff, tempered to some extent by groundwater and reservoir storage. The timing, amount, and form of precipitation from year to year are unpredictable, although historical data and seasonal runoff forecasts provide some guidance for water users.	Short-term	Agricultural
					M&I
					Environmental
				Long-term	Agricultural
					M&I
					Environmental

[1] This sub-objective is divided into 2 sub-objectives in the Programmatic Environmental Impact Statement and Report (PEIS/R), Chapter 1.2
Additions found **only** in Program Goals and Objectives - Programmatic EIS/EIR - Technical Appendix (March 1998)

CALFED ROD – Storage Program

The ROD states that "Expanding water storage capacity is critical to the successful implementation of all aspects of the CALFED Program. Not only is additional storage needed to meet the needs of a growing population but, if strategically located, it will provide much needed flexibility in the system to improve water quality and support fish restoration efforts. Water supply reliability depends upon capturing water during peak flows and during wet years, as well as more efficient water use through conservation and recycling."

The Storage Program includes recommended surface water storage projects and a groundwater storage program. The ROD identified five potential surface water storage projects that could provide up to 3.5 MAF of storage and stated that CALFED Agencies will facilitate and fund locally supported, managed and controlled groundwater and conjunctive use projects with a total of 500 TAF to 1 MAF of additional storage capacity by 2007.

Recognizing an important guiding principal of the CALFED Program, the ROD stated groundwater and conjunctive use would be implemented through locally supported and managed projects or through partnerships with local and regional interests. Further, the ROD stated that CALFED agencies intend to support voluntary, locally controlled groundwater projects designed to address local water needs first, before considering regional or statewide benefits. Accordingly, surface storage would be pursued to provide increased system wide water supply reliability, and groundwater projects would be pursued to primarily provide increased local water supply reliability. It is recognized that groundwater and conjunctive use projects could contribute to increasing system-wide water supply reliability in addition to increasing local supplies.

The storage targets of 3.5 MAF for surface storage and 500TAF to 1MAF for groundwater storage do not directly relate to the quantity of water that would become available (output) from these actions. Changes in water supply reliability resulting from development of new storage would depend on the specific formulation and operation of the projects.

CALFED ROD – Conveyance Program

The CALFED goal for Delta conveyance is to identify and implement conveyance modifications that will improve water supply reliability for in-Delta and export users, support continuous improvement in drinking water quality, and complement ecosystem restoration. More specifically for export and environmental purposes, conveyance improvements are needed to improve the pumping capabilities of the State Water Project (SWP) export facilities to: (1) restore water project reliability and operational flexibility; (2) allow the EWA to transfer and store water; (3) allow a reliable water transfer market to function; (4) allow SWP facilities to convey larger amounts of water during periods of high quality water in the Delta to improve water quality for urban use; and (5) provide greater capability for SWP facilities to be used to improve the reliability

of the Federal Central Valley Project (CVP) supplies for both its water users and wildlife refuges.

The ROD identified about ten projects with goals to increase pumping capacity to 8,500 cfs and ultimately to 10,300 cfs. The ROD also stated that as a result of implementing several initial actions in the Conveyance Program, including an intertie between the CVP and SWP, and a Joint Point of Diversion agreement, the long-term reliability of CVP water supplies delivered to south of delta water users should increase from about 60 percent to 75 percent of contract amounts.

CALFED ROD – Water Use Efficiency

The goal of the Water Use Efficiency Program is to accelerate the implementation of cost-effective actions to conserve and recycle water throughout the State. Water use efficiency measures are included in the CALFED Program for many reasons, including (a) water use efficiency investments can yield real water supply benefits to urban and agricultural users in the short term, especially compared to surface storage and major conveyance improvements that will take at least 5 to 10 years to complete; and (b) water use efficiency investments can generate a net increase in water quality and timing of in-stream flows, even where they may not generate a net increase in available consumptively used water.

CALFED ROD – Water Transfers

The transfer of water between willing sellers and buyers represents an economically and environmentally sound part of the State's water strategy. Voluntary water transfers provide an important water resource management tool by fostering efficient allocation of water resources throughout the State. In some areas, local water transfers are common and CALFED Agencies will continue to support such local transfers. The successful implementation of the CALFED Program depends upon access to California's major water transportation systems and removing other barriers to transfers: physical, institutional and legal. Therefore, the goal of CALFED Water Transfer Program is to encourage the development of a more effective water transfer market that facilitates water transfers and streamlines the approval process while protecting water rights, environmental conditions, and local economic interests.

SELECTING PERFORMANCE OBJECTIVES FOR WATER SUPPLY RELIABILITY

The five water supply reliability objectives listed in the CALFED purpose and need statement described above and summarized in WSR Table 1 were used as a starting point in selecting water supply reliability performance objectives for this analysis. Each CALFED water supply objective was analyzed to determine whether it would be relevant for assessing performance, and if so, whether any documentation exists demonstrating how the performance could be measured and whether a performance goal or target was established

1. *Maintain an adequate water supply to meet expected in-Delta beneficial use needs* – This objective is targeting the water supply demands related to timing, quality, and quantity for in-Delta agriculture, municipal and industrial (M&I), and fish and wildlife. Performance goals for these beneficial uses will be further explored in phase 2 and incorporated into the water supply reliability performance objectives.

2. *Improve export water supplies to help meet beneficial use needs* – Improving Delta export capability is a clear objective of the CALFED Program as is articulated in the objectives of the Conveyance Program, which states that improved conveyance capability would significantly enhance the state's ability to conduct transfers as described above. Measuring Delta water supply export capability is relatively straightforward since several analytical models have already been developed and peer reviewed for this purpose and the CVP and SWP export capacity is continuously monitored as part of project operations. Although the CALFED ROD recommended implementing several projects that would improve export capability, it does not appear that it or any of the pre-ROD supporting documents established performance goals or targets for improved export quantity or quality

3. *Improve the adequacy of Bay-Delta water to meet Delta outflow needs* – There was no apparent performance goal or target in the CALFED ROD or the pre-ROD supporting documents related to Delta outflow needs above and beyond the existing regulatory flows. Before this objective could be used as a CALFED performance objective, the CALFED agencies, in coordination with the Environmental Restoration Program and other stakeholders, would need to develop appropriate science-based performance goals and targets.

4. *Reduce the vulnerability of Bay-Delta levees* – Although Delta water supply exports and in-Delta water supplies could be interrupted as a result of catastrophic levee failures, there was no apparent performance goal or target in the CALFED ROD or the pre-ROD supporting documents related to reducing vulnerability of Delta levees. Before this objective could be used as a CALFED performance objective, the CALFED agencies, in coordination with the Levee Program and other stakeholders, would need to develop appropriate science-based performance goals and targets, measurement methods, models and data collection techniques. This objective will likely be considered as part of the levee system integrity performance objectives during phase 2.

5. *Improve the predictability of the water supply available from the Bay-Delta system for beneficial use needs* – Pre-ROD documents state that a water supply reliability objective is to improve the predictability of water supplies from the Bay-Delta for planning and management for efficient water use in the coming season and in the long-term. However, no apparent performance goal or target related to improving water supply predictability was provided in the CALFED ROD or the pre-ROD supporting documents. Before this objective can be used as a CALFED performance objective, the CALFED agencies, in coordination with stakeholders, would need to develop appropriate science-based performance goals and targets.

INITIAL PROPOSED PERFORMANCE OBJECTIVES

Historically, the CALFED Program has defined its highest-level goal for water supply reliability to be to "reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system." While this is an apt description of the intent of the CALFED Program, there are many challenges in defining performance measures that can be used to adequately describe progress towards achieving this broad goal.

One primary challenge is to define the current and projected beneficial uses dependent on the Bay-Delta system. At this time, we cannot measure current beneficial uses precisely, and due to their dynamic nature, predicting beneficial uses in the future is even more difficult. Many laypeople interested in the CALFED Program may believe that the term "beneficial use" refers to more direct application of water to satisfy human wants in categories such as municipal and domestic, industrial, and agricultural uses of water. Of course, "beneficial use" also refers to the broader uses of water that provide public benefit, such as providing good conditions for fish and wildlife, maintaining freshwater in water bodies, recreation, and hydropower. (The State Water Resources Control Board has identified 24 categories of beneficial uses of water.)

While it is challenging to precisely quantify the current and projected beneficial uses of water in the classical categories of municipal and industrial and agricultural uses, we have much more experience approximating future use for these categories than quantifying the projected beneficial uses of water for other categories of use, such as maintaining fish and wildlife and preserving water quality. Recent experience with the Pelagic Organism Decline clearly shows the need for better scientific understanding about the relationship between the availability and movement of water and a healthy ecosystem. Moreover, considering ongoing changes in the Bay-Delta system due to exotic species, climate change and the growing number of water quality constituents of concern, any quantifiable projection of beneficial uses dependent on the Bay Delta System will continue to evolve for the foreseeable future.

Given these challenges, any comprehensive performance measures for the water supply reliability goal of the CALFED Program must be tied to performance measures for both the ecosystem restoration goals and the water quality improvement goals of the Program. While it is possible to measure deliveries of Bay-Delta water supplies for municipal and industrial and agricultural uses, this measure provides an indirect and limited indication of how successful the CALFED Program is in producing the intended benefits. If this delivery indicator is not used in conjunction with a much broader range of information, little can be learned about the success of the program with regard to "current and beneficial uses dependent on the Bay-Delta system." Examples of other information that must be considered to evaluate success include application of other sources of water supplies, changes in water use infrastructure or water use practices

that improves water use efficiency, water quality at various locations and for different uses, and some meaningful indication of the long-term health of the affected ecosystem.

Unless advances in scientific understanding prove otherwise, the best indicators of any mismatch between Bay-Delta supplies and beneficial uses related to ecosystem restoration and maintaining water quality will be the overall success of those programs as measured by the performance measures developed for those programs.

To develop indicators of water supply reliability for the subset of municipal, industrial and agricultural uses, two primary recommendations are offered, as follows:

1. To date, CALFED has attempted to evaluate the total portfolio of available water supplies and demands for all Delta Water Users with the goal being to produce an acceptable balance between the two. Upon consideration of the CALFED ROD and supporting documents, it appears that this approach may over reach the CALFED mission and authority, would be unmanageable within the context of the CALFED Program, and would divert the focus of CALFED agencies from addressing specific Bay-Delta beneficial use needs.

   Part of the outcome of the review and refocusing effort of CALFED in 2005 was recognition that CALFED's mission was too large and that the Program should be re-scoped to provide more direct attention to Delta issues. To that end, CALFED should focus on the Delta aspects of improving Statewide Water Management Systems to make Delta water conveyance more sustainable and reliable. As part of their broader missions 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. The California Water Plan update process should serve as a forum for agencies to continue coordination, seek public input, and provide transparency in policy development and implementation.

   Through the California Water Plan update process, DWR and other agencies will compile and integrate regional goals set through emerging Integrated Regional Water Management planning processes. Based on this work, DWR and other agencies will evaluate progress in improving statewide water resources management and develop and articulate State water policy. CALFED water management goals and performance measures should be informed by these broader goals set by the California Water Plan, and vice versa. The Delta Vision and Delta Risk Management Strategy (DRMS) development processes will also inform the California Water Plan update process.

2. As part of the core mission of the 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. Consider changes in those deliveries and predictability of

deliveries as indicators (using probabilistic measures of deliveries over time that can accommodate the inherent variability of conditions in California and the dynamic nature of demand to produce meaningful comparisons), and evaluate these indicators together with performance measures for ecosystem restoration and water quality, as an overall performance measure for the CALFED water supply reliability goal.

Recommended Approach: Refine and more clearly articulate the CALFED Program goal for Water Supply Reliability

The underlying commitment of CALFED is that sustainable progress will be made on all of the Program objectives through a balanced set of actions. The goal for the CALFED Water Supply Reliability program objective should be refined in such a way that accomplishments can be measured and that expectations are reasonable given the refocused CALFED strategy.

Below are two proposed strategic objectives that describe how water supply reliability accomplishments should be measured as they relate to 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
The stability of water supplies for uses both within and exported from the Bay-Delta system is linked to the sustainability of the Delta ecosystem and Delta water quality for both aquatic species and municipal, industrial and agricultural uses.

Performance Objective 1a Provide water supply in sufficient quantity and timing to improve Delta Water quality and contribute to fish restoration efforts. Water supplies for these purposes will be provided subject to the terms included in the Bay-Delta Water Quality Control Plan, ESA Biological Opinions, HCP and NCCP agreements, OCAP, EWA, and any other relevant regulations or agreements among CALFED implementing agencies. These regulations and agreements should evolve based upon best available scientific understanding of the water supply needs to provide for water quality improvement and ecosystem restoration in the Bay-Delta system.

- Indicator: Acre-feet of water made available and dedicated for Bay-Delta system water quality and fish restoration improvements
- Indicator: Progress in meeting ERP and WQ program goals as measured by established performance measures for those programs.
- Targets: To be coordinated with the ERP and WQ programs.

Performance Objective 1b: Maximize Sustainable Delta Deliveries. As part of a balanced CALFED Program, CALFED agencies should seek to maximize long-

term, sustainable water deliveries from the Bay-Delta system, while providing for all other beneficial uses, including restoring ecosystem health and improving water quality.

- Indicator: Ten year moving average of annual water delivered from the Bay-Delta system in Acre-feet. (Or some other instructive measure of actual water deliveries that accounts for the variation of annual deliveries from year to year based on hydrologic conditions and changing patterns of demand.)
- Targets: Targets should reflect the benefits that could be provided through the implementation of activities in the CALFED ROD to enhance delivery capability and must be evaluated and updated regularly and reflect currently institutionalized constraints to deliveries, including updates to the Bay-Delta Water Quality Control Plan, ESA Biological Opinions, Habitat Conservation Plan and NCCP agreements, OCAP, and others. These constraints should evolve based upon best available scientific understanding and established needs for other beneficial uses of the Bay-Delta system including ecosystem health and water quality.

Performance Objective 1c: Minimize unanticipated and uncompensated reductions in scheduled Delta water deliveries. One important component of water supply reliability is the degree of confidence that a scheduled quantity of water will be delivered during the time planned (referred to here as delivery stability). Delivery stability can be diminished by conditions that arise in the Delta that reduce or prevent delivery of scheduled water. The delivery stability will be measured as the amount of unanticipated and uncompensated reductions in scheduled deliveries via the SWP and CVP pumps caused by conditions within the Delta that prevent those deliveries.

- Indicator: TAF/year of unanticipated and uncompensated reductions in scheduled deliveries.
- Performance target: No unanticipated and uncompensated reductions in scheduled deliveries.

Strategic Objective 2. End User Supply Reliability (To be administered by DWR and other agencies through the California Water Plan update process and reported to the CALFED Program)

Long-term, sustainable, water supply reliability is best measured at the end user, capturing the balance of supply and demand considering all sources of supply, demand management, and other water management strategies. As discussed above, DWR and other State agencies are encouraging the development of Integrated Regional Water Management Plans (IRWMP) throughout California, as described in the 2005 California Water Plan Update. The water management goals and actions resulting from IRWM planning will be assessed on a statewide basis by DWR and other agencies through

future California Water Plan Update processes. Specific indicators and targets will be developed in cooperation with local and regional agencies, in consideration of statewide and regional water management objectives.

B. WATER QUALITY

The CALFED Record of Decision (ROD) establishes the following long-term objective for water quality:

> *The CALFED Program is committed to achieving continuous improvement in the quality of the waters of the Bay-Delta system with the goal of minimizing ecological, drinking water, and other water quality problems (p. 17)*

The CALFED Water Quality Program has concentrated on improving Delta water quality as a drinking water source, while environmental uses have generally been included in the Ecosystem Restoration Program (see ROD, p. 65). The current work on water quality indicators and performance measures address water quality "strategic objectives" across these distinct CALFED program activities.

Drawing from work conducted by state and federal agencies [e.g., Central Valley Regional Water Quality Control Board (Central Valley Water Board), Department of Fish and Game, and the US Geological Survey], the ROD and the Water Quality and Ecosystem Restoration Program Plans contain more specific objectives for addressing specific water quality issues in the Bay-Delta system. Considering this context, core outcome indicators and performance measures should be developed in this first phase for a range of beneficial uses of water: drinking water / municipal supply, fish and wildlife, and human health. Indicators for the drinking water quality component are related to water quality at the Delta intakes (***organic carbon, salinity/bromide, nutrients, and pathogens***) and at the "tap" (disinfection ***byproducts, salinity, taste and odor, and disinfection type***). For environmental water quality and human health, it is useful to distinguish between contaminants which bioaccumulate, and others for which effects are directly related to concentration in water. Within this framework, ***mercury*** and ***toxicity*** were selected as first priority subjects for indicator development.

In addition to these first phase contaminant topics, the Technical Work Group considered other water quality impairments, such as selenium and PCBs (bioaccumulants); low dissolved oxygen (a subject related to nutrients and of interest to drinking water quality, as well as to fish effects); and other sources of toxicity, such as specific metals. Although salinity in the Delta is a key parameter for ecosystem conditions, this subject is best addressed at this time through other CALFED agency efforts. The group also recognized that focusing on particular contaminants could overlook significant synergistic effects or (in the case of fish consumption advisories for mercury) mischaracterize the safety of fish which could contain other bioaccumulants. These issues could be addressed in future work but are not further discussed in this chapter or in the survey of resource needs (Chapters 5 and 6)..

CH4 Water Quality: Table 1 displays the strategic objectives and related performance measures selected for water quality.

Chapter 4: Water Quality Table 1: Relationship of Program Goals to Core Outcome Indicators

Core Program Objective	Strategic Objective	Long-Term Performance Objective	Performance Goal or Target	Outcome Indicator
WQ1	Provide safe, reliable, affordable drinking water by maintaining water quality at the intakes	Provide water containing no higher than 50 ug/l bromide at the Delta intakes [or the equivalent level of public health protection (ELPH)] Provide water containing no higher than 3 mg/l total organic carbon at the Delta intakes (or ELPH) [1]	50 ug/l bromide at Delta intakes or ELPH[1] 3 mg/l total organic carbon at Delta intakes (or ELPH) [1]	Water quality at the Delta intakes: percent compliance (organic carbon, nutrients, salinity/ bromide, pathogens)
WQ2	Provide safe, reliable, affordable drinking water with an equivalent level of public health protection (ELPH) by using a cost-effective combination of alternative source waters, source control and treatment technologies.	Provide drinking water quality at the tap that meets drinking water standards for disinfection byproducts, salinity, pathogens, and taste and odor aesthetic	tbd	Drinking water quality at the tap (Delta source water providers): percent compliance (disinfection byproducts, salinity, taste and odor, level and type of disinfection)

[1] CALFED Record of Decision, 2000, p. 65.

WQ3a	Identify parameters of concern in water and sediments within the Bay, Delta, Sacramento River, and San Joaquin River and implement actions to reduce their toxicity to aquatic organisms.[2] Reduce the loadings and concentrations of toxic contaminants in all aquatic environments in the Bay-Delta estuary and watershed to levels that do not adversely affect aquatic organisms, wildlife and humans. [3] Conduct appropriate studies to identify unknown toxicity and develop management actions as appropriate.[4]	Successful identification of causal agents of aquatic organism toxicity in the Delta, Bay, Sacramento River and San Joaquin River regions.	tbd	Indications through toxicity identification evaluations (TIEs) that toxicity is or may be attributable to known sources in the Delta system.
WQ3b		Significant reduction (or elimination) of the amount of toxicity present in rivers and sediments due to successful implementation of control measures for toxicants identified in the Comprehensive Monitoring, Assessment, and Research Program (CMARP).	tbd	No likely significant toxicity to aquatic test organisms in sediment or aquatic toxicity tests.
WQ3c		Determination of the degree to which contaminants are a causal factor in the decline of pelagic organism species in the Delta.	tbd	Establish whether water contaminants are a significant factor in the decline of pelagic organisms in the Delta and, if so, identify which contaminants and their sources.

[2] CALFED Water Quality Program Plan, p. 11-1.
[3] Ecosystem Restoration Program Plan, Goal 6, Objective 1.
[4] Multi-Species Conservation Strategy Milestones: 37, 53, 83, 111.

WQ4a	Improve and/or maintain water and sediment quality to levels that do not adversely affect aquatic organisms, **humans**, and wildlife.[5]	Reduce mercury exposure through consumption of harvested fish, wildlife, and invertebrates in the Delta and its tributaries to levels that protect public health. Reduce mercury in fish to safe consumption levels.	tbd tbd	Public health benefits (expressed as a measure of reduced risk of exposure to mercury) Mercury concentrations in the tissue of representative Bay-Delta species eaten by humans
WQ4b	Improve and/or maintain water and sediment quality to levels that do not adversely affect **aquatic organisms,** humans, and **wildlife**.	Reduce mercury and methyl mercury in the Bay-Delta ecosystem to levels where fishery resources, wildlife, and human health are unaffected.	tbd. Recommend using goals and targets based on RWQCB TMDLs and other regulatory-based measures designed to meet wq objectives or ESA prescriptions..	Mercury concentrations in representative biosentinels (fish, avian, mammal species).

[5] Ecosystem Restoration Program Plan, Goal 6.

Drinking Water Quality:

The CALFED Record of Decision (ROD) describes some clear long-term strategic objectives and performance objectives for the program. The ROD and Water Quality Program Plan do not specify any short-term performance objectives or targets – other than continuous improvement.

> *CALFED Agencies have adopted a general target of continuously improving Delta water quality for all uses, including in-Delta environmental and agricultural uses. For the drinking water quality program, CALFED Agencies have developed a specific goal based upon extensive stakeholder and agency involvement. CALFED Agencies' target for providing safe, reliable, and affordable drinking water in a cost-effective way, is to achieve either: (a) average concentrations at Clifton Court Forebay and other southern and central Delta drinking water intakes of 50 µg/L bromide and 3.0 mg/L total organic carbon, or (b) an* ***equivalent level of public health protection*** *using a cost-effective combination of alternative source waters, source control and treatment technologies.* (Page 65 CALFED Record of Decision)

Based on the goals and objectives described in the ROD and the subsequent planning and analyses, four general topics have been chosen for indicator development:

- **Water quality at Delta intakes** (includes organic carbon, salinity/bromide, nutrients and pathogens)
- **Water quality at the tap** (after treatment by drinking water treatment plants, before conveyance to customers' taps; includes disinfection byproducts, salinity, taste and odor, level/type of disinfection
- Cost
- Reliability & flexibility

The first two topics were chosen for development and evaluation in this effort (Phases 1-3), with the other areas to be developed in the future. These two areas were chosen because of relevance to the program, relationship to other efforts currently underway, and availability of data.

Drinking Water Quality: Core indicators information inventory

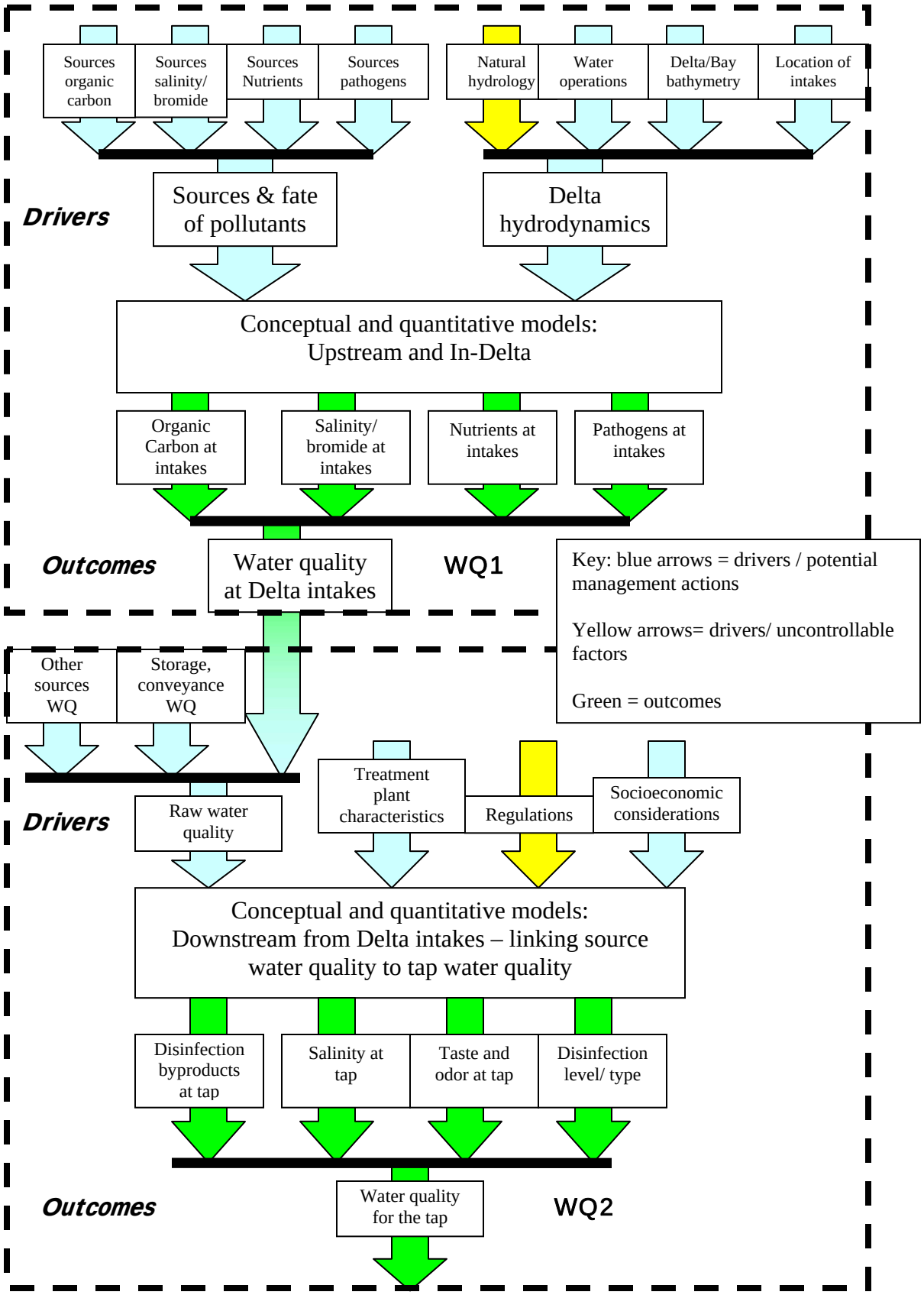
The CALFED Water Quality Program is working with the Central Valley Drinking Water Policy workgroup to develop conceptual models and comprehensive data assessments for prioritized drinking water constituents of concern. This effort will contribute to completion of a policy for drinking water which the Central Valley Water Board would incorporate in the Basin Plan. For the past eighteen months, this work has focused on water quality at Delta (and Central Valley) intakes. The workgroup is now beginning work on the linkage of Delta water quality to treated water quality, in parallel with the CALFED Water Quality Program's final assessment.

Drinking water constituents of concern are monitored to varying degrees throughout the Delta and its tributaries. The largest amounts of monitoring data exist at the ends of the major tributaries to the Delta and at the Delta intakes, with significantly less data available as one moves upstream. Salinity is the most frequently measured, followed by organic carbon, nutrients, and pathogens, which are infrequently or not monitored at these locations. Flow is reasonably well measured throughout the Central Valley and Bay, at higher frequency than water quality data. Efforts are underway to better understand the drivers of water quality at intakes, through assembling and assessing existing data.

The California Department of Health Services (CDHS) regulates drinking water systems and collects considerable monitoring data from public water systems for regulatory compliance purposes. There is need to better understand the ways in which Delta water quality affects treatment plant operations and delivered water quality. A report commissioned by the California Urban Water Agencies' took the first step in describing this linkage. The Central Valley Drinking Water Policy project and the CALFED Drinking Water Program's final assessment are further investigating this linkage, along with other drivers. An understanding of this relationship can inform a system-wide strategy for cost-effective operations and investments to improve water quality and to meet future federal and state drinking water regulations.

There also is need to better understand future options for treatment technology and operations to improve water quality and to meet possibly more restrictive regulations in the future. Regulations also influence treatment decisions in terms of construction and operations. For the CALFED program, these regulations are an "uncontrollable" factor, although they are generally predictable in terms of their timing.

The following diagram outlines the drivers and outcomes evaluated for these two core indicators.


Sources organic carbon
Sources salinity/ bromide
Sources Nutrients
Sources pathogens
Natural hydrology
Water operations
Delta/Bay bathymetry
Location of intakes
Drivers
Sources & fate of pollutants
Delta hydrodynamics
Conceptual and quantitative models: Upstream and In-Delta
Organic Carbon at intakes
Salinity/ bromide at intakes
Nutrients at intakes
Pathogens at intakes
Outcomes
Water quality at Delta intakes
WQ1
Key: blue arrows = drivers / potential management actions
Yellow arrows= drivers/ uncontrollable factors
Green = outcomes
Other sources WQ
Storage, conveyance WQ
Drivers
Raw water quality
Treatment plant characteristics
Regulations
Socioeconomic considerations
Conceptual and quantitative models: Downstream from Delta intakes – linking source water quality to tap water quality
Disinfection byproducts at tap
Salinity at tap
Taste and odor at tap
Disinfection level/ type
Outcomes
Water quality for the tap
WQ2

Chapter 4 Table 2: Information Survey: Core Outcome Indicators for Drinking Water Summary

	OUTCOMES					DRIVERS			
Core objective	**Outcome**	**Conceptual model**	**Quantitative model**	**Past monit. data**	**Current / future monit. data**	**Driver key word**	**Driver Concept. (CM) or quantitative model (QM)**	**Driver Past monitor.**	**Driver Current/ future monitor.**
WQ1	Water Quality at intakes	2.5	2	2	3	Delta hydrodynamics	3.5 CM 3 QM	3	3
						Sources / fates of pollutants	2 CM 1 QM	2	2
WQ2	Water Quality at tap	2	2	3.5	3.5	Raw water quality	2.5 CM 2.5 QM	3	3.5
						Treatment plant characteristics	4 CM 4 QM	4	4
						Socio-economic considerations	2	2	2
						Regulations	4	4	4

Key:
--: not applicable
0 = no information available
1 = minimal information available
2 = some information available, but major gaps
3 = information is fairly comprehensive, minor information gaps
4 = information is fairly complete

Toxicity

The CALFED Water Quality Program Plan lists toxicity as one indicator of ecosystem water quality and includes the following action:

> *Through research and monitoring, identify parameters of concern in the water and sediment and implement actions to reduce their impacts to aquatic resources. . (Page 11-1, Water Quality Program Plan, Technical Appendix to CALFED Programmatic EIR/EIS 2000)*

There are also several significant strategic goals and objectives in the Ecosystem Restoration Program Plan and Multi-Species Conservation Strategy Milestones:

> *Reduce the loadings and concentrations of toxic contaminants in all aquatic environments in the Bay-Delta estuary and watershed to levels that do not adversely affect aquatic organisms, wildlife and humans. (Ecosystem Restoration Program Plan, Goal 6, Objective 1)*
>
> *Conduct appropriate studies to identify unknown toxicity, and develop management actions as appropriate. (Multi-Species Conservation Strategy Milestones 37,53,83 and 111, Technical Appendix to CALFED Programmatic EIR/EIS 2000)*

Detail about the process developed to accomplish the goals related to toxicity is described in the Strategy to Address Toxicity of Unknown Cause (2001), which was developed by a multi-agency technical workgroup. Development of monitoring and indicators related to toxicity of unknown cause should closely link to work on the "pelagic organism decline" in the Delta.

Based on these documents and current priorities, the following topics have been chosen for indicator development:

- **Water column and sediment toxicity to laboratory test organisms in Delta and upstream tributary watersheds**
- **Determination of degree to which contaminants contribute to population level impacts**
- Copper, cadmium and zinc concentrations at Sacramento R. above Hamilton City and below Shasta Dam
- Organophosphorus (OP) pesticide concentrations in the Delta and upstream tributary watersheds

Indicators for the topics highlighted in bold text above will be the initial focus for indicator development. The remaining topics may be included in the future.

Chapter 4 Water Quality Table 2: Information Survey: Core indicators for Toxicity Summary

	OUTCOMES					DRIVERS			
Core objective	**Outcome**	**Conceptual model**	**Quantitative model**	**Past monitoring data**	**Current / future monitoring data**	**Driver key word**	**Driver Conceptual (CM) or quantitative model (QM)**	**Driver Past monitoring**	**Driver Current/ future monitoring**
WQ3A	Water column toxicity	2	0	2	2				
WQ3B	Sediment toxicity	2	0	2	2				
WQ3C	Population-level effects	1	0						

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Mercury

Mercury contamination is extensive throughout the Bay-Delta watershed. This was recognized in several program documents developed by CALFED. The ROD notes the nexus between the water quality and ecosystem restoration programs when dealing with program actions designed to improve water quality to protect environmental beneficial uses. The Water Quality Program Plan recognizes that the "mercury levels of certain species of fish in the Delta and San Francisco Bay are at sufficient concentrations to warrant fish advisories for human consumption" (WQPP, p.4-1) and singles out that significant risks to ecosystem and human health exist from exposure to mercury and methylmercury. Additionally, the Ecosystem Restoration Program Plan sets a goal of improving and/or maintaining water quality.

More recently, CALFED has funded development of the "Mercury Strategy for the Bay-Delta Ecosystem: A Unifying Framework for Science, Adaptive Management, and Ecological Restoration" (hereafter referred to as Mercury Strategy) to guide activities and to integrate investigations needed to build a scientific foundation for ecosystem restoration, environmental planning, and the assessment and eventual reduction of mercury related risks in the Bay-Delta ecosystem" (p.iii). Guided by this strategy a number of efforts are underway to better understand pathways of mercury exposure and to reduce "total mercury" and methylmercury levels and exposure to aquatic organisms, wildlife, and humans.

Various CALFED Program activities are linked to mercury, either as "drivers" in producing bioavailable methylmercury or because mercury contamination could impede Program objectives. For example, because there is potential for conditions at wetlands to increase mercury exposure through methylation and subsequent uptake by aquatic organisms, there is a need to monitor this process and manage restoration projects to minimize conditions that promote this reaction. Additionally, mercury in fish can cause neurological problems in humans. This is a particular concern for certain ethnic and low-income communities who consume a large amount of fish that bioaccumulate methylmercury.

The strategic goals and objectives identified in the CALFED working documents that are most applicable to this issue are:

Water Quality Program Plan – objective

- Reduce mercury in water and sediment to levels that do not adversely affect aquatic organisms, wildlife, and human health. (ERP p.4-2)

Ecosystem Restoration Program Plan - goals

- Goal 2: Rehabilitate natural processes in the Bay-Delta estuary and its watershed to fully support, with minimal ongoing human intervention, natural aquatic and associated terrestrial biotic communities and habitats, in ways that favor native members of those communities.

- Goal 4: Protect and/or restore functional habitat types in the Bay-Delta estuary and its watershed for ecological and public values such as supporting species and biotic communities, ecological processes, recreation, scientific research, and aesthetics.

- Goal 6: Improve and/or maintain water and sediment quality conditions that fully support healthy and diverse aquatic ecosystems in the Bay-Delta estuary and watershed; and eliminate, to the extent possible, toxic impacts to aquatic organisms, wildlife, and people.

Other documents lay out a number of objectives that could be used as performance measures for the reduction and management of mercury contamination. These include:

- Reduce risk to human populations through effective risk communication and management of exposure. (Mercury Strategy)

- Reduce mercury and methyl mercury in the Bay-Delta ecosystem to levels where fishery resources, wildlife, and human health are not adversely affected.

Possible management actions include:

- Identifying ecosystem restoration sites susceptible to production and uptake of methyl mercury and monitoring these sites for changes in mercury processes
- Managing restoration sites such that methylmercury and total mercury loads are reduced for export to the food chain or other biota
- Managing wetlands for activities that are appropriate at the site, taking into account the mercury cycling occurring at that location
- Educating at risk communities about mercury contamination in fish and offering safer alternatives

Outcome indicators for mercury (Chapter 4: Water Quality Table 1) have been selected for their linkage to ecosystem and human health effects. Fish tissue indicators for the ecosystem and human health are consistent with the approach recommended in the Central Valley Water Board's Delta TMDL for mercury (Revised Draft June 2006). Additional human health and fish consumption indicators are based on information from applicable studies and expert advice.

Table 2 (below) summarizes a preliminary estimate of knowledge and data for the outcome indicators and drivers.

Chapter 4 Water Quality Table 2: Information Survey: Core outcome indicators for Mercury Summary (to be revised)

	OUTCOMES					DRIVERS			
Core Objective	**Outcome**	**Conceptual Model**	**Quantitative Model**	**Past Monitor. Data**	**Current / Future Monitor. Data**	**Driver Key Word**	**Driver Conceptual (CM) or Quantitative Model (QM)**	**Driver Past Monitor.**	**Driver Current/ Future Monitor.**
WQ4A	Human health effects: Public health benefits	2	0	1	1	effective risk communic.	1 CM 0 QM	1	1.5
	Human health effects: mercury concentrations in sport fish	2	1	2	3	Fish consumption	2 CM 1 QM	2	3
WQ4B	Mercury effects on the ecosystem: Mercury concentrations in biosentinels	2	1	1	2.5	sources	2 CM 1 QM	1	2
						transport	2 CM 1 QM	1	2
						methylation	2 CM 0 QM	1	2
						bioaccum.	2 CM 1 QM	1	2
						aquatic, wildlife exposure effects	2 CM 1 QM	1	2

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2 = some information available, but major gaps
3 = information is fairly comprehensive, minor information gaps
4 = information is fairly complete

C. Levee System Integrity:

Because the Delta levees delineate channels that are key parts of the water conveyance system and help maintain water quality in the Delta, all other CALFED program elements depend on the Delta levees. The performance measures for Water Supply Reliability, Water Quality (both drinking water quality and ecosystem water quality), and even Ecosystem Restoration should consider the condition of the Delta levees and emergency response to eminent failure. Every CALFED program element is at risk if the western Delta experiences a levee failure, therefore every CALFED program element would benefit if the condition of levees and/or emergency response are improved. So there is a clear overlap between Levee System Integrity performance and Water Quality, Water Supply Reliability, and the Ecosystem

It is recognized that having and presenting data and information about the state of the Delta levees is important, and indeed critical, for managing the Delta levee system and for informing agencies, stakeholders and publics about the state of the Delta levees. However, due to many competing demands, implementing agency staff for the CALFED Levees program have not been able to participate fully in preparing this report.

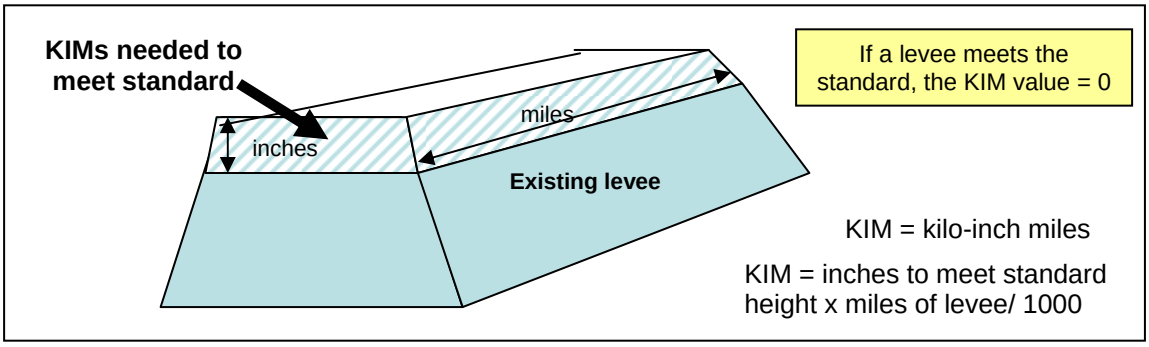
Some previous work has been done on choosing and developing indicators and performance measures for the CALFED levees program. Some of these prior efforts have identified 5 key areas for outcome indicators to be chosen:

- Resources at risk
- Levee base level protection
- Levee stability and seismic stability
- Habitat
- Emergency response

The Delta Risk Management Strategy (DRMS) is doing some data gathering and analyses for other purposes, but some of that information will be relevant for the development of indicators and performance measures. DRMS is gathering and analyzing existing data that is available, but there is a need to develop a long-term monitoring program in order to provide this information in a consistent and timely manner. For example, surveys of levee elevations should be done at least every 5 years and involve the local reclamation districts. Borings and engineering analyses are needed to evaluate levee stability. Additional research is needed to further understand the major risks to levee stability – including levee fragility studies, understanding the seismic response of peat soils, and investigating whether the CRCV is an active fault.

The first area for development of indicators and performance measures is Levee Base Level Protection. In the past about 50 percent of the failures have been from overtopping and about 50 percent have been from internal weaknesses that developed in the levee structure. Therefore, two metrics are being proposed to address these two different aspects.

A metric called the "KIM" (for "**K**ilo-**I**nch **M**ile) is being proposed to provide information on the levee status in resistance to overtopping. The KIM is a simplified volumetric number that assumes a certain levee width (including both crown and sides) and sums up the number of inches of material needed to meet a certain standard (PL84-99, HMP, or other standards) multiplied by the miles of levee that the material is needed. When all levees meet the standard – KIM is 0. KIM can be calculated from elevation data taken from surveys or LIDAR. LIDAR surveys of the Delta are expected to be completed in early 2007 and available to provide baseline information on the height of the levees.



The second proposed metric is related to detecting and repairing weaknesses in the levee that could pose a risk for levee failure. A new method, magnetic anomaly surveys are being used this year to detect areas of seepage and other anomalies that may weaken the levee structure. This will be compiled in a metric – number of anomalies that are detected and repaired. State (DWR) and Federal (FEMA) funds are being provided to cost share with the reclamation districts in 2006-07. It is expected that approximately 60 percent of the Delta levees may be surveyed using these electromagnetic methods this year.

In order to inventory, compile and analyze the important information that is needed to report on the state of the Delta levees, additional staff resources are needed in the next year. One full-time staff person is needed to lead the development and reporting of indicators and performance measures, assisted by a multi-agency technical advisory team. More details are provided in Chapter 5 about the tasks to be accomplished by the leader and the team, and the time commitments that would be needed from staff of each implementing agency. Additional funds would also be needed to ensure the participation of the consultants for the Reclamation Districts on the technical advisory team.

D. Ecosystem Restoration

Ecosystem

Status

The purpose of the Ecosystem Restoration Program (ERP) is to achieve CALFED's ecosystem restoration goals and objectives. Since its inception, the ERP has acknowledged the need to establish ecosystem indicators and performance measures,

and much work has been conducted in these areas during the past several years. The ERP fully supports the need to measure and report on program performance, as identified in the CALFED 10-Year Action Plan. The ERP implementing agencies (FWS, DFG, and NMFS) are currently developing a strategy to achieve several tasks associated with development of performance measures, including adding resources and staff.

During Stage 1 implementation, the ERP has relied on "milestones" to track program progress. The milestones were identified in the CALFED programmatic biological opinions and Natural Community Conservation Plan (NCCP) determination, and comprise actions and objectives intended to benefit species covered in the biological opinions and NCCP determination. An assessment of milestones progress was completed by the ERP in 2004, and another assessment is planned for the end of Stage 1.

Since assignment of the performance measures task to agency staff (Performance Measures Subcommittee) by the Executive Leadership Council (ELC), the ERP implementing agencies (DFG, FWS, and NMFS) have been meeting with the Subcommittee to coordinate work on the assignment. In addition, the Subcommittee subgroup for ecosystem performance measures, staffed by the ERP implementing agencies, has met with members of the CALFED Science Program to initiate development of ecosystem performance measures. It was recognized and agreed that the ecosystem subgroup will need to coordinate with subgroups working on other objectives, such as water quality and water supply reliability. However, during these initial efforts on the performance measures task, the ERP implementing agencies recognized several problems with carrying out the task in the current time frame.

Development of ecosystem performance measures with the current level of staff and resources is encumbered by several near-term activities of the ERP. These activities include preparation of the Year 7 Program Plan, end of Stage 1 Milestones Assessment, review of the current Conservation Agreement and regulatory documents for the program, development of the Bay-Delta Conservation Plan (BDCP), assessment of present ecological conditions of the Bay-Delta watershed, and development of conceptual models for the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). These activities will inform needs for conservation, restoration, and performance measures.

In addition, the Comprehensive Monitoring, assessment, and Research Program (CMARP) and Interagency Ecological Program (IEP) are working on conceptual models, monitoring indicators and performance measures. These activities and DRERIP need to confer on respective goals and objectives and coordinate efforts to most efficiently address the range of environmental indicators and performance measures needed, and avoid duplication of effort.

Next Steps

Notwithstanding these near-term considerations of the ERP, the implementing agencies recognize the need to continue science-based development of performance measures, and are committed to continue the effort. The framework of indicator categories proposed by the CALFED Science Program appears suitable for developing a systematic and biologically sound foundation for ecosystem performance measures.

To move forward, the ERP implementing agencies are preparing a "concept paper," to be completed by the end of summer, which will describe how the ERP will conduct end of Stage 1 evaluations, including CALFED's progress toward ecosystem restoration objectives and regulatory compliance with the Multi-Species Conservation Strategy-ERP milestones. The concept paper also will guide development of a conservation strategy for Stage 2, which will be foundational to the ERP and EWA, DRERIP, BDCP, and Delta Vision. The concept paper also will describe processes for development of performance measures, comprehensive monitoring, coordination of Endangered Species Act re-consultation for the Bureau of Reclamation's Central Valley Project Operations Criteria and Plan (OCAP), and public participation. Because a top-down approach is being used to develop performance measures, the concept paper and conservation strategy are important to define the driving factors at the top, as we move from Stage 1 into Stage 2.

The ERP implementing agencies plan to form a conservation strategy team consisting of ERP implementing agency staff, science advisors, and representatives from other state and federal agencies, and stakeholders. The conservation strategy team will be responsible for conservation planning, development of conceptual models to support review of potential environmental actions under the ERP and BDCP, and development of performance measures for ERP and BDCP goals and actions. It is expected that developed performance measures will evolve over time, and additional measures would be developed as we implement monitoring and performance measurement, and implement adaptive management.

A new action is included in the Year 7 Program Plan titled "Coordinated Monitoring and Indicator/Performance Measure Strategy Project," that describes Year 7 funding of $2M. Under this project, an interagency team will develop a coordinated monitoring and indicator/performance measure strategy for the ERP and begin implementation of that strategy.

Staffing, Budget, and Schedule

Because of the near-term ERP issues, it is difficult to accurately estimate staffing needs, budget, and scheduling at this time. Once the ERP implementing agencies have further addressed these near-term ERP issues, it will be possible to better identify budget and staffing resources needed, acquire appropriate staff, and establish a time frame for completing an initial set of performance measures. However, for purposes of this planning report, preliminary estimates can be offered.

It is anticipated that development of performance measures will not include dedicated, full time staffing. The ERP implementing agencies are planning to acquire additional staff soon, but they likely will work on multiple programs, teams, and committees to address the near-term ERP issues, including performance measures. Existing staff will participate in this work, as well. It is estimated that the equivalent of 6 to 10 full time staff will be needed to develop initial performance measures over the next 18 months, at a cost of $1.16M to $1.93M. An additional $320k to $540k is estimated for technical assistance contracts.

CHAPTER 5: RESOURCES NEEDED

Water Supply Reliability

The efforts related to the further development of water supply reliability performance goals and indicators must be integrated with other efforts including the California Water Plan update process.

Specific effort to develop indicators and targets for Strategic Objective 1, Enhance Long-Term Stability of Delta Water Supplies, will be met using existing staff within DWR and Reclamation. However, this overall effort could exceed $400,000 per year—approximately one FTE from DWR and one from Reclamation and support from Program staff from the following program areas: Conveyance, Surface Storage, Transfers, and the Environmental Water Account.

Further engagement and cooperation with local and regional agencies will be needed to develop indicators, targets, and the data needed for accurate analysis under Strategic Objective 2: End User Supply Reliability. Resource needs are under development but unknown at this time.

For the Water Supply Reliability program to complete this effort, resources may need to be dedicated within the Ecosystem Restoration and Water Quality subgroups to develop science based environmental water demand targets for tributaries to the Delta, in Delta, and Delta out flow. It is likely that a significant amount of the environmental water demand targets will be developed in ongoing efforts, (e.g., Bay-Delta Conservation Plan); however, this information may not be available in the near future and interim targets for environmental demands may need to be developed. Ultimately, resource allocation decisions for these purposes would be made by ERP and WQ program agencies.

Water Quality

Limited staff resources are currently committed to developing water quality performance measures and indicators, or to conducting the activities needed on an ongoing basis to generate information and scientific understanding required for good performance measures. As described below, some staff are conducting work related to performance measures and indicators for drinking water quality, but this is not the case for indicators and performance measures associated with toxicity or mercury.

1. Resources needed for Drinking Water Quality

Development of drinking water quality performance measures and indicators has benefited from a ROD milestone to develop a Central Valley Drinking Water Policy. The Central Valley Drinking Water Policy project has (a) compiled a comprehensive water quality database, (b) proceeded midway through the development of conceptual models and comprehensive data assessments, and (c) recently initiated efforts aimed at

defining the linkage between Delta intake water quality and treated water quality. The project is managed by the Central Valley Water Board with the guidance of a broad agency and stakeholder group. CALFED staff has also provided funding, which ends in 2007, and technical assistance to the project, as its products also support program strategy and performance measure development.

As of June 2006, the water quality database has been compiled, but needs to be updated and made more uniform. Conceptual models for organic carbon and nutrients have been completed, and models for pathogens and salinity will be done by late 2006. However, further data analysis (including statistical analysis) is needed to identify critical data gaps, prioritize sources that can be reduced, and improve model input. With current resources, an optimistic timeframe for completing data analysis is December 2006. CALFED staff expects that this work will show there are significant data gaps for all constituents except salinity.

CALFED is also initiating work on a Final Assessment that will present the synthesized results of these analyses; some consultant help may be used to support this effort, which is due in 2007 to support end of Stage 1 decisions.

Additional work will be conducted in the next year on water quality "at the tap." Some treated water quality data and treatment plant information is collected by CDHS, to confirm regulatory compliance. Additional information and data from treatment plants are collected and held by local utilities, and there are hundreds of treatment plants in or served by the Central Valley. CDHS and CALFED staffs are working on identifying these treatment plants and determining whether representative treatment categories can be created for conceptual model purposes.

In summary, current implementing agency and CALFED staff resources are focused on work needed to support end of Stage 1 decisions and related work for the Central Valley Drinking Water Policy: Additional resources (implementing agencies, CDHS and SWRCB) will be needed to complete comprehensive data assessments, develop a strategic monitoring plan, and develop performance indicators with existing information for FY 06-07 and succeeding years.

There is also the need for greater detail on the Delta hydrodynamics driver, including better bathymetry, elevation, and flow data. Our understanding of the transport of constituents through the Delta is severely hampered by a lack of data on key factors affecting hydrodynamics, and additional resources should be dedicated to collection and evaluation of this information.

2. Resources Needed for Ecosystem Water Quality:Toxicity

In 2001, a multi-agency technical work group convened to develop a strategy to address toxicity of unknown cause in water and sediment. The strategy document summarized existing information and toxicity monitoring programs in the Central Valley and Bay-Delta and described the significant data and knowledge gaps related to toxicity of

unknown cause. Only limited resources have been allocated to work on aspects of the strategy so much of the information needs identified in 2001 remain today.

First, there is need to update the strategy with data and research information gathered since 2001. Fate and transport models for specific constituents exist but there is a lack of models for the general parameter "toxicity." Data for toxicity driver indicators exist for specific constituents (i.e., pesticides). However, in many cases the driver causing the toxicity could not be determined, making it impossible to identify needed analysis for the toxicant: That is, toxicity of unknown cause (TUC) is essentially a data gap.

Furthermore, knowledge regarding ecological impacts of TUC is extremely limited. Bioassessments, toxicity testing on resident species, and biomarker analyses could contribute to a weight-of-evidence assessment of impacts on aquatic ecosystem populations. This approach is being pursued in the context of Delta "Pelagic Organism Decline" (POD) investigations. Fiscal year 2006/2007 work for the POD includes investigation of toxicity as a contributing factor through toxicity testing, study of contaminant trends, and biomarker analyses.

If the issue of TUC is to be resolved, toxicity identification evaluation (TIE) and analytical chemistry procedures need to be refined, or new ones developed. For the most part, toxicity testing projects have focused on major tributaries and downstream of major reservoirs. To gain a better understanding of toxicity in these watersheds, monitoring programs that include TIEs must be expanded and focused on critical events and locations (e.g., storms, land use activities). In addition, ambient toxicity monitoring associated with NPDES permit discharges has largely been ignored. Analysis of these data, which are largely only available in hard copy format, could assist in understanding toxicity in the Central Valley and San Francisco Bay water bodies.

Finally, identification of sources and the practices or actions that result in toxicants entering surface waters would be helpful in designing control strategies.

Overall, additional resources at the Regional Water Board and at the California Department of Fish and Game will be needed in addressing these toxicity data gaps, including refining procedures, expanding monitoring, retrieving existing data into compatible electronic formats, and evaluating such data.

3. Resources Needed for Ecosystem Water Quality and Human Health: Mercury

Mercury ranks high among water quality issues for the Bay-Delta system and is relevant to Delta restoration planning and human health. Information about mercury cycling, transport, transformation, bioaccumulation, speciation, food web interactions, and human health risks associated with fish consumption is being generated from several grant-funded projects and can be used in the development of initial indicators and performance measures. However, resources are needed to synthesize information developed from these projects, reexamine the Mercury Strategy and update it as appropriate, identify next steps, and develop a coordinated work plan based on the

updated Strategy. Further, a long-term mechanism has yet to be identified for funding projects that address appropriate next steps as well as those that develop data to fill in gaps. The majority of the existing work effort will conclude in 2007. This presents a serious funding need that must be addressed to continue the current work effort moving forward (both to continue the Mercury Program and to develop performance measures).

Ecosystem processes and effects

Our understanding is limited regarding how environmental factors facilitate or inhibit methylmercury production and how, for example, wetlands habitat restoration might alter biotic exposure to methylmercury. As the current set of mercury-related projects winds down, the important next steps would likely include: (1) development of pilot projects utilizing the new knowledge base to investigate management options at different types of wetlands, (2) refinement of conceptual models, and (3) continued development of a comprehensive set of indicators concurrent with the work on conceptual models. Further work could also investigate the relationships between mercury concentrations (both total and methyl mercury) in the water column and concentrations in animal tissues. This work would provide information for performance measures and indicators. Funding sources and agency staffing for these activities have not been identified.

The draft TMDL for mercury in the Delta (Central Valley Water Board) is recommending that wetlands managers characterize their runoff and determine whether methylmercury is being produced. This is part of a larger strategy to manage wetlands to minimize production of methylmercury and has clear relevance to habitat restoration projects. In such projects there may be opportunities to use “hypothesis-driven design” or changes in management practices to improve understanding of how management actions can help control of methyl and total mercury loads to the Bay-Delta. .However, at the present time there is no staffing identified within the CALFED implementing agencies to provide the technical guidance and coordination required to link habitat management activities with mercury investigations.

Human heath

Although there are ongoing activities which could contribute information for indicators relating to human health and risk communication, there are not currently resources available for preparation of performance measures per se. There is information available on mercury-related risks to humans consuming fish and shellfish high in mercury concentrations. Where data are adequate, the Office of Environmental Health Hazard Assessment (OEHHA) can issue advisories for the sport-fishing public. A CALFED-funded project that concludes in 2007 currently supports OEHHA staff in developing advisories for mercury in the Sacrament River and North Delta and the San Joaquin River and the South Delta. This same funding enables CDHS to provide public outreach and risk communication about the OEHHA advisories. Currently there are no staff resources to address the CALFED-funded after 2007, when the current CALFED contract ends.

Focused monitoring to address human health and risk communication can augment the work being done by CDHS and OEHHA. Some of the data needs include tissue analysis of fish consumed by people and wildlife in areas where consumption and capture occur, identifying and characterizing populations that are highly exposed to mercury, determining the rates and amounts of fish consumed, assessing actual exposure to mercury, identifying effective risk communication methods, and evaluating the effectiveness of these methods in conveying risk information. A fish consumption study for the Delta would be of particular value in developing appropriate indicators and performance measures for mercury. Funding and staff to pursue these information gaps are not currently available.

Summary of mercury resource needs

A number of agencies are currently involved in mercury-related work (e.g., the SWRCB and Regional Water Boards, CDHS, CDFG, OEHHA, U.S. FWS, USGS, and U.S. EPA). . Although OEHHA is not an implementing agency for the CALFED Program, this agency's fish consumption advisory program is key for risk communication issues. In addition to the Water Quality Program agencies, other agencies whose participation is important are the Ecosystem Restoration Program implementation agencies.

Current staffing is inadequate to support further work related to performance measures. Additional resources for the implementing agencies, including the California Department of Fish and Game, will be needed to build on current contract work scheduled to end in 2007. Priorities are: linking mercury monitoring and science to "driver" projects in the field, addressing data gaps, improving conceptual models for the drivers, assessing watershed management activities with respect to total mercury and methylmercury loads, investigating the processes of mercury methylation, and monitoring.

One staff role which could be of particular value is a "mercury coordinator." This position was initially recommended by the Mercury Strategy to serve as "scientific leader, facilitator, communicator, and point of contract on mercury issues for the Bay-Delta Program." A recent CALFED Program mercury workshop has also emphasized the importance of a coordinator.

Project (grant) funding is needed for:

- Pilot projects and data gaps (resulting data also contributes to indicator and performance measure development) - $7M
- Delta fish consumption study (resulting data also contributes to indicator and performance measure development) - $3 M.

Resources needed for the Levee System Integrity Program

The implementing agencies for the CALFED Levee program (CA Dept. of Water Resources, US Army Corps of Engineers, and CA Dept. of Fish and Game) do not have the staff capacity to work on the development and reporting of indicators and

performance measures for the program. Work will not progress in a timely manner unless additional resources are provided and staff dedicated to this effort.

The resources being requested are one full-time person that could do most of the work and coordinate with other efforts, advised by a multi-agency technical advisory team. The technical advisory team would meet approximately ½ day per month, with some additional time for reviewing and commenting on materials. Therefore, each member of the technical advisory team would need to contribute about 10 days per year toward this effort – over the next year. The suggested make-up of the technical team should be 4 state staff (2-DWR, 1-CBDA, 1-DFG), 3 federal staff (2-USACE, 1-USBR) and 3-4 representatives of the reclamation districts (3 consultants). Funds would be needed to pay the Reclamation District consultants for their participation in the effort (approx 10 days per year). In the future, funds would be needed for a long-term monitoring program and staff for data compilation, analysis and reporting.

Tasks to be completed in 2006-2007 with additional resources:

- Use relevant information from the DRMS study to apply toward indicators and performance measures
- Refine conceptual / quantitative models needed to link drivers and outcomes
- Develop measurable meaningful indicators to improve our understanding of the system and report on progress towards goals.
- Evaluate and analyze existing data and monitoring programs – identify gaps
- Develop a long-term monitoring program needed to report on indicators, including funding needs and methods
- Identify key research needs to improve our understanding of the levee system and risks
- Develop a web-based information report that includes any existing data, conceptual or quantitative models, relevant research and white papers, including GIS-based data.

Summary of resources needed for Fiscal year 2006-2007 for Levees

Agency	Description	PY	Approx cost
DWR	Team Leader	1	
DWR	Technical Advisors (2 @ 10 days ea)	.08 PY	
USACE	Technical Advisors (2 @ 10 days ea)	.08 PY	
DFG	Technical Advisor (1 @ 10 days)	.04 PY	
USBR	Technical Advisor (1 @ 10 days)	.04 PY	
CBDA staff	Technical Advisor (1 @ 10 days)	.04 PY	
Reclamation Districts	Technical Advisor (3 @ 10 days ea)	.12 PY	
	Total	**1.4 PY**	

Resources needed for the Ecosystem Restoration Program:

The ERP implementing agencies (FWS, DFG, NMFS) currently do not have adequate resources (i.e., staff and funding) to work on development of performance measures for the program. Work cannot progress in a timely manner unless additional resources and staff are dedicated to this effort.

This section provides a general overview of the resources needed by the ERP implementing agencies to develop rigorous, science-based ecosystem performance measures. The resources requested would include a champion to coordinate the effort (ERP agency staff) and a performance measures collaborative to keep the momentum going. Furthermore, other supporting agency and non-agency staff would be available, as needed, to support this effort. The performance measures collaborative would be a substantial effort that must take into account several lessons learned by other programs that have initiatives to develop indicators/performance measures, including:

- Realize at the outset the amount of time it takes to develop appropriate science-based performance measures and products
- Understand who the target audience is and continue to communicate with them
- Involve a wide range of interests and stakeholders from the beginning (don't do it in a vacuum)
- Define the questions and issues early
- Use information that already exists regarding performance measure development for a particular program
- Develop appropriate conceptual models that address the need of the performance measures
- Select performance measures with clear and direct linkages between the indicators and results (e.g., management decisions, program funding, informing the public/policy makers, etc.)
- Design for flexibility (replacement indicators) if an indicator does not produce meaningful results
- Understand and design communication documents (reports, fliers, websites, etc.) for a range of audiences (scientists, managers, public, and policy makers, etc.).

Once these questions/considerations can be addressed by the performance measures collaborative, a more detailed description of the resources required can be developed. However, to provide a preliminary estimate of resources needed for the development of ERP performance measures, we anticipate the following staff are needed (at a minimum):

Summary of minimum staff resources needed for ERP performance measures development.

Agency	Description	Full time equivalent staff	Approximate cost (18 months)
ERP	Team Leader*	1.0	$193k
FWS	Collaborative member	1.0	$193k
DFG	Collaborative member	1.0	$193k
NMFS	Collaborative member	1.0	$193k
Resources Agency (Science Program staff)	Collaborative member	1.0	$193k
FWS	Technical Advisors (2 @ 23 days ea)	0.25	$48k
DFG	Technical Advisors (2 @ 23 days ea)	0.25	$48k
NMFS	Technical Advisors (2 @ 23 days ea)	0.25	$48k
Resources Agency (Science Program staff)	Technical Advisors (2 @ 23 days ea)	0.25	$48k
Total staff		**6.0**	**$1.16M**

* Team leader to be determined. Leader will be from DFG, FWS, or NMFS.

This is a minimum estimate. It is anticipated that up to 10 full time equivalent staff may be needed to develop initial performance measures over the next 18 months, at a cost of $1.93M.

In addition, $320k to $540k is estimated for technical assistance contract needs.

Chapter 6: Next Steps and Time Frame

Water Supply Reliability:

Recommended Next Steps

1. Coordinate with Ecosystem Restoration and Water Quality Program agencies to ensure that initial targets are established for water supply volume, flows and timing to support CALFED ecosystem and water quality goals. It should be made clear that these targets may change in the future as on-going and planned research activities are completed.
2. Coordinate with the California Water Plan update, Delta Vision, and DRMS processes to include Delta risk management and Delta sustainability information.
3. Coordinate the performance measures proposal to the BDPAC Water Supply Subcommittee to allow it to provide recommendations to the BDPAC on how to proceed.

Drinking Water

Next steps

1. Coordinate with/support of Central Valley Drinking Water Policy: (i) update water quality database, (ii)complete and refine conceptual models to form basis of watershed performance measures, and (iii)define health basis of potential watershed standards. The items (i) and (ii), without additional resources, will be completedby early 2007, dependent on continued commitment of CALFED staff resources.
2. Support CALFED Water Quality Program's Final Program Assessment, which both synthesizes watershed information and develops conceptual models of linkages between Delta surface water and treated water quality. Staff in CDHS and CALFED are working on identifying these treatment plants and determining whether representative treatment categories can be created for conceptual model purposes. Completion by the end of 2007 is dependent on availability of CALFED and CDHS staff.
3. In order to complete comprehensive data assessments, develop a strategic monitoring plan (to prioritize data needs), and develop performance indicators with existing information by June 2007, additional resources are needed at each implementing agency (CDHS and SWRCB).
4. There is also need for additional detail on the Delta hydrodynamics driver, including better bathymetry, elevation, and flow data. Our understanding of the transport of constituents through the Delta is only as good as this information, and additional resources should be dedicated to this.

Baseline activities (without additional resources)

The first two items under next steps are underway. Currently, performance measure information is extracted from information developed therein.

Toxicity

Next steps:

1. Update information developed for the "Strategy to Address Toxicity of Unknown Cause" (2002). This activity would retrieve information, assess the information being generated through current programs (see below, for example), identify toxicity data gaps and refine procedures, and prepare a plan for further work on toxicity, including a design for expanded monitoring. Additional staff would be needed at the Central Valley Water Board and California Department of Fish and Game.
   To complete this task by the end of 2007, additional staff would be needed at the Central Valley Water Board and California Department of Fish and Game. Without additional resources, approximately 25% of Stap 1 could be covered over the period of a year. However, the utility of this work given the pressing need for assessment of information being generated is questionable.
2. Using information from Task 1 and supporting work from the POD investigations, refine conceptual models characterizing toxicity mechanisms and effects in an ecosystem context.
   There are no existing resources for Task 2. This task would require someone to coordinate a technical group focusing on conceptual models.
3. Fund additional biomarker research and investigate incorporation of biomarkers as indicators of toxicity.
   Task 3 could be funded through research grants (cost tbd). However, currently no funding source has been identified for this task.

With no added resources, there will not be a system-wide compilation and analysis of current toxicity data; existing practices for reporting individual research and monitoring projects would continue. Current programs support some monitoring, toxicity profiling and TIEs but these activities are limited in geographic scope and purpose, and, in particular, do not provide for coordinated and comprehensive assessment.

Baseline activities:

1. Some monitoring is required through regulatory programs such as NPDES permitting and irrigated lands.
2. The Sacramento River Watershed Program sponsors some monitoring and assessment but is not supported by permanent funding.
3. The Surface Water Ambient Monitoring Program (SWAMP) supports some limited toxicity monitoring in localized areas.
4. In the Bay region, the Regional Monitoring Program addresses toxicity.
5. POD supports special studies for FY 2006-2007.
6. Some grants issued by the State Board and CALFED for water quality-related work will generate data. Some of these activities are tracked by the Central Valley RWQCB.

Mercury

Next steps:

1. Compile, synthesize, and assess information developed through CALFED-funded grants and related mercury projects; identify data gaps, refine conceptual models, and identify further research needs. Focus this activity on key drivers of mercury methylation and biotic and human exposure.
2. Develop protocols and guidance for (1) key factors to consider when designing a hypothesis-driven restoration project, and (2) methyl mercury monitoring associated with activities such as watershed management, wetlands habitat restoration in the Delta and habitat restoration in upstream sites with high mercury levels.
3. Continue biosentinel and sport fish monitoring and regional monitoring of methyl and total mercury in water and sediment; continue work on human consumption of contaminated fish and effectiveness of risk communication. Monitoring should provide more complete coverage of the Delta and upstream waters for both ecosystem and human health concerns.
4. Identify methyl mercury sources from wetlands, agricultural runoff, and urban stormwater.
5. Provide support for studies designed to evaluate methods for the reduction of loads of total and methyl mercury using management activities/best management practices (e.g. restoration, wetlands, floodways, agriculture, urban runoff, water conveyance and storage). Identify and implement opportunities to design habitat management and restoration projects to test hypotheses regarding methylation processes.
6. Develop best management practices, pilot studies and implement control programs.

Current staff resources to support the activities identified above or to further develop CALFED Program performance measures are limited to certain “baseline activities” listed below. Additional resources are needed to synthesize and build on current contract work, scheduled to end in 2007,that offers a scientific and information basis for performance measures. At a minimum, a mercury program coordinator could provide direction for these activities.

There are staff to continue some portions of the baseline activities 4-6 (below).

Baseline activities:

1. CALFED-funded grants investigating aspects of mercury will wind down in 2007 (see list at: http://www.delta.dfg.ca.gov/erp/docs/wq_mercuryissues/List_of_Mercury_Projects.pdf).
2. The Science Program conference in fall 2006 will survey mercury work accomplished to date and projects underway.

3. In spring 2007 an Ecosystem Resoration Program workshop is planned to further review projects and information developed since the inception of the Mercury Strategy (December 2003), and to discuss appropriate next steps.
4. Mercury monitoring is conducted in the context of some regulatory programs (NPDES permits) and certain ambient monitoring programs. (See summary prepared for the SWAMP; Jay Davis, SFEI.)
5. The San Francisco Bay and Central Valley Water Boards are developing TMDLs and control programs for methyl mercury. The Central Valley Water Board's work includes mass balances for the Delta and tributaries. Special studies include evaluating methyl mercury from Delta islands and marshes in Mud Slough and the Yolo Bypass. (However, follow-through work on control measures. pilot studies, and control program implementation are not funded baseline activities.)
6. In the field of human health, OEHHA uses available fish tissue data as the basis for public health advisories; CDHS conducts public outreach and risk communication based on the advisories.