

Recommended Stage II Program

This section summarizes the structure and tasks recommended to develop an integrated monitoring assessment and research program for the Bay/Delta and its watershed. The core program includes five tasks to be completed over nine months at a cost of approximately \$1.8 million. The details of each task are described below, and Figure 3 shows the timelines for all recommended tasks.

Stage II will be managed by a small Steering Committee consisting of CALFED and agency staff and stakeholders. With the exception of a representative from SFEI, Steering Committee members' salaries and expenses will be covered by their agencies or affiliations.

As illustrated in Figure 2, the Steering Committee will oversee completion of all recommended tasks. Participation on the Steering Committee will require a major commitment of participant time, and supporting organizations must agree to that commitment. It is expected that much of the work necessary to develop a CMARP will be completed by technical teams (and sub-teams for some programs) established to consider monitoring assessment, and research needs for each of the CALFED common programs. Participants on the technical teams will include individuals from the CALFED agencies, stakeholder organizations, and academic institutions as appropriate. In addition to the technical teams, two committees, a Data Management Committee, and a Data Analysis and Reporting Committee, will be established to lead completion of these key project elements. Finally, the Steering Committee will continually interact with CALFED program managers, and CALFED agency program managers. This interaction will occur through direct meetings, through individual assignments to various technical teams, and through completion of directed assignments.

Task 1- Refine Goals, Objectives, and Needs

The fundamental mission of the CALFED Bay-Delta Program is to "... develop a long-term comprehensive plan that will restore ecological health and improve water management for beneficial uses of the Bay-Delta system." The specific objectives of this program, still under development, currently include the following four primary considerations:

1. to provide good water quality for all beneficial uses;

2. to improve and increase aquatic and terrestrial habitats and improve environmental functions in the Bay Delta to support sustainable populations of diverse and valuable plant and animal species;
3. to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system;
4. to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees.

Activities during Stage II will begin with a review of the established CALFED goals and objectives for all six common programs, and work with agency staff and stakeholders to identify CALFED agency goals and objectives for existing monitoring and research programs. Individuals assigned to this task will work to further refine these goals and objectives so they can direct the development of an CMARP.

The goal of any monitoring program is to produce information on the effectiveness of actions that is useful in making management decisions. This goal is enabled by ongoing two-way communication between scientists responsible for designing and implementing monitoring programs and the users of the monitoring information. Ensuring this communication occurs is a crucial task that will be addressed during Stage II. The CMARP Steering Committee will work with the CALFED program managers, agency staff, stakeholders, the scientific community, and the general public to further refine expectations and goals of the efforts to collect monitoring information, which will feed back to the development of the monitoring, assessment, and research strategies. The process for identifying the specific questions to be addressed by an CMARP would be achieved through the following activities:

1. Review information already collected during CALFED problem identification workshops, and in CALFED documents.
2. Review documents to be prepared by the CALFED program managers for each common program that provide detailed descriptions of the program monitoring and research needs as envisioned by CALFED staff and their respective stakeholders.
3. Identify goals and objectives for existing CALFED agency monitoring and research programs.

4. Review existing, relevant, peer-reviewed scientific literature to achieve an appropriate level of scientific understanding of the Bay-Delta and its watershed.
5. Consult with agency staff and stakeholders to specify the problems already identified and to define expectations and goals for information necessary to determine the state of each problem, in priority order;
6. Identify relevant laws, regulations, and permit requirements that include monitoring requirements;
7. Form a focused review group composed of stakeholders, CALFED program managers, and technical experts for facilitated discussions aimed at synthesizing information in items 1-5 to develop clear goals objectives, and needs for the CMARP.

This process, as with all components of the CMARP, will be iterative. It is expected that specification of goals and objectives will be sufficiently refined over the first three months of Stage II, although work to refine the program goals and objectives will likely continue throughout Stage II. The results of this task will serve as a foundation for all other work completed in Stage II.

Timeline: One month: compile CALFED goals and objectives
 Three months: compile Agency major program goals and objectives
 Nine months: complete synthesis of goals and objectives

Funds: \$ 25,000

Lead: CALFED, EPA, and SFEI

Task 2 - Developing a Conceptual Framework

The activities recommended under this task are intended to address the conceptual frameworks for all six CALFED common programs. The description that follows, however, focuses on the ecosystem restoration program, as an example of what this task is intended to achieve and how the activities would be accomplished. The ecosystem restoration program was chosen as the example, because of the large body of information that currently exists, and because CALFED has already devoted substantial effort to the development of a conceptual framework for the ecosystem restoration program.

Conceptual models are needed to incorporate current thinking by Bay-Delta scientists about how the ecosystem is structured and how it functions, about the effects of environmental stressors on relevant ecosystem processes, and about the effects of specific rehabilitation actions. The importance of conceptual models in ecosystem monitoring and assessment has been aptly described in a report issued by the National Research Council, *Managing Troubled Waters - The Role of Marine Environmental Monitoring* (National Academy Press 1990):

A description (i.e., a conceptual model) of the cause-effect links between human activity and anticipated environmental change is the central feature in developing specific questions to be answered [in a monitoring program]. It is the conceptual model that is the means of predicting environmental change and the results of management action - predictions that efficiently direct and focus monitoring efforts.

Conceptual models describe links among the resources at risk: the physical, chemical, and biological attributes of the ecosystem; and human and natural causes of change. The understanding that results permits testable questions to be clearly stated and ultimately evaluated. By providing a context for organizing existing scientific understanding, a conceptual model also identifies important sources of uncertainty.

Although many of the questions arising from a review of existing programs and CALFED documents were developed from implicit conceptual models of how the system works, many of these models need to be made explicit. Explicit conceptual models are not only useful in designing a future monitoring program, but are also useful to document the basis for earlier decisions about program design. Providing an objective basis through explicit conceptual models for both the design of a monitoring program and documentation of earlier decisions is a feature essential to development of an CMARP using an iterative approach.

The CALFED Indicators Group has undertaken construction of broad ecosystem models, based on the interconnections among the issues of water quality, hydrology, sediment supply, nutrients, and migrating species as they bear on habitats, ecosystem processes and interactions, and stressors.

The CMARP Steering Committee will work with the CALFED Indicators Group, the ERPP Strategic Plan core drafting team, and local academic and private sector experts to refine the broad models into appropriately detailed conceptual models to address the following objectives:

1. identify the highest priority issues to be addressed in the monitoring program (from system-wide and restoration-project-specific);
2. clarify both the goals and expectations of a monitoring program;
3. develop specific, testable questions for further research;
4. identify possible cause-effect relationships;
5. develop predictions i.e., how a particular environmental perturbation is expected to affect a monitored parameter and/or how a specific management action might affect an important resource; and
6. help identify gaps in knowledge where further research is needed.

During Stage II, the CMARP Steering Committee, in collaboration with the CALFED Indicators Group the ERPP Strategic Plan core drafting team, and CALFED program managers would accomplish the following as a start to the development of conceptual frameworks for CALFED's six common programs:

- A. Organize at least two workshops between April and June 1998 to summarize the status of Bay/Delta, and watershed conceptual modeling, including the work of the CALFED Indicators Group; to begin listing and prioritizing the major issues to be addressed in both system-wide and restoration-project-specific monitoring programs; to hear presentations from one or more experts about how monitoring, assessment, and research programs have been successfully developed elsewhere and how these programs have used conceptual models; and to develop recommendations about the next steps that should be taken in developing conceptual models that will facilitate achieving the CMARP goals and objectives. A written summary of the workshop proceedings and recommendations will be prepared and distributed for review by CALFED participants. A final report will be made available to all interested parties.

Timeline: Three months

Funds: \$10,000

Lead: DWR and USGS

- B. Organize several working panels of scientists to summarize our current understanding about the system and the effects of the six CALFED common programs. Work on this task will begin with the Ecosystem Restoration Program because it is further along in these efforts than the other five common programs. The working panels will focus on developing the conceptual model framework necessary to design effective monitoring programs and to identify data and information gaps that need to be the focus of additional research efforts. The workshops may include both local and national scientists with experience in other systems, and scientists representing stakeholders. Each of these workshops would culminate in the preparation of a "white paper" discussing the state of knowledge in the workshop subject area, posing testable hypotheses and unanswered questions; and recommending appropriate strategies for both monitoring and research programs.

Timeline: Six months

Funds: \$300,000

Lead: CMARP Steering Committee

- C. Produce an overall report describing the conceptual framework of the CALFED six common programs upon which the CALFED monitoring, assessment, and performance measurement programs will be based. This report will include conceptual models, text to summarize the known structure and function of the ecosystem, description of scientific questions and hypotheses upon which monitoring and focused research will be based; and specific recommendations applicable to monitoring program design, such as identification of key parameters and functional linkages. The level of detail will vary among the six common programs, with the most detail expected for the conceptual framework associated with the Ecosystem Restoration Program Plan.

Timeline: Three months
Funds: \$50,000
Lead: CMARP Steering Committee

Task 3-Monitoring Program Design

This section addresses two subjects. The first is initial development of a long-term CMARP, which is the major focus of Stage II. The second is the development of an institutional process designed to work in early implementation (1-3 years) specifically addressing Category III project monitoring.

Successful design of a long-term integrated monitoring assessment and research program depends upon identifying focused questions, which are based on clear statements of goals and objectives. Preliminary work, including definition of goals and objectives, conceptual model review, knowledge of existing programs and pilot monitoring are necessary to refine questions and technical aspects of monitoring designs. Some of this work (e.g. defining goals and objectives, conceptual model development) is described above in Tasks 1 and 2. The remaining work is described here.

A. Inventory Existing Monitoring Programs

This task will identify and assess existing monitoring programs in the Bay/Delta and its watershed. Monitoring needs determined through Tasks 1 and 2 can then be matched with efforts in existing monitoring programs to identify where integration of existing monitoring programs can fulfill current and future needs. In addition, this analysis will serve to identify redundancies, as well as gaps in monitoring where augmentation is needed.

This task will build on efforts conducted by CAMP, SFEI, and DWR's Municipal Water Quality Investigations program among others. The product will be a metadata information system providing program-specific information on program objectives, questions addressed through monitoring, spatial coverage, attributes monitored, location of sampling sites, frequency of monitoring, primary contact, reporting scheme, and funding. The system will be designed for continuous use for coordination, information on program status, and program gap analysis.

Process: SFEI will take the lead in development of the monitoring metadata system. Stakeholders, CALFED and CALFED agency staff will review a prototype design of the product and provide input as necessary until development is completed.

Timeline: Six months

Funds: \$250,000

Lead: SFEI

B. Develop Monitoring Elements

The goal of this task is to narrow the focus of monitoring from the vast number of questions and parameters that could be examined to those that respond to the specific CALFED information needs. This task will run in conjunction with Tasks 1 and 2, addressing currently known needs of CALFED (as provided by descriptions of monitoring needs from CALFED program managers) and CALFED agencies. Additional information derived from Task 2 and the previous tasks (inventory of existing monitoring programs) will be used to subsequently modify monitoring elements to ensure their effectiveness.

Based on information obtained during Stage II, an integrated monitoring assessment and research program that focuses on CALFED's needs (ecosystem restoration, water quality, watershed management, levee stability, water transfers, water use efficiency, conservation strategy, Category III project monitoring, and mitigation monitoring) and CALFED agency needs will be developed. The strategy will be to identify current needs, identify and assess existing programs, and identify monitoring gaps. This information will be used to recommend modifications to the existing programs, to improve monitoring efficiency, and to fill the monitoring gaps. Quality assurance and control programs will be reviewed and a QA/QC element will be established to ensure consistent data collection and storage protocols. A process for linking individual databases will be described to facilitate comprehensive data assessment. The product will be a document identifying monitoring objectives, focused questions, specific monitoring elements to address the questions, and will include a recommended comprehensive monitoring and assessment program.

It is expected that many existing monitoring programs and elements will be recommended for integration into the proposed program. As mentioned previously, it is also expected that the level of detail for the recommended monitoring and assessment program will

vary among the six common programs, due largely to the level of available information and the phasing of program implementation. For example, Stage II results will likely include a fairly detailed description of a recommended monitoring and assessment program for the Ecosystem Restoration Program. Whereas Stage II may include only a series of recommendations for monitoring and assessment associated with the Water Transfers Program, ready for implementation once the program begins. The recommended monitoring and assessment program for the Levee Stability Program may be something in between.

Process: Technical work teams comprised of program managers of existing programs, agency staff, and stakeholders will meet under the direction of the CMARP Steering Committee to: 1) determine program needs; 2) assess existing monitoring programs to increase efficiencies and reliability; 3) identify whether the needs can be met with existing monitoring programs, or if new programs are required; and 4) determine how best to coordinate the existing programs. Such a strategy has already been proposed for water quality monitoring (Inquiry Proposal for CALFED Category III funding), by which IEP's water quality monitoring program, SFEI's Regional Monitoring Program, the Sacramento Watershed Program, DWR's Municipal Water Quality Program, the USGS' estuarine and river-basin monitoring program and the Central Valley and San Francisco Regional Boards water quality programs would be coordinated and augmented to meet CALFED's needs. The technical work teams would be responsible to the CMARP Steering Committee and all work would be reviewed periodically by a focused group of stakeholders, CALFED staff and agency staff. The CMARP Steering Committee will be responsible for organizing and collating all work into a useable product that will constitute recommendations for an integrated environmental monitoring program.

The monitoring program will be established to accommodate any compliance monitoring required as part of the conservation strategy or mitigation for CALFED actions and projects. For example, permits for a tidal marsh restoration project required as compensatory mitigation for CALFED actions may include specific monitoring and reporting requirements. Monitoring and reporting under the CMARP would be adjusted to fulfill these requirements.

Timeline: Nine months

Funds: \$415,000

Lead: CMARP Steering Committee and CALFED Agency
Program Managers

C. Develop a process for data management

Data management is important to all aspects of the CMARP data collection and dissemination processes. Ultimately, the CMARP must make data/information readily accessible to CALFED Bay/Delta and agency staff and stakeholders. Data will also need to be updated regularly to meet the different program reporting time-lines in a way that allows information from one program to be related to another.

The purpose of an integrated database system is to allow for comprehensive, data management that permits broad access to biological, water quality, hydrodynamic, and physical data from the Bay/Delta and its watershed. The intent of the CMARP database project is not to duplicate or replace the efforts of any entity involved, but to provide a comprehensive, integrated source of data for scientists and decision-makers. Important features of such a database may include:

1. The data can be spatially referenced through a Geographic Information System.
2. The data base would include data from public agencies, municipalities, and larger private companies and consultants.
3. Simple queries may be conducted "on-the-fly" by scientists through menu-driven or graphical user interfaces, while more complex queries can be generated by each entity's database programmers.

The CMARP will ultimately include numerous data providers whose data management capability will vary substantially. A major cost of managing data from different groups will be developing a mechanism for obtaining or providing access to this data, in a standardized format, with adequate QA/QC and in time to meet program objectives. To manage this very large and diverse volume of information, a data management "infrastructure" will be recommended. This infrastructure will provide the ability for the data providers to manage their data locally, integrate data with other data collected in the system, and provide comprehensive access to all relevant data.

Process: A committee of technical experts (including agency staff and stakeholders) will review current data management systems, develop components necessary to provide the best system for managing data collected under an CMARP, and develop a prototype upon which to base a complete system. Specific tasks include:

- develop a list of data providers and their current information technology capability;
- determine the cost associated with obtaining and providing access to these data sources;
- determine how comprehensive access of existing data systems should occur;
- develop a process and estimate the cost for obtaining data from data providers;
- determine the cost of computer applications that are necessary to turn data into information; and
- evaluate GIS needs.

At the end of Stage II we will demonstrate an expandable system capable of managing data from a remote data provider where data management is conducted locally by the provider, but with ready data access by other parties. This access is essential to an integrated monitoring and assessment program consisting of a large number of separate entities.

Timeline: Nine months

Funds: \$100,000

Lead: CMARP Steering Committee and CALFED Agency Program Managers.

D. Develop a Process for Data assessment and Reporting

Technically sound, understandable reports released in a timely manner provide the all-important feedback about monitoring results to managers, regulators, and stakeholders. Appropriate interpretation and display must accompany monitoring data. Annual monitoring reports are envisioned, which include both data analyses and interpretive graphs and text.

Process: The Steering Committee will appoint a workgroup to design a decision support system* that will integrate data collection, assessment, and reporting. The work group will assign a project leader to:

1. review information needs of CALFED program managers, agency staff, and stakeholders;

2. review decision support systems used in other locations such as Puget Sound, Chesapeake Bay, and South Florida;
3. hold one or more workshops with local and outside scientists and managers to synthesize the information gained from steps 1 and 2 above;
4. submit a recommended plan to the Steering committee; and
5. work with the CMARP Steering Committee to establish an outside scientific review panel to perform periodic review of the program.

Timeline: Within the nine-month period identified in Task 3B

Funds: \$100,000

Lead: CMARP Steering Committee and CALFED Agency Program Managers.

E. Category III Monitoring Institutional Process

A short-term institutional process is needed now to coordinate monitoring of approved Category III projects. To make Category III monitoring more effective, CALFED is awarding a grant to develop guidelines and protocols to ensure that:

- monitoring plans associated with Category III projects are sufficient to identify whether or not project goals and objectives are being met; and
- a process is established for the orderly flow of data collection to information from all Category III project monitoring to provide resource managers with information on individual project effectiveness and cumulative project impacts (both positive and negative).

Process: The Category III monitoring project began in Stage I with funding from a Category III grant to establish a dedicated chair/coordinator position. The chair is assembling a workgroup to review existing and proposed monitoring elements of Category III projects and develop recommendations for standardized monitoring protocols. The workgroup will also prepare recommendations for data management and information dissemination. Additional funding will be needed in Stage II to support the efforts of the workgroup throughout Stage II.

Timeline: Three months for process development

Funds: \$200,000 (not including the \$100,000 previously granted by CALFED).

Lead: CMARP Steering Committee and CALFED Category III Staff

Task 4 - Design a CALFED Focused Research Program

This section describes the recommended approach for design of a focused research program and resumption of a research enhancement program. As previously stated, the goals of the focused research program are to reduce areas of scientific uncertainty affecting program actions, to identify cause and effect relationships, to corroborate relationships in conceptual models, and to provide information useful in evaluating the effectiveness of existing monitoring protocols and performance standards. The goal of the research enhancement program is to stimulate the involvement of the academic community in expanding our understanding of this complex system. The process described hereafter would be used to implement both programs.

CALFED needs a focused research program to support staged implementation of the six common programs, and to investigate causes of trends detected in monitoring data. As suggested by the list of example uncertainties in Appendix D, the common programs face a number of unresolved questions that may reduce the effectiveness of large-scale actions. The list illustrates the breadth of uncertainties, many of which are not being addressed by current study programs. If uncertainties are left unresolved, some CALFED actions could lead to funding projects that do not achieve the desired benefits, or worse, cause irreversible environmental consequences.

The general approach would be to develop and maintain a list of study questions, to objectively select and fund a group of focused research projects, and annually to evaluate and present new study findings to CALFED agencies and stakeholders. During Stage II a focused research program would be developed by involving the CMARP Steering Committee with the technical teams described in Task 3. The proposed design would be subjected to the normal CALFED approval process and summarized in a report during Stage II. The initial list of study questions would come primarily from:

- an assessment of management questions and study needs of CALFED's six common programs completed by the technical teams and facilitated by CMARP staff;
- the results of the 1997 Category III RFP process, which identified several information gaps;
- gap in knowledge identified in the conceptual models completed through Task 2; and
- the body of scientific literature on the estuary and its watershed (such as the technical report series of IEP, the Status and Trends reports of the San Francisco Estuary Project, the USGS bibliography of publications for the bay and delta, the State of the Estuary conference proceedings, and the SFEI Regional Monitoring Program annual reports).

The final list of study questions would address the most serious uncertainties related to implementing CALFED program elements. The list of questions would serve as the basis for soliciting proposals from the scientific community. During Stage II a proposal review and approval process will be designed that includes:

1. an anonymous peer review process;
2. a technical review panel composed of agency staff and stakeholders;
3. review by the CALFED integration panel; and
4. review and approval by the BDAC, CALFED Management Team, and the CALFED Policy Group.

In addition to integrating the research findings into the CMARP decision support system, an annual evaluation and presentation of new study findings could occur through:

- an annual presentation of progress by principal investigators of funded proposals at a CALFED science conference each September;
- presentations at the IEP annual conference in February; and
- technical reports and peer reviewed literature.

Research enhancement program. This program was begun by EPA's San Francisco Estuary Project and IEP about ten years ago. The program funded about 20 graduate students to work on problems judged relevant to the management problems of the bay-delta estuary. Although this program was less directed at management questions than the focused research program will be, it generated many worthwhile findings before it was discontinued for lack of funding. Given availability of CALFED funds, the CMARP Steering Committee would perform necessary staff work to resume this program with an appropriately expanded geographical extent and problem scope.

Stage II activities. The CMARP Steering Committee would undertake and/or oversee completion of the following tasks during the nine months of Stage II:

- A. A preliminary assessment of CALFED needs would be performed for each of the common programs. Program documents would be reviewed and program managers would be queried about the actions proposed and management questions associated with each program. Based on these queries and on the existing literature, a preliminary list of management and study questions would be created. This preliminary list would serve as a starting point for deliberations within the appropriate technical team. The lists emerging from the technical teams would then be submitted for review and approval through the usual CALFED process.

Timeline: Six months

Budget: \$200,000

Lead: CMARP Steering Committee

- B. One or more requests for proposals (RFPs) would be designed to solicit proposals for addressing the identified study questions. Similarly, the brochure for the research enhancement program would be revised to address CALFED's geographic extent and problem scope. These documents would be submitted to the CALFED approval process, as done for Category III RFPs.

Timeline: Three months

Budget: \$25,000

Lead: CMARP Steering Committee

- C. An anonymous peer review process, similar to that used by the National Science Foundation, would be designed to judge the technical merit and relevancy of the proposals, and to provide these results to the CALFED integration panel via an in-house technical review panel. A process for the identification and compensation of reviewers would be designed in consultation with appropriate academic institutions.

Timeline: Three months

Budget: \$25,000

Lead: CMARP Steering Committee

- D. An agenda for a first CALFED science conference would be devised, session chairs would be selected, and a preliminary program of invited presentations would be developed. The focus of the initial conference would be the state of scientific knowledge in the areas pertinent to CALFED's proposed actions, and presentations of early results of research projects funded with Category III funding. This draft program would be submitted for CALFED approval and funding. If approved, the conference would be held in 1999, and would be timed to coincide with release of the first RFPs.

Timeline: Three months

Budget: \$25,000

Lead: CMARP Steering Committee

- E. Results of these four tasks would be summarized in a report or in a section of the CMARP Stage II report.

Timeline: Three months

Budget: \$25,000

Lead: CMARP Steering Committee

Task 5-Develop an Institutional Structure for the CMARP

An extraordinary amount of coordination, collaboration and integration will be required for effective implementation of a system-wide CMARP that meets the needs of CALFED and other resource management mandates of the CALFED agencies. Much of the

monitoring required to fulfill the adaptive management needs of CALFED is already in place. Adjustments or expansions to existing programs will be needed, and for some common programs, new monitoring programs will be recommended. Because of the size of the system and the large number of monitoring programs already in existence, numerous agencies at the federal, state, regional and local levels, academic institutions, non-governmental organizations, and stakeholders will need to be involved.

It is unlikely that any one organization can implement an CMARP over the entire Bay/Delta watershed and its water management infrastructure. What may come of this planning process instead, is an 'umbrella' structure that would draw substantially on existing monitoring programs under numerous agencies and organizations, and assist those agencies and organizations in filling the gaps identified in the current system. The goal of this umbrella structure would be to ensure that an integrated program emerged from a myriad of inter-organizational coordination and collaboration efforts, that information for decision-making was reported from these programs in a timely manner, and that this information was clearly communicated to decision-makers and the public. The umbrella structure must, however, provide assurance that the needed monitoring and research will be completed.

During Stage II, the CMARP Steering Committee will develop recommendations for creating an institutional structure to implement the CMARP over the long-term. Because the actual program configuration will continue to evolve over the next several years, an emphasis will be placed on flexibility, insuring that new players can become fully involved as needed, and additional monitoring and research questions can be addressed as they are identified. The committee recommendations will be developed after examining the strengths and weakness of current cooperative working relationships, considering the information needs of the CALFED participating agencies, consulting with organizations that will be involved as partners in the CMARP, and consulting with stakeholders.

Timeline: Six months
 Budget: \$50,000
 Lead: CMARP Steering Committee

Figure 1. Listing of Some Factors Influencing Distribution and Abundance of Generalized Central Valley Chinook Salmon Stock

Life Stage	Factors		
Spawning/egg deposit	Barriers and effects of delays		Water temperature
	Flow (stability and rate)		Predation on adults and eggs
Incubation	Gravel permeability		Flow
	Water temperature		Dissolved oxygen
	Sediment/turbidity		Contaminants
	Egg quality		Disease
Early Rearing	Water temperature		
	Food supply (amount and quality)		
	Diversions		
	Availability of escape habitat		
	Competition and compensatory mechanism		
	Rearing location (in-river/estuary)		
Active Migration to Ocean	Fishing	Predation	Contaminants
	Diversions	Competition	Disease
	Water temperature	Barriers	Streamflow
	Delta hydraulics		
Ocean Rearing	Food	Water temperature	El Nino/La Nina
	Harvest	Predation	Disease/parasites
Return to Freshwater	Food reserves	Harvest	Barriers
	Availability of migratory areas		Streamflow

Figure 2. CMARP Stage II Information Flow Diagram. Goals, objectives, and policy issues are addressed through interactions among the Steering Committee, and CALFED and Agency staff and management. Data management, analysis and reporting, QA/QC protocols, and other analytical issues are addressed via other committees. Technical guidance on monitoring and research strategies comes from teams assembled in coordination with CALFED Program Managers and their existing technical teams. Core staff are also members of the technical teams. A Scientific Review Panel provides independent review of the Stage II results.

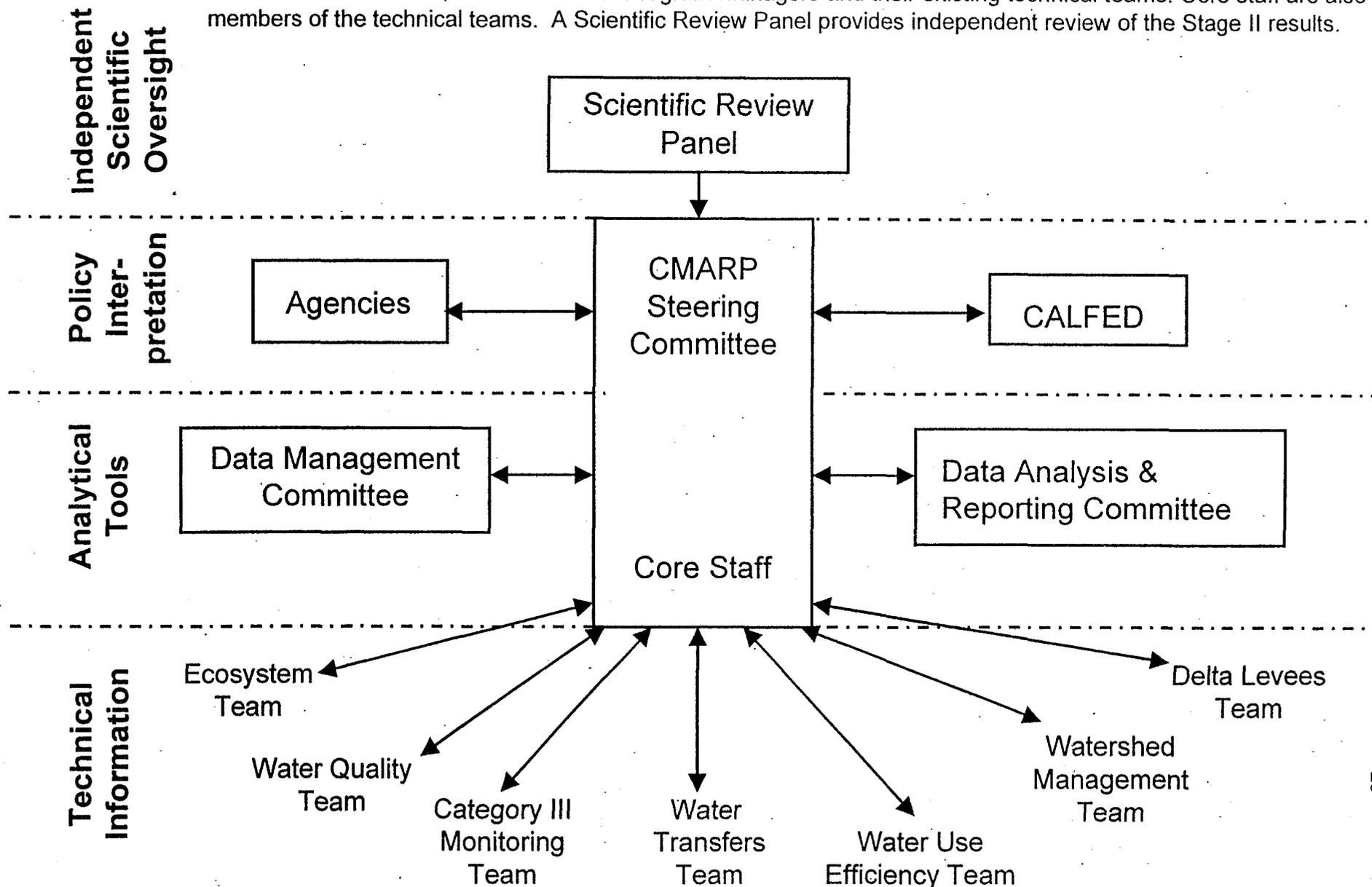


Figure 3. Timeline funding allocation and lead entity for CMARP Stage II

Task Number and Name	Funds requested	Lead	1998	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	1999
			Apr									Jan
One: Define Expect., goals & Obj.	\$25,000	CALFED/EPA/SFEI		Compile CALFED an	Agency Pgm. G & O							syn. Rept
Two: Develop a Concept. Framework.	\$360,000											
A. workshop on relevant exper.	\$10,000	DWR/USGS		report								
B. working panel summaries	\$300,000	CMARP							wht papers			
C. overall conceptual framework	\$50,000	CMARP										report
Three: Monitoring Prog. Design	\$1,065,000											
A. invent. Exist. Mont. Pgms.	\$250,000	SFEI							data sys.			
B. develop mont. Elements	\$415,000	CMARP/CALFED										report
C. develop data mgmt. process	\$100,000	CMARP/CALFED										demo sys
D. develop data report process	\$100,000	CMARP/CALFED										rept. Plan
E. Category III Monit. Process	\$200,000	CMARP/CALFED				wkgrp proc						
Four: Focused Research Program	\$300,000	CMARP										
A. Assess CALFED needs	\$200,000	CMARP							quest. List			
B. Design RFP's	\$25,000	CMARP									RFPs	
C. Peer review process	\$25,000	CMARP										Peer Rev.
D. Science conference	\$25,000	CMARP										Conf. in 99
E. Summarize four tasks	\$25,000	CMARP										report
Five: Develop. Institutional Structure	\$50,000	CMARP							rec. struc			
Stage II Summary Report		CMARP						interim rept				final report
Total requested Stage II funds	\$1,800,000											