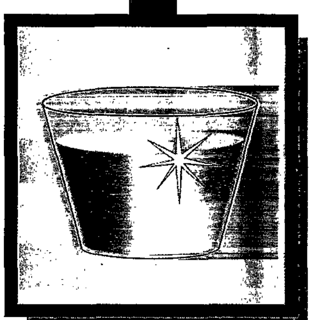
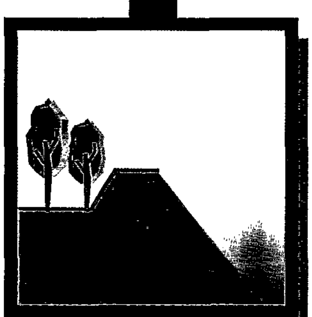
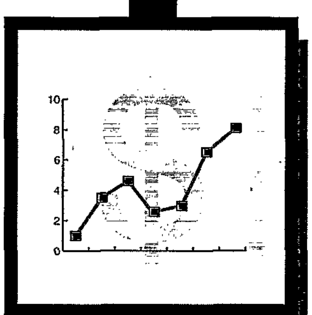


CALFED
BAY-DELTA
PROGRAM

Phase II Interim Report

Programmatic EIS/EIR Technical Appendix

March 1998

C-007571

CALFED PHASE II INTERIM REPORT

March 1998

CALFED Bay-Delta Program
1416 Ninth Street, Suite 1155
Sacramento, California 95814

Either we have hope within us or we don't. It is a dimension of the soul and is not essentially dependent on some particular observation of the world. It is an orientation of the spirit, an orientation of the heart. It transcends the world that is immediately experienced and is anchored somewhere beyond its horizons. Hope in this deep and powerful sense is not the same as joy that things are going well or a willingness to invest in enterprises that are obviously headed for early success, but rather an ability to work for something because it is good, not just because it stands a chance to succeed. Hope is definitely not the same thing as optimism. It is not the conviction that something will turn out well, but the certainty that something makes sense regardless of how it turns out. It is hope, above all, which gives the strength to live and continually try new things.

-- Vaclav Havel

EXECUTIVE OVERVIEW

At the confluence of California's two largest rivers, the Sacramento and San Joaquin, the San Francisco Bay and adjoining Sacramento-San Joaquin Delta (Bay-Delta)together form the largest estuary in the western United States. The Bay-Delta is a haven for plants and wildlife, supporting over 750 plant and animal species. The Bay-Delta supplies drinking water for two-thirds of California's citizens and irrigation water for over 7 million acres of the most highly productive agricultural land in the world.

There is a rich history of conflict over resource management in the Bay-Delta system. For decades the region has been the focus of competing interests--economic and ecological, urban and agricultural. These conflicting demands have resulted in several resource threats to the Bay-Delta: the decline of wildlife habitat; the threat of extinction of several native plant and animal species; the collapse of one of the richest commercial fisheries in the nation; the degradation of the Delta as a reliable source of high-quality water; and a Delta levee system faced with an unacceptably high risk of failure.

Even though environmental, urban, and agricultural interests have recognized the Delta as critical, for decades they have been unable to agree on appropriate management of the Delta resources. Consequently, the numerous "traditional" efforts made to address the Bay-Delta problems, including government decrees, private remediation efforts, and seemingly endless rounds of litigation, have failed to reverse the steady decline of the Delta as fish and wildlife habitat or as a reliable source of high-quality water.

A significant breakthrough in this ongoing conflict occurred in 1994, when state and federal agencies and representatives of the major interest groups signed the Bay Delta Accord. The Accord contained agreements on interim water quality protections for the Bay-Delta, on several procedural and substantive concerns under the state and federal endangered species acts, and on a multi-million dollar effort to address nonflow factors affecting ecosystem health in the Bay-Delta. The Accord represented the first successful attempt at a comprehensive approach to Bay-Delta problems, addressing environmental concerns about the ecosystem as well as providing more certainty and reliability for water users. The CALFED Bay-Delta Program (Program) is a continuation of the consensus-seeking, comprehensive approach to California water management issues hoped for in the Accord.

The CALFED Bay-Delta Program is an open, collaborative, state-federal-stakeholder effort seeking to develop a comprehensive long-term plan to restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. The Program is fundamentally different from previous efforts because it seeks to address ecosystem restoration, water quality, water supply reliability, and levee and channel integrity as co-equal program purposes. The Program is developing a comprehensive package of Program elements that, together, must:

- Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species

- Provide good water quality for all beneficial uses

- Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system

- Reduce the risk to land use and associated economic activities, water supply infrastructure, and the ecosystem from catastrophic breaching of Delta levees

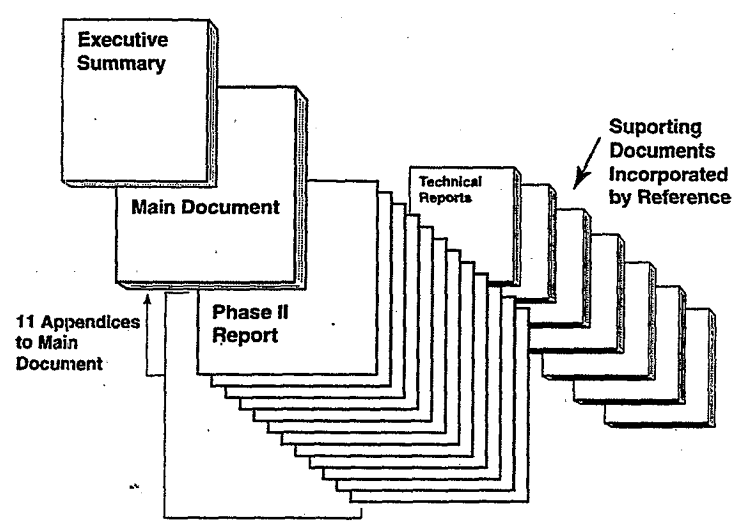
The unprecedented scope of the Program cannot be overstated. The vast geographic extent of the area under consideration, the variety and complexity of the hydrological and ecological process involved, and the magnitude of the potential economic consequences for California's enormous commercial, agricultural, and industrial base all combine to make this effort the most ambitious of its kind anywhere in the world. In the United States, only the well-known efforts at addressing environmental and institutional problems in the Chesapeake Bay and in the Florida Everglades can serve as comparisons.

The CALFED Program has used public workshops, an advisory council, technical work groups, and an interagency team to identify and evaluate potential long-term solutions. This work was divided into three discrete phases. In Phase I, completed in September 1996, the Program identified the problems confronting the Bay-Delta system, developed a mission statement and guiding principles, and devised three basic alternative approaches to solving the identified problems.

In Phase II the Program has refined the preliminary alternatives, is conducting a comprehensive programmatic environmental review, of which this report is a portion, and is developing an implementation strategy. A final environmental document is targeted for completion in late 1998.

In Phase III, beginning in 1999, the Program, including any additional site-specific environmental review and permitting, will be implemented over the next 20 to 30 years.

This Phase II Report is one of many supporting documents published in conjunction with the draft Programmatic



Environmental Impact Statement/Environmental Impact Report (EIS/EIR). The main body of the EIS/EIR provides a technically oriented analysis of the broad environmental effects that might accompany Program implementation. This Phase II Report describes the CALFED process, solution alternatives and the fundamental Program concepts that have guided their development, and analyses that have revealed the comparative technical advantages of each alternative. Finally, this report describes how CALFED will use analysis results in a public process to proceed to selection of a preferred program alternative by late 1998. This Phase II Report and the Executive Summary of the EIS/EIR are being widely disseminated. The full EIS/EIR, other technical appendices, and supporting technical reports -- comprising thousands of pages -- are available from CALFED.

Some basic concepts related to the Bay-Delta system and its problems have guided the development of potential CALFED solutions. These concepts are discussed in more detail in Chapter 2. First, for water in the system, the greatest conflict occurs when it is scarce. We can take advantage of this time value of water to store water in surface and groundwater storage in times of high flow in order to release it for agricultural, environmental, and urban purposes in times of shortage, when the greatest conflicts exist among the competing uses.

Second, many of the system's problems are interrelated, so the solution must be comprehensive; no single action or project can possibly resolve all of the conflicts.

The foundation of every CALFED alternative is the common Program elements: the ecosystem restoration program, water quality program, water use efficiency program, levee protection plan, water transfer policy framework, and watershed management coordination program. These common Program elements differ only slightly between alternatives. Each of the individual common Program elements is a major program on its own, and each represents a significant investment in and improvement to the Bay-Delta system. For example, the ecosystem restoration plan is the largest, most complex ecosystem rehabilitation effort ever undertaken anywhere.

A significant part of the overall performance of the CALFED Bay-Delta Program is attributable to the common Program elements. These common Program elements are described in more detail in Chapter 3, and full descriptions of each element are available in the technical appendices accompanying the Draft Programmatic EIS/EIR.

During the Phase II process, stakeholders have raised significant questions and issues about different aspects of the common Program elements. CALFED recognizes that addressing these questions and issues on common Program elements is fundamental to the success of the Program. In Chapter 3, we have included sidebar discussions of stakeholder concerns; in Chapter 3 and Chapter 5 we have laid out proposed processes for resolving these critical concerns.

The Program alternatives evaluated in this EIS/EIR fall into three basic approaches to solving the problems:

Alternative 1 - Includes programs for ecosystem restoration, water quality, levee and channel integrity, water use efficiency, water transfers, and watershed management coordination. In addition, Alternative 1 proposes existing Delta channels, with some modifications for water conveyance and various storage options.

Alternative 2 - Includes programs for ecosystem restoration, water quality, levee and channel integrity, water use efficiency, water transfers, and watershed management coordination. In addition, Alternative 2 proposes significant modifications of Delta channels to increase water conveyance across the Delta combined with various storage options.

Alternative 3 - Includes programs for ecosystem restoration, water quality, levee and channel integrity, water use efficiency, water transfers, and watershed management coordination. In addition, Alternative 3 includes Delta channel modifications coupled with a conveyance channel that takes water around the Delta with a various storage options.

Each alternative must satisfy six solution principles adopted by the CALFED Bay-Delta Program. Any acceptable solution will:

- Reduce major conflicts among beneficial uses of water
- Focus on solving problems in all problem areas. Improvements for some problems will not be made without corresponding improvements for other problems
- Be implementable and maintainable within the foreseeable resources of the Program and stakeholders
- Have political and economic staying power and will sustain the resources they were designed to protect and enhance
- Have broad public acceptance and legal feasibility, and will be timely and relatively simple to implement compared with other alternatives
- Will not solve problems in the Bay-Delta system by redirecting significant negative impacts, when viewed in their entirety, within the Bay-Delta or to other regions of California

In Phase II, the Program has performed technical analyses to determine how the three alternatives perform when measured against 18 distinguishing characteristics. All of the alternatives share a high level of performance by virtue of the program elements that are common to all three: ecosystem restoration, water quality, levee and channel integrity, water use efficiency, water transfers, and watershed management coordination. The distinguishing characteristics are intended to help CALFED and members of the public determine the relative performance levels of each alternative. The distinguishing characteristics:

More Critical Distinguishing Characteristics	Less Critical Distinguishing Characteristics
• In-Delta water quality	• Storage and release of water
• Export water quality	• Water transfer opportunities
• Diversion effects on fisheries	• South Delta access to water
• Delta flow circulation	• Total cost
• Water supply opportunities	• Habitat impacts
• Assurances difficulty	• Land use changes
• Operational flexibility	• Socio-economic impacts
• Risk to export water supplies	• Ability to phase facilities
• Consistency with the solution principles	• Brackish water habitat

Among these characteristics, some were found, through the evaluation process, not to vary greatly among the three alternatives, while other characteristics truly allowed us to distinguish differences in performance. These more critical characteristics are the ones in the left column above.

At this time, CALFED has not made any determination about how the alternatives perform in terms of the "assurances" or "consistency with solution principles" characteristics. Although extremely critical to the ultimate decision of a preferred program alternative, evaluation of these two characteristics is highly subjective, and CALFED intends to make that evaluation only after considering the comments of the interested public. As to the remaining distinguishing characteristics listed above, CALFED is presenting in this Phase II Report the results of the technical evaluations of these characteristics performed thus far. Based on the assumptions made in the technical evaluations, Alternative 3 appears to have the potential to provide greater performance on these particular characteristics. At the same time, however, Alternative 3 appears to present the most serious challenges in terms of assurances and implementability.

CALFED has not identified a preferred program alternative. A great deal of additional technical review and dialog will need to take place among elected officials, CALFED agencies, local agencies, interest groups, and the public before a decision can be made. Together, all interests will need to answer questions such as:

- Are the assumptions and technical evaluations performed by CALFED valid?

- Are the common Program elements contained in each alternative adequate to ensure overall Program success?

- How well does each alternative meet the CALFED solution principles? Is any one alternative clearly superior to others?

- Is the construction of water facilities (such as an isolated conveyance facility) acceptable to the public?

- Are beneficiaries willing to pay for a comprehensive Bay-Delta solution?

- Can we devise an adequate assurance package of actions and mechanisms to assure that the Program will be implemented and/or operated as agreed?

Deliberations that enable us to answer these questions and select the preferred program alternative will be the focus for the rest of Phase II of the Program. This report will help you prepare to participate in these deliberations. It is structured to introduce the Program (Chapter 1) and describe some significant fundamental Program concepts (Chapter 2). It also describes the Program alternatives (Chapter 3), explains the technical evaluation (Chapter 4), and explains the process that CALFED will use to identify a preferred program alternative (Chapter 5). Chapter 5 discusses many policy and programmatic questions on which CALFED is requesting specific input. Resolution of these questions and issues is imperative before State and Federal decision makers and interested stakeholders can decide on a comprehensive solution.

The format of this report includes "sidebars" that identify the issues of concern or areas where greater detail is provided on a particular topic. Because this is a summary report of the Phase II process, it includes references to sections in the Programmatic EIS/EIR where additional information and/or detail may be found.

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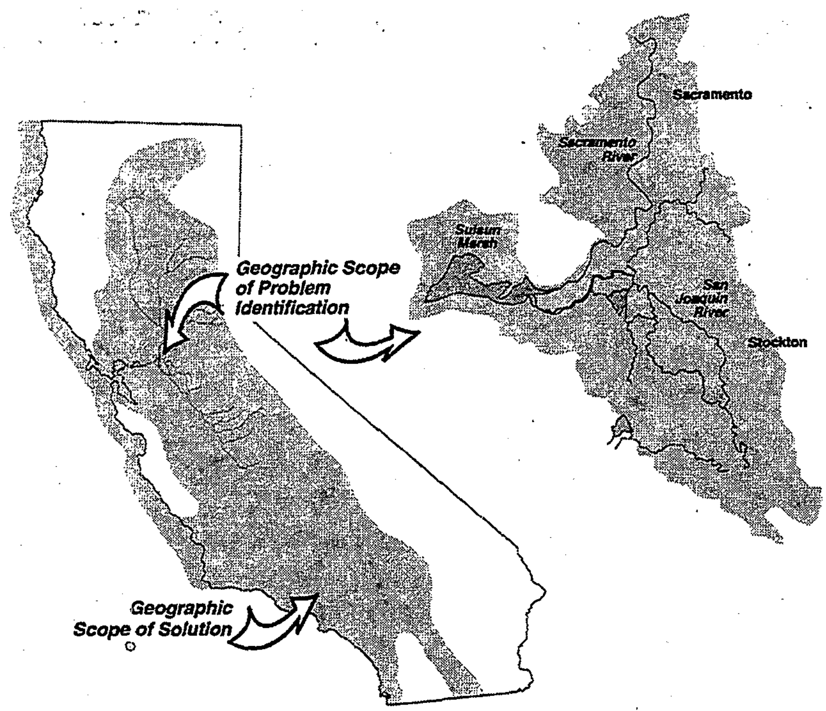
1. INTRODUCTION

A maze of tributaries, sloughs, and islands, the San Francisco Bay/Sacramento-San Joaquin Delta estuary (Bay-Delta) is the largest estuary on the West Coast. It is a haven for plants and wildlife, supporting over 750 plant and animal species. The Bay-Delta is critical to California's economy, supplying drinking water for two-thirds of Californians and irrigation water for over 7 million acres of the most highly productive agricultural land in the world.

The Bay-Delta is also the hub of California's two largest water distribution systems - the Central Valley Project (CVP) operated by the U.S. Bureau of Reclamation and the State of California's State Water Project (SWP). The CVP an SWP were built to provide river regulation, improvements in navigation and flood control, water supplies for irrigation, municipal, and industrial uses, and hydropower generation. In addition, at least 7,000 other permitted water diverters, some large and some small, have developed water supplies from the watershed feeding the Bay-Delta estuary. Together, these water development projects divert about 20 percent to 70 percent of the natural flow in the system depending on the year.



When combined with the effects of increased population pressures throughout California, the introduction of exotic species, and numerous other factors, these water diversions and the related facilities have had a serious impact on the fish and wildlife resources in the Bay-Delta estuary. This impact, as well as other effects of the continued resource conflicts in the Bay-Delta system, are discussed in detail below.

Geographic Scope for Problems and Solutions

The geographic **scope for the problems** consists of the legally defined Delta, Suisun Bay (extending to the Carquinez Strait) and Suisun Marsh.

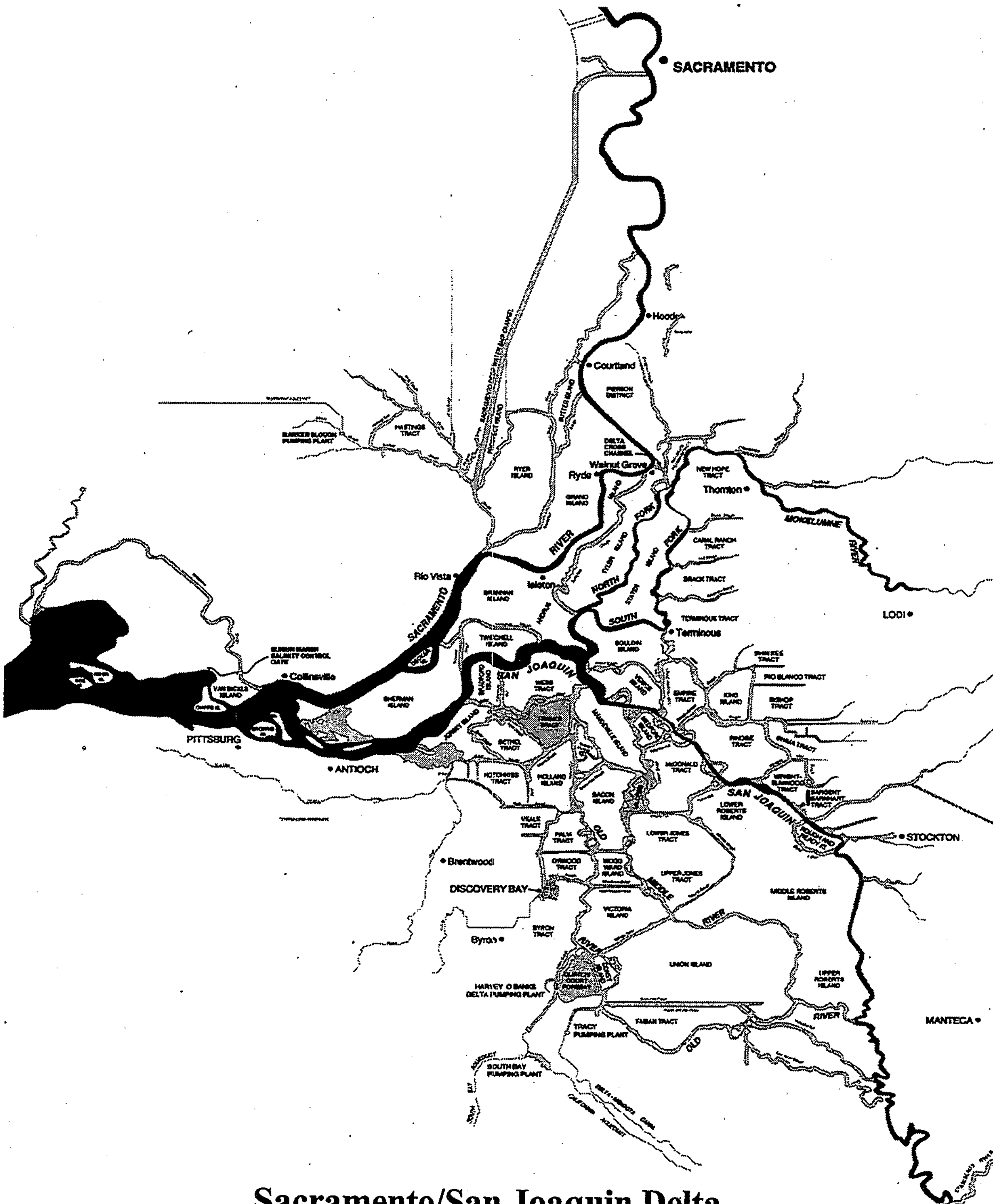
The geographic **scope for developing possible solutions** includes a much broader area that extends both upstream and downstream of the Bay-Delta. This solution scope includes the Central Valley watershed, the Southern California water system service area, San Pablo Bay, San Francisco Bay and near-shore portions of the Pacific Ocean out to the Farallon Islands and north to the Oregon border.

Although all agree on the importance of the Bay-Delta estuary for both fish and wildlife habitat and as a reliable source of water, few agree on how to manage and protect this valuable resource. In the past two decades, these disagreements have increasingly taken the form of protracted litigation and legislative battles; as a result, progress on virtually all water-related issues has become mired down, approaching gridlock.

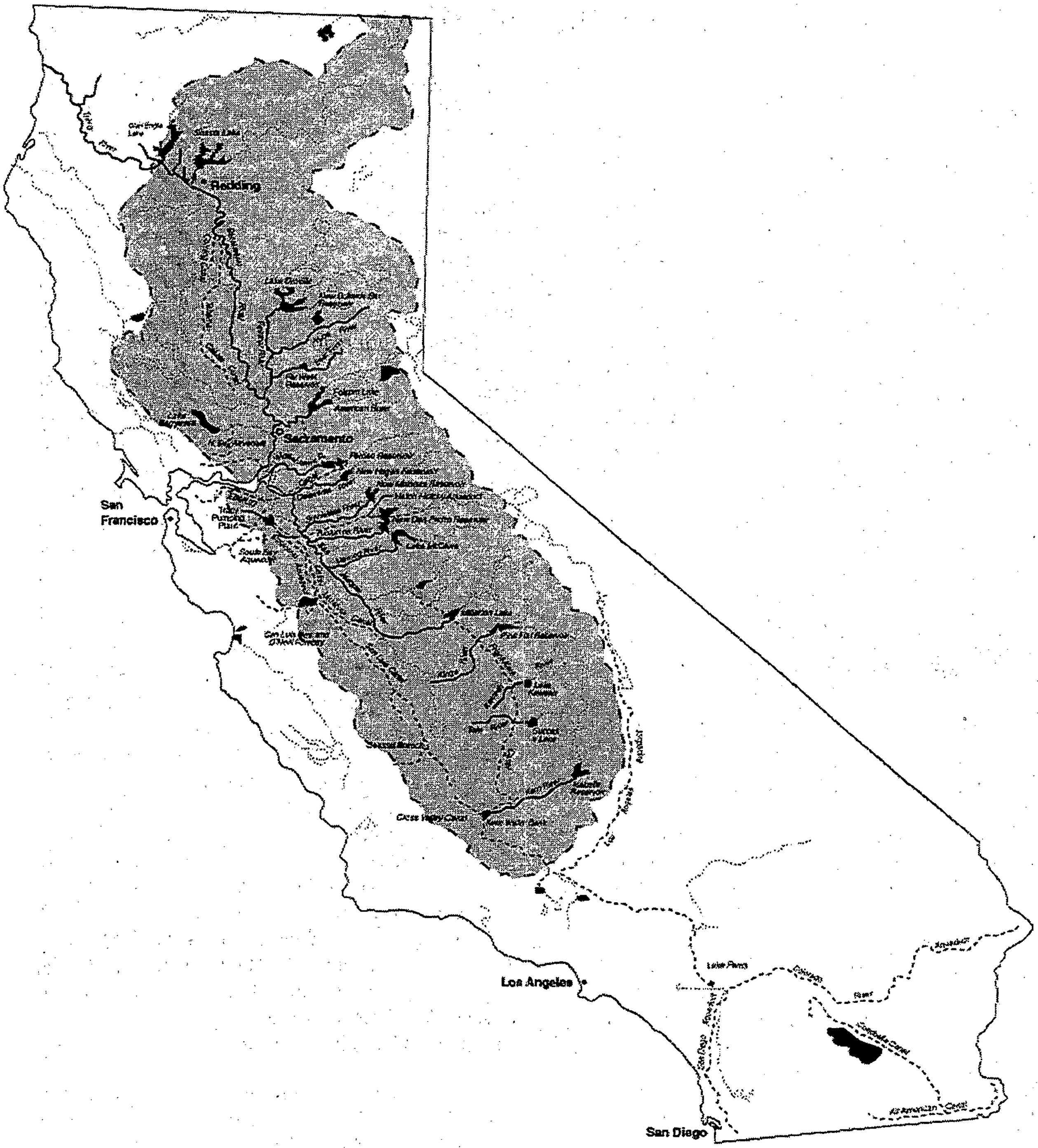
The CALFED Bay-Delta Program was established to reduce conflicts in the system by solving problems in the resource areas of ecosystem quality, water quality, water supply reliability, and levee and channel integrity. The Program seeks to do this by developing a long-term comprehensive plan that will restore ecological health and improve water supply and water supply reliability for beneficial uses of the Bay-Delta system. The Program has crafted alternatives that recognize the importance of water quality improvements that will protect Delta drinking water supplies and improve the quality of aquatic habitat. Maintaining and improving the integrity of Delta levees and channels will protect agricultural, urban, and environmental uses within the Delta and protect the quality of water used elsewhere in the state. Water conservation and recycling programs can assure the efficient use of existing water supplies and any new supplies developed through the Program.

Given the rich history of conflict in the Bay-Delta system, CALFED recognizes that any proposed program to address this broad spectrum of resources will be controversial. Stakeholders participating in the CALFED process have already identified significant concerns about virtually every component in the Program. Many of these concerns are summarized in Chapter 3 and elsewhere in this report. CALFED encourages all members of the public to review the material in this report and the Draft EIS/EIR and to provide us with comments for further consideration.

The most intense conflict over the available water supply occurs during times of drought. It is during these times that fish and wildlife are most stressed and demands for water from the Delta are greatest. During periods of shortage, water holds its highest value for all uses. An important part of the CALFED approach to this conflict is to take water from the system in times of plenty and then to release these flows in times of need. By supplementing the existing flows during drought periods, the CALFED Program may be able to help prevent disastrous consequences to fish populations that travel through, live-in, or are in some way dependent upon the Delta for habitat during critical life stages. These additional flows will also improve water supply reliability. Through the creation of additional aquatic habitat along the rivers tributary to the Delta, removing obstructions to upstream fish migration, recreating spawning beds, restoring riparian vegetation, increasing the acreage of wetlands, and restoring more natural flow patterns within the Delta, CALFED hopes to help restore fish and wildlife whose viability has been threatened by land and water development.



Sacramento/San Joaquin Delta



Watershed for the Sacramento/San Joaquin Delta

A Vision for Year 2030
Return to a Healthy Bay-Delta System

The following is a vision of the future with implementation of a CALFED solution:

For a third straight year, biologists have observed record returns of winter-run and spring-run chinook salmon to their Central Valley spawning grounds. Over the past three decades, habitat rehabilitation and improvements in river flow management have provided the impetus for rebounding populations of all the major migratory and resident fish in the Bay-Delta. There are no longer any fish species in this system listed under the Endangered Species Act. The combination of a rigorous management program with augmented stream flows have minimized the adverse effects of undesirable exotic species in the aquatic environment. For the first time since the early part of the twentieth century, both the commercial fishing industry along coastal California and the sports fishery in the Bay-Delta and on the Sacramento and San Joaquin rivers are thriving.

Other wildlife resources in the Bay and Delta have experienced a similar revival. The substantial restoration of riparian habitat upstream and in the Delta has reversed the decline of both aquatic and terrestrial species that were threatened with extinction at the end of the last century. The innovative use of "set-back" levees and flood bypass easements on the upstream tributaries, and waterside berms in the Delta, provided critical dual benefits during last year's heavy rains. In addition, a portion of the flood waters were moved into storage for later use by water users and to provide environmental flows in drier times. Not only did the Valley avoid catastrophic levee failure and loss of agricultural resources, but the floodways provided a major stopover for the migratory waterfowl on the Pacific Flyway. With its patchwork of restored habitat and working farms, the Delta has become a favorite destination for hunters, anglers, and "eco-tourists" alike.

Unlike last year, with its heavy rains, this year promises to be extremely dry. Nevertheless, even though California's population now exceeds 50 million people, urban and agricultural water users will avoid the economic dislocation and inconvenience of unexpected water shortages. Innovative programs of water conservation and water recycling have allowed all water users to reduce their demand on California's water resources. With an efficient water market in place, many water providers are relying on short-term voluntary water transfers and local groundwater management programs to see them through the dry period. Although transfers were initially controversial, local governments and water agencies have worked out arrangements for water transfers that protect local economies and water resources. Sustained improvements in the fish and wildlife populations have led to reduced environmental restrictions on the operations of the state's water conveyance facilities, so water can be transferred from groundwater banks and other storage facilities to the areas of greatest need.

All of the state's water users have benefitted from better water quality in the Delta. Better management practices have substantially reduced the negative effects of agricultural run-off in the Delta and its tributaries, and most of the toxic discharges into the Bay and Delta have been curtailed by a combined program of regulatory enforcement and economic incentives. Even the long-term problem of toxic drainage from abandoned mines is close to resolution, as the substantial investments in treatment and containment over the past 30 years have drastically reduced the volume of heavy metals entering the Bay-Delta ecosystem. These water quality improvements have resulted in a cleaner, safer supply of drinking water for a large percentage of California's 50 million residents.

The return to a healthy Bay-Delta system that meets California's needs was made possible by a spirit of cooperation and grassroots involvement. Many groups are responsible for this success story including state/federal/local partnerships, conservancies, and local land owners.

Bay-Delta Resource Conflicts - 1998

Water Quality Problems

The Delta is a source of drinking water for millions of Californians and is critical to the state's agricultural sector. In addition, good water quality is required to maintain the high quality habitat needed in the Bay-Delta system to support a diversity of fish and wildlife populations. Yet, despite improvements in Bay-Delta water quality, the issue remains a primary concern in the Delta.

Water quality parameters of concern enter the Delta through a variety of sources, including sewage treatment plants, industrial facilities, forests, farms and farm fields, mines, residential landscaping, urban streets, and natural sources. They find their way to even the Delta's most remote areas where they interact with water, sediment, plants, and animals. The pollutants, pathogens, natural organics, and salts in Delta waters impact to varying degrees existing fish and wildlife, as well as human and agricultural use of these waters. The salts, entering the Delta through the Bay from the ocean and from agricultural returns upstream, decrease the utility of Delta waters for many purposes, including agriculture, drinking water, and the ecosystem. The level of natural organics in the water (mainly resulting from the natural process of plant decay on many of the Delta peat soil islands) is of concern because of the way natural organics react with other chemicals during the treatment process necessary to produce safe drinking water. During this treatment, certain by-products are created which may produce potentially adverse human health effects. Pathogens, which include viruses, Giardia and Crypto sporidium, enter the Delta through various sources and pose human health and treatment-related concerns.

Ecosystem Problems

The Bay-Delta system no longer provides a broad diversity of habitats nor the habitat quality necessary to maintain ecological functions and support healthy populations and communities of plants and animals. Declining fish populations and endangered species designations have generated major conflicts among beneficial uses of water in the Bay-Delta system. The health of the Bay-Delta ecosystem has declined in response to a loss of habitat to support various life stages of aquatic and terrestrial biota and a reduction in habitat quality due to several factors.

The steady decline in habitat quantity, quality, and diversity results from many activities both in the Delta and upstream. The earliest major damaging event was the unrestricted use of hydraulic mining in the river drainage along the eastern edge of the Central Valley, which greatly increased the amount of sediment entering the river systems. The hydraulic mining resulted in habitat degradation in Central Valley streams as channel beds and shallow areas filled with sediment. The reduced capacity of the sediment-filled channels resulted in an increase in frequency and extent of periodic flooding. This accelerated the need for flood control measures to protect adjacent agricultural lands. Levee construction to protect these lands eliminated fish access to shallow overflow areas, and dredging operations to construct levees eliminated tule bed habitat along the river channels. Since the 1850s, 700,000 acres of overflow and seasonally flooded land in the Delta have been converted to agriculture or urban uses. Many of the remaining stream sections have been dredged or channelized to improve navigation, increase stream conveyance during periods of flood, and facilitate water export.

Upstream water development, depletion of natural flows, and the export of water from the Delta have changed seasonal patterns of inflow, reduced annual outflow, and diminished the natural variability of flows into and through the Delta. Facilities constructed to support water diversions cause straying or direct losses of fish (e.g. unscreened diversions) and increased predation (e.g., Delta cross channel and Clifton Court Forebay). Entrainment and export of substantial quantities of food web organisms (eggs, larvae, and young fish) further added to habitat decline.

Habitat alteration and water diversions are not the only factors that have caused ecosystem problems. Water quality degradation caused by pollutants and increased concentrations of substances such as pesticides and herbicides may also have contributed to the overall decline in the health and productivity of the Delta. In addition, undesirable introduced species compete for available space and food supplies, sometimes to the detriment of native or economically important introduced species.

Bay-Delta Resource Conflicts - 1998
(Continued)

Water Supply Reliability Problems

The Bay-Delta system provides the water supply for a wide range of instream, riparian, and other beneficial water uses which are authorized by appropriative, riparian, and pre-1914 water rights. While some water users depend on the Delta system for only a portion of their water supply, others have become highly or totally dependent on Delta water supplies. As water use and competition among uses has increased during the past several decades, conflicts have increased among users of Delta water. Heightened competition and conflict during certain seasons or during water-short years has magnified the impact from natural fluctuations in the hydrologic cycle.

In response to declining fish and wildlife populations, water flow and timing requirements have been established for certain fish and wildlife species with critical life stages dependent on freshwater flows. These requirements have reduced flexibility to meet the quantity and timing of water exports from the Delta. There are concerns that additional restrictions that might be needed to protect species could increase the uncertainty of Delta water supplies. This basic disparity between water needs and water availability has created economic uncertainty in the water service areas and increased potential conflict over supplies.

A related concern is the vulnerability of the Delta water transport system of levees and channels to catastrophic failure due to earthquakes, structural failure, or overtopping during floods. This system is also vulnerable to general failure as a result of decreasing levee stability. Such failures in the system could result in interruptions in water use in the Delta or water transport across the Delta for periods that could vary in length from days to several months.

Levee System Integrity Problems

Settlers first constructed levees in the Sacramento-San Joaquin Delta during the late 1800s. Initially settlers built levees to turn tidal marshes into agricultural land and over time increased the levee heights to maintain protection as both natural settling of levees and shallow subsidence of Delta island soils (oxidation lowers the level of land over time) occurred. The increased levee heights combined with poor levee construction, and inadequate levee maintenance makes Delta levees vulnerable to failure, especially during earthquakes or floods. Delta island farmland, wildlife habitat, and critical infrastructure can be flooded as a result of a levee failure. Delta islands adjacent to a large body of open water created by flooded Delta islands can be exposed to increased wave action, possible levee erosion, and increased seepage if the levee is not repaired and the flooded Delta island drained. Levee failure on specific Delta islands can have direct or indirect impacts on water supply distribution systems. Direct impacts result from flooding of distribution systems such as the Mokelumne Aqueduct, and indirect impacts result from salty water moving up into the Delta, as an island is flooded. The increased salinity in the Delta would be of particular concern in a low water year, when less freshwater would be available to drive back the incoming salt water. Long-term flooding of specific Delta islands can have an effect on water quality by changing the rate and area of the mixing zone. A long interruption of water supply for in-Delta and export use by both urban and agricultural users could result, until the salt water could be flushed from the Delta.

Local reclamation districts are concerned with the cost of maintaining and improving the Delta levee and channel system. The complex array of agencies with planning, regulatory, disaster assistance, and/or permitting authorities over levees and channels creates additional obstacles in rehabilitation and maintenance efforts. Regulatory measures that protect endangered species or critical habitat can further increase the vulnerability of the system. These measures can conflict with and prolong or defer important levee rehabilitation and maintenance work needed to maintain system integrity.

The Program

The CALFED Bay-Delta Program began in May of 1995 to address the tangle of complex issues that surrounds the Delta. The CALFED Program is a cooperative, interagency effort of state and federal agencies with management or regulatory responsibilities for the Bay-Delta.

The CALFED agencies appointed an executive director to oversee the process of developing a long-term comprehensive plan for the Bay-Delta. The Executive Director selected staff from the CALFED agencies to carry out the task. In addition, the CALFED agencies and stakeholders worked with the interagency CALFED Program team through multi-level technical and policy teams.

The CALFED Program is a collaborative effort including representatives of agricultural, urban, environmental, fishery, business, and rural counties who have contributed to the process. The Bay-Delta Advisory Council (BDAC), a 34-member federally chartered citizens' advisory committee, provides formal comment and advice to the agencies during regularly scheduled public meetings.

CALFED

State Agencies

Resources Agency of California*
- Department of Water Resources
- Department of Fish and Game

California Environmental Protection Agency
- State Water Resources Control Board

Federal Agencies

U.S. Department of Interior
- Bureau of Reclamation*
- Fish and Wildlife Service*
- Bureau of Land Management
- U. S. Geological Survey

U.S Army Corps of Engineers*

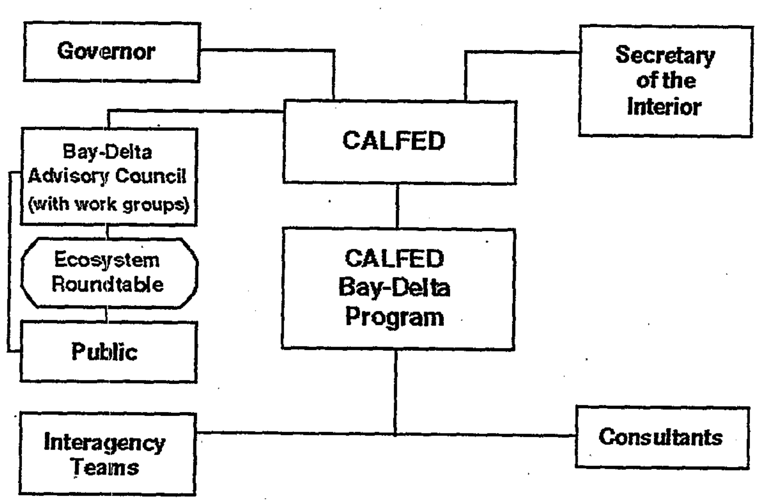
U.S. Environmental Protection Agency*

U.S. Department of Commerce
- National Marine Fisheries Service*

U.S. Department of Agriculture
- Natural Resources Conservation Service*
- U.S. Forest Service

Western Area Power Administration

* Co-lead agencies for EIS/EIR



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In addition, the CALFED process has included members of the public in development of every Program component from ecosystem restoration to financing.

Phase I

The Program was divided into three discrete phases. In Phase I, completed in September 1996, CALFED identified the problems confronting the Bay-Delta, developed a mission statement and guiding principles, and devised three preliminary categories of solutions. The goals established during Phase I are to provide good water quality for all beneficial uses; to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species; to reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system; and to reduce the risk to land use and associated economic activities, water supply, infrastructure and the ecosystem from catastrophic breaching of Delta levees.

Following scoping, public comment, and agency review, CALFED concluded that each Program alternative would include a significant core set of Program elements addressing levee system integrity, water quality improvements, ecosystem restoration, and water use efficiency measures. These Program elements have generally been referred to as the "common programs". In addition,

CALFED BAY-DELTA PROGRAM MISSION STATEMENT AND SOLUTION PRINCIPLES

The 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.

In addition, any CALFED solution must satisfy the following solution principles:

- ***Reduce Conflicts in the System*** Solutions will reduce major conflicts among beneficial uses of water.
- ***Be Equitable*** Solutions will focus on solving problems in all problem areas. Improvements for some problems will not be made without corresponding improvements for other problems.
- ***Be Affordable*** Solutions will be implementable and maintainable within the foreseeable resources of the Program and stakeholders.
- ***Be Durable*** Solutions will have political and economic staying power and will sustain the resources they were designed to protect and enhance.
- ***Be Implementable*** Solutions will have broad public acceptance and legal feasibility, and will be timely and relatively simple to implement compared with other alternatives.
- ***Have No Significant Redirected Impacts*** Solutions will not solve problems in the Bay-Delta system by redirecting significant negative impacts, when viewed in their entirety, within the Bay-Delta or to other regions of California.

CALFED identified three preliminary alternatives to be further analyzed in Phase II. The three preliminary alternatives represented three differing approaches to conveying water through the Delta. The first conveyance configuration relies primarily on the existing conveyance system, with some minor changes in the south Delta. The second configuration relies on enlarging channels within the Delta. The third configuration includes in-Delta channel modifications and a conveyance channel that would move some water around the Delta. Each of these alternatives also includes consideration of new ground and surface water storage options. Also, the potential for no storage remains an option for each alternative.

MAJOR CONCLUSIONS FROM PHASE I

- The complexity of the problems will require a long-term sustained effort lasting perhaps 20-30 years to achieve a healthy Bay-Delta system.
- Based on public comment, significant Program elements are needed for levee system integrity, water quality, ecosystem restoration and water use efficiency in all alternatives. These Program elements remain relatively unchanged between the alternatives.
- The alternatives must encourage local participation and partnerships to further Program objectives rather than rely on an exclusively-regulatory approach.

Phase II

In Phase II, CALFED is refining the preliminary alternatives, is conducting comprehensive programmatic environmental review, and is developing the implementation strategy. The final environmental document is scheduled for release in late 1998. Thus far, in Phase II, CALFED has added greater detail to each of the Program elements (levee system integrity, water quality, ecosystem restoration, and water use efficiency) and has begun to craft frameworks for a water transfers policy and watershed management coordination. Pre-feasibility studies and modeling aided evaluation of many variations of the three broad alternatives. Phase II will conclude with the development and selection of a preferred program alternative, which will be reviewed in a Final Programmatic EIS/EIR. A programmatic EIS/EIR, also referred to as a first-tier document, is typically prepared for a series of actions that can be characterized as one large project and is required for actions proposed by or approved by state and federal agencies. In addition, Phase II will generate a final implementation plan including a financing package and an "assurance" package. The assurance package will be a set of actions and mechanisms designed to assure all agencies and stakeholders that the Program will actually be implemented and operated as agreed. The assurances package will most likely include provisions to phase or stage parts of the Program over time, and as discussed in detail below, will include mechanisms to revise the Program as new information or events arise.

This Phase II Report is one of many supporting documents published in conjunction with the Draft Programmatic EIS/EIR. The main body of the EIS/EIR provides a technically-oriented analysis of the broad environmental effects that might accompany Program implementation. This Phase II Report describes the CALFED process, solution alternatives and the fundamental Program concepts that have guided their development, and analyses that have revealed the comparative technical advantages, potential problems, and uncertainties of each alternative. Finally, this report describes how CALFED will use various analyses in a public process to develop a preferred program alternative by late 1998. This Phase II Report and the Executive Summary of the EIS/EIR are being widely disseminated. The full EIS/EIR, other technical appendices, and supporting technical reports -- comprising thousands of pages -- are available from CALFED.

Phase III

In Phase III, following completion of the Final Programmatic EIS/EIR, implementation begins. This period will include additional site-specific environmental review and permitting, as necessary. Because of the size and complexity of any of the alternatives, implementation is likely to take place over a period of decades. Part of the challenge for Phase II is designing an implementation strategy that acknowledges this long implementation period and keeps all participants committed to the successful completion of all phases of implementation.

Public Involvement

During Phase I, CALFED held scoping meetings, technical workshops, public information meetings, public BDAC meetings, and public BDAC workgroup meetings. This commitment to active public involvement has continued through Phase II with additional public meetings, presentations before focused groups, media outreach, special mailings of newsletters, regular updated information placed on the Program's website, and a new toll-free public information telephone line.

WHERE TO FIND PUBLIC OUTREACH INFORMATION

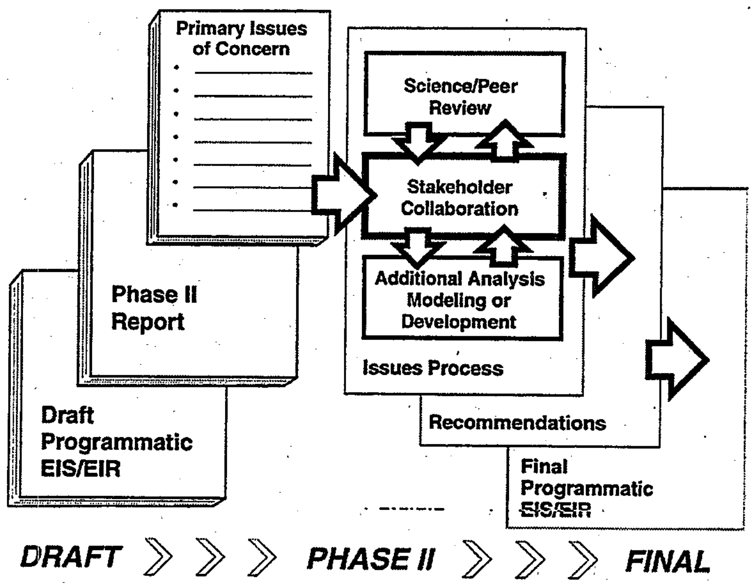
- Program's website (http:\\calfed.ca.gov)
- Toll-free public information telephone line (1-800-700-5752)
- *CALFED News*, *EcoUpdate* and Factsheets (available from CALFED Bay-Delta Program, 1416 Ninth Street, Suite 1155, Sacramento, CA 95814; phone 916-657-2666)
- BDAC and other public meetings

Next Steps in Phase II

Between the Public Draft Programmatic EIS/EIR and the Final EIS/EIR, work will continue on refining, evaluating, developing, and selecting a preferred program alternative. This will include additional technical evaluations of parts of the common programs as well as storage and conveyance options, selecting the method of Delta conveyance, studying potential operating criteria, and developing the package of financing and assurances. CALFED will work with elected officials, local agencies, interest groups, and the public over the coming months to develop a preferred program alternative that reduces major conflicts in the system, is equitable, affordable, durable, implementable, and will solve problems in the system without redirecting significant impacts.

The entire Program can benefit from further focused technical review and implementation planning. CALFED will work with stakeholders in developing implementation strategies for all Program elements to clarify the goals and objectives, underlying assumptions, tools and strategies, conceptual models, adaptive management, and measures of success. Chapter 5 more fully describes these efforts.

Work will continue between the Draft and Final Programmatic EIS/EIR on resolving the primary issues of concern that remain, many of which are identified in this Phase II Report. Additional issues may be identified during the public comment period for the Draft Programmatic EIS/EIR. A series of scientific/peer reviews and additional analyses will be linked through stakeholder collaboration to arrive at recommendations for the preferred program alternative and its associated implementation including financing and assurances.



Finally, during the Phase II process, stakeholders have raised significant questions and issues about different aspects of the common Program elements (the ecosystem restoration program, water quality program, water use efficiency program, Delta levee protection plan, water transfer policy, and watershed management coordination program). The success of these common Program elements is essential to the performance of the overall CALFED effort. CALFED recognizes that addressing these stakeholder questions and issues on common Program elements are fundamental to the success of the Program. In Chapter 3, we have included sidebar discussions of stakeholder concerns; in Chapter 3and Chapter 5 we have laid out proposed processes for resolving these critical concerns.

Some Delta Statistics

Area of the Watershed: The system drains more than 61,000 square miles, or 37% of the state.
Area of the Delta: The legal Delta includes 738,000 acres.
Delta Inflow*: Inflow ranges from 6 to 69 million acre feet (MAF) per year; average is 24 MAF.
Diversions: Over 7,000 diverters draw water from the system, including 1,800 in the Delta itself.
Delta Exports*: The SWP and CVP draw an average of 5.9 MAF (approximately 3.6 MAF for agriculture and 2.3 MAF for urban uses) from the Delta each year .
In-Delta Water Use: Net in-Delta water use averages approximately 1 MAF annually.
Flora: Over 400 plant species can be found in the Delta, not including agricultural crops.
Fauna: The Delta harbors about 225 birds, 52 mammals, and 22 reptile and amphibian species.
Fish: There are 54 fish species in the Delta, and a total of 130 in the Delta and Bay.
Marshes: There are 8,000 acres of tidal marsh in the Delta; originally, there were 345,000 acres.
Levees and Channels: Over 700 miles of waterways are protected by 1100 miles of levees.
Subsidence: Some Delta lands are more than 20 feet below sea level.
Delta Farmland: Over 520,000 acres are farmed in the Delta.
Principal Crops: The most commonly grown Delta crops are wheat, alfalfa, corn, and tomatoes.
Agricultural Value: Average annual gross value of Delta production is $500 million.
Recreation: Recreational use of the Delta is about 12 million user days per year

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* Simulated flow based on historical hydrology, but with existing storage and conveyance facilities in place and operating to meet 1995 levels of demand.

2. FUNDAMENTAL PROGRAM CONCEPTS

Three fundamental concepts related to the Bay-Delta system and its problems have guided the development of proposed CALFED solutions. These concepts are not new, but CALFED has looked at them in new ways to develop options for solving problems successfully. These concepts are so important that this chapter is devoted to a detailed description of them.

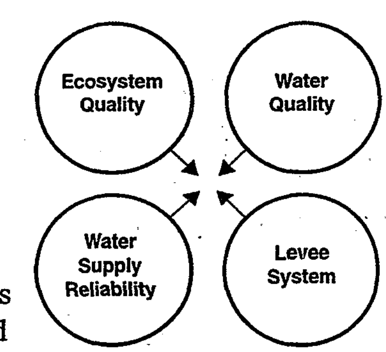
First, problems in the four resources areas (ecosystem quality, water quality, water supply reliability, and levee system integrity) are **interrelated**. We cannot effectively describe problems in one resource area without discussing the other resource areas. It follows that solutions will be interrelated as well; many past attempts to improve a single resource area have achieved limited success because solutions were too narrowly focused.

Second, there is great **variation** in the flow of water through the system and in the demand for that water at any time scale we might examine (from year to year, between seasons, even on a daily basis within a single season). The value of water for all uses tends to vary according to its scarcity and timing. We can take advantage of this variability to reduce conflict and solve problems in several resource areas.

Finally, the solutions we implement must be guided by **adaptive management**. The Bay-Delta ecosystem is exceedingly complex, and it is subject to constant change as a result of factors as diverse as global warming and the introduction of exotic species. We will need to adapt our management of the system as we learn from our actions and as conditions change.

This chapter describes each of these concepts in greater detail. An additional fundamental concept is that of **assurances**. The preferred program alternative will need to include a set of actions and mechanisms to assure that the Program will be implemented and operated as agreed. These actions and mechanisms must be able to foster more constructive relationships between the many California water interests that are traditionally more accustomed to conflict than to efforts at consensus decision-making. Assurances are discussed in Chapter 5.

Interrelationships



In the past, most efforts to improve water supply reliability or water quality, improve ecosystem health, or maintain and improve Delta levees were single-purpose projects. A single purpose can keep the scope of a project manageable but may ultimately make the project more difficult to implement. The difficulty occurs because a project with narrow scope may help to solve a single problem but have impacts on other resources, causing other problems. This in turn leads to conflict. Ultimately no problem is solved, or one problem is solved while others are created.

The CALFED Program takes a different approach, recognizing that many of the problems in the Bay-Delta system are interrelated. Problems in any one resource area cannot be solved effectively without addressing problems in all four areas at once. This greatly increases the scope of our efforts but will ultimately enable us to make progress and move forward to a lasting solution.

What are the problems that face the Bay-Delta system and why have they occurred? At the simplest level, problems occur when there is conflict over the use of resources from the Bay-Delta system. As California's population increases, we ask more of the system, and there is more conflict. Single-purpose efforts to solve problems often fail to address the conflict. To the extent that these efforts acquire or protect resources for one interest, they may cause impacts on other resources and increase the level of conflict. Major conflicts are summarized below.

- *Fisheries and Water Diversions.* The conflict between fisheries and water diversions results primarily from fish mortality attributable to water diversions. This includes direct loss at pumps, reduced survival when young fish are drawn out of river channels into the Delta, reduced spawning success of adults when migratory cues are altered, and reduced survival associated with reduced Delta outflows. The need to protect species of concern has necessitated regulations that allow sufficient fishery flows to remain in the natural system, which can restrict the quantity and timing of diversions.

- *Habitat and Land Use.* Habitat to support various life stages of aquatic and terrestrial plants and animals in the Bay-Delta has been lost because of conversion of that habitat to other uses, such as agriculture or urbanization. In addition, some habitat has been lost or adversely altered due to construction of flood control facilities needed to protect developed land. Efforts to restore the habitat can also create conflict with existing uses, such as agriculture and levee maintenance.

- *Water Supply Availability and Beneficial Uses.* As water use and competition for water have increased during the past several decades, so has conflict among users. A major part of this conflict is between the volume of instream water needs and out-of-stream water needs, and the timing of those needs within the hydrologic cycle.

- *Water Quality and Human Activities.* Water quality for ecosystem and consumptive uses can be adversely affected by a broad range of human activities. In addition to particular activities that discharge pollutants (such as current or abandoned mines or industrial sources), urban and agricultural areas produce degraded surface runoff that can seriously affect the Bay-Delta's many beneficial uses.

From these central conflicts, CALFED identified a series of problems in each resource area. From each problem, a Program objective was developed. The main problems and objectives are shown on the following page. A complete set of identified problems and program objectives is contained in the *Program Goals and Objectives Appendix* to the Draft Programmatic EIS/EIR.

BAY-DELTA PROBLEM AREAS & PROGRAM OBJECTIVES

ECOSYSTEM QUALITY

Problems	Objectives
• Important aquatic habitats are inadequate to support production and survival of native and other desirable estuarine and anadromous fish in the Bay-Delta system. Examples of fishes that have experienced declines related to changes in Delta habitat include delta smelt, longfin smelt, Sacramento splittail, chinook salmon, striped bass, and American shad.	• Improve and increase aquatic habitats so they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary.
• Important wetland habitats are inadequate to support production and survival of wildlife species in the Bay-Delta system.	• Improve and increase important wetland habitats so they can support the sustainable production and survival of wildlife species.
• Populations of some species of plants and animals dependent on the Delta have declined.	• Increase population health and population size of Delta species to levels that assure sustained survival.

WATER QUALITY

Problems	Objectives
• Water quality is often inadequate or is perceived as inadequate for drinking water needs.	• Provide good water quality in Delta water exported for drinking water needs.
• Delta water quality is often inadequate for agricultural needs.	• Provide good Delta water quality for agricultural use.
• Delta water quality is often inadequate for industrial needs.	• Provide good Delta water quality for industrial use.
• Delta water quality is often inadequate for recreational needs.	• Provide good Delta water quality for recreational use within the Delta.
• Water quality is often inadequate for environmental needs for the Bay-Delta system.	• Provide improved Delta water quality for environmental needs.

WATER SUPPLY RELIABILITY

Problems	Objectives
• Water supplies of the Bay-Delta system do not meet needs because of conflict among beneficial uses and because of system inadequacies.	• Reduce the conflict between beneficial uses and improve the ability to transport water through the Bay-Delta system.
• Bay-Delta system water supplies are uncertain with respect to short- and long-term needs.	• Reduce the uncertainty of Bay-Delta system water supplies to help meet short- and long-term needs.

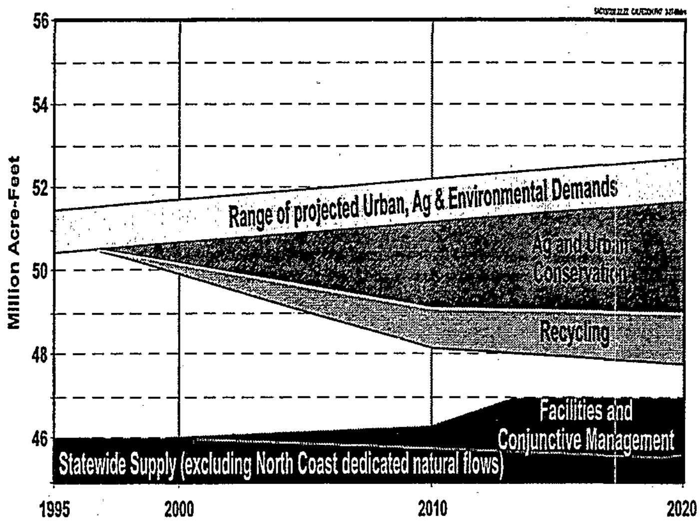
LEVEE SYSTEM INTEGRITY

Problems	Objectives
• Existing agricultural land use, economic activities and infrastructure in the Delta are at risk from gradual deterioration of Delta conveyance and flood control facilities as well as sudden catastrophic inundation of Delta islands.	• Manage the risk to existing land use, associated economic activities, and infrastructure from gradual deterioration of Delta conveyance and flood control facilities and catastrophic inundation of Delta islands.
• Water supply operations and facilities in the Delta are at risk from increased salinity intrusion which can result from sudden catastrophic inundation of Delta islands.	• Manage the risk to water supply facilities and operations in the Delta from catastrophic inundation of Delta islands.
• Water quality in the Delta is at risk from increased salinity intrusion which can result from sudden catastrophic inundation of Delta islands.	• Manage the risk to water quality in the Delta from catastrophic inundation of Delta islands.
• The existing Delta ecosystem is at risk from gradual deterioration of Delta conveyance and flood control facilities as well as catastrophic inundation of Delta islands.	• Manage the risk to the existing Delta ecosystem from gradual deterioration of Delta conveyance and flood control facilities and catastrophic inundation of Delta islands.

Will CALFED Solve California's Water Problems?

For many years, water managers have projected an increasing gap between California's water supply and the demand for that water. This gap can result in economic and environmental hardships when water needs are not met. The CALFED Program is striving to balance the Bay-Delta system to increase water supply reliability, but the Program will not completely close the gap between water supply and projected demand. Even with all the CALFED actions in place, there still may be economic and environmental hardship during drought years when supplies cannot satisfy California's demand for water. The figure below depicts the relative effect during drought periods of various water management measures contemplated within the CALFED Program.

Demand projections, depicted by the top line in the figure, represent the needs of a statewide population estimated to surpass 45 million by 2020. Even with the continued implementation of current levels of water conservation and the loss of some irrigated agricultural lands in the Central Valley, statewide demand is still projected to increase because of population growth. As our understanding of the Bay-Delta ecosystem has improved, we have also recognized additional environmental water needs, such as increased instream flows. There is uncertainty regarding future demands, so these demands are depicted by the range shown in the figure.



Statewide water supply projections, shown at the bottom of the figure, represent all of the water sources available to the state. (Water dedicated to remain in north coast rivers and streams has been excluded from the graph.) All other supply sources are included -- from local groundwater to reclaimed water, and from the Colorado River to the Central Valley's rivers and streams.

Also depicted on the figure are potential supply increases and demand reductions that might be achieved through conjunctive management, new surface storage, new facilities, and a host of efficiency measures, including more extensive urban and agricultural water conservation and water recycling.

Demand reductions anticipated from increased water use efficiency and water recycling are detailed later in this document. Collectively, they represent the potential for roughly 4 million acre-feet of reduced future demand. This level of savings will increase over time: much of the urban conservation potential reflects a reduction from future demand levels that are projected but not yet reached.

The use of new surface storage, conjunctive management of ground, and surface water resources, and new facilities could improve the flexibility to manage water that is available for the state's urban, agricultural, and environmental uses. Though the expected contribution to supply in acre-feet is significantly less than that expected from water use efficiency, the ability to increase the value of water through storage, improved conveyance, and changes in system operations could provide numerous benefits that do not show up as "increased yield". Rather, these benefits are seen through improvements in water supply reliability.

Following are the strategies for solving problems in the four resource areas:

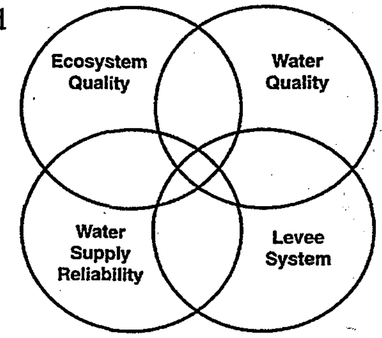
Ecosystem Quality - The primary ecosystem quality objective of the Program is to "Improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species." The strategy to achieve this objective is to reverse the decline in ecosystem health by reducing or eliminating factors that degrade habitat, impair ecological functions, or reduce the population size or health of species. These factors may cause direct mortality of plants and animals in the system, but more often they result in indirect mortality by degrading habitat conditions or functions. For this reason, the Program objectives emphasize the improvement of habitats and ecological functions.

Water Supply Reliability - The primary water supply reliability objective of the Program is to "Reduce the mismatch between Bay-Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system." The Program has a three-part strategy to reduce conflict and meet water supply reliability objectives. This strategy seeks to: reduce the mismatch between supply and beneficial uses through a variety of actions; reduce the impacts of water diversions on the Bay-Delta system; and increase the flexibility to store and transport water.

Water Quality - The primary water quality objective of the Program is to "Provide good water quality for all beneficial uses." Good water quality means different things to different users, and there are different ways to achieve the objective. For example, organic carbon that is naturally present in Delta water can contribute to carcinogenic treatment byproducts in drinking water, but this carbon does not generally pose problems for ecosystem quality. The Program's strategy to achieve the water quality objective includes reducing or eliminating parameters that degrade water quality at its source. Many of the Program's water quality sub-objectives concentrate on this direct source control approach.

Levee System Integrity - The primary levee system vulnerability objective of the Program is to "Reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees." Failure of Delta levees can result either from catastrophic events, such as earthquakes and floods, or from gradual deterioration. Subsidence of the Delta island peat soils and settling of levee foundations places additional pressure on levees and increases the risk of failure. The Program's strategy for achieving the system integrity objectives is to implement a comprehensive plan to address long-term levee maintenance, stabilization, and emergency levee management.

Significantly, there are many linkages among the objectives in the four resource areas and among the actions that might be taken to achieve these objectives. Solving problems in four resource areas at once does not require a four-fold increase in the cost or number of actions. Most actions that are taken to meet Program objectives, if carefully developed and implemented, will make simultaneous improvements in two, three, or even four resource areas.



What kinds of actions can be taken to solve problems in the Bay-Delta system? The actions can be grouped into categories of water use efficiency, water transfers, water storage, Delta conveyance modifications, levee system improvements, ecosystem restoration, water quality improvements, watershed coordination, and financing. Specific actions range from physical restoration of habitat in the Delta to water conservation measures. The actions in our problem-solving "toolbox" are described below, along with examples of the problems that can be solved and the multiple benefits that can be gained from each type of action. A more detailed description of various Program elements is presented in Chapter 3 of this document. Complete descriptions of Program elements are contained in various technical appendices to the Draft Programmatic EIS/EIR.

Water Use Efficiency Interrelationships

Water use efficiency measures include the conservation of water used in urban areas, in agricultural areas, and on wildlife refuges, as well as water recycling. Efficiency measures reduce water demand, thereby reducing the mismatch between supply and demand. Efficiency measures provide other benefits as well. Reduced demand can mean reduced diversion of water from the Bay-Delta system and reduced diversion impacts associated with the entrainment of fish. Efficient use can also yield water quality benefits. Careful application of water to gardens, lawns, and farm fields can result in less runoff of herbicides, pesticides, fertilizers, and salts back into water bodies that provide drinking water sources and aquatic habitats.

Water Transfers Interrelationships

A water transfer is a voluntary transaction in which a person or entity that possesses the right to use water can sell the use of the water for a period of time to another person or entity. Transfers reduce the mismatch between supply and demand by satisfying the strongest demands for water and compensating others for reducing their use of that supply. A water transfer that moves water from upstream of the Delta to Delta export (water diversion from the Delta used for purposes outside the Delta) regions may provide ecosystem benefits by increasing flow into the Delta or modifying the timing of flows in ways that may benefit the ecosystem. Transfers of water between two users in Delta export areas may reduce the need to pump water from the Delta and reduce the environmental impacts of that Delta pumping. Transfers can reduce the need for new or expanded reservoirs. In some cases, conserved water can be transferred so the ability to transfer water offers an economic incentive to conserve. Finally, water can be transferred from diverters to instream uses, restoring beneficial timing of flows and increasing Delta outflow during critical periods.

Transfers are not without potential impacts, and these impacts must be clearly recognized and either avoided or adequately mitigated. Increased flows from water transfers may benefit riverine fisheries, but export of this transferred water in the Delta can adversely affect fish in the Delta. In addition, transfers may result in potential critical impacts on groundwater resources and effects on local economies. Water transfers can cause depletion of groundwater if water users transfer their surface water supplies and replace them by pumping groundwater. Local economies can be affected if farmers fallow land and transfer the water. Both the buyer and seller may benefit, but third parties may be seriously affected. Creative water management approaches, such as periodic fallowing or switching to less water-intensive crops, can provide the benefits of transfers while minimizing these third party impacts. Nevertheless, an active water transfers market must recognize these potential impacts and offer mechanisms for avoidance or acceptable mitigation.

Water Storage Interrelationships

CALFED is evaluating additional storage as one approach to increasing water supply reliability and providing instream flow benefits during periods of greater ecosystem need. Water can be captured and stored in several different ways, including surface storage (dams and reservoirs) and storage in underground aquifers where groundwater can be banked or used in conjunction with surface supplies. Increasing the capacity to store water by building new dams or increasing the size of existing ones is controversial, because the construction and operation of dams can have serious environmental impacts. However, careful reservoir operation can yield a net environmental benefit while providing water for other uses. This fundamental Program concept is discussed in detail later in this chapter. In addition, storage facilities can be very costly. Historically, these costs have been subsidized by public funds. Current support, however, for public subsidies is less than it has been historically.

A broader discussion of the role of new storage facilities in the ultimate CALFED solution is included in Chapter 3. In spite of the potential benefits we have outlined, the development of new on or off stream storage has been extremely controversial in California. Environmental interests have frequently voiced concerns about both on-site and indirect impacts of new storage facilities. In addition, given that many of the most desirable storage sites have already been developed, the rising costs associated with constructing new storage have become a major hurdle in completing new projects. These issues must be addressed before any conclusions about storage projects are made.

Storage has the potential to offer different benefits, depending on its function, operation, and location in the Bay-Delta system. Storage upstream of the Delta has the potential to increase the amount of water flowing into the Delta during dry periods and the reliability of a predictable amount of water flowing into the Delta. This is possible because new storage lets more water be held upstream of the Delta in times of high flows. During dry periods, this water can be released to increase the flow for many purposes. Ideally, these releases can be planned to produce instream benefits for the ecosystem and water quality, as well as diversion benefits, from the same release of water. Off-aqueduct storage (south of Delta storage filled by deliveries from the Delta Mendota Canal or California Aqueduct) and in- or near-Delta storage has the potential to reduce demand on the Delta during periods when diversions would have the greatest impact, including times when vulnerable fish species could be at risk of entrainment from Delta pumping. Water can be exported from the Delta into this storage during less critical periods so that when water from the Delta is not available or when impacts of Delta pumping would be high users can turn to this stored water as an alternative.

Use of existing or new storage can also improve opportunities for water conservation and water recycling. For example, reservoirs or aquifers can hold water that is not needed at a specific time because conservation measures have reduced demand. This water can be carried over into subsequent years when water shortage might otherwise require more vigorous drought conservation measures. Local storage can make recycling projects more feasible by giving water managers flexibility to hold water and better balance a constant supply of recycled water against a demand that may be variable.

Delta Conveyance Modifications Interrelationships

CALFED has examined three broad choices for conveyance through the Delta: minor physical modifications coupled with operational changes, increases in the capacity of certain Delta channels to facilitate conveyance through the Delta, and a dual system that increases the capacity of certain channels and includes a new isolated channel to convey water from the Sacramento River around the Delta to water export pumps in the south Delta. To varying degrees, all three decrease the detrimental effects on the ecosystem and Delta water users of using the Delta for water conveyance while improving the effectiveness of the Delta as a conveyance hub.

Conveyance modifications can enable drinking water to be moved through the Delta with less risk of contamination by seawater or naturally occurring organic material found in the Delta. The conveyance modifications can also reduce the detrimental effects on fish of moving water through the Delta by reducing unnatural flow patterns, screening diversions, and providing alternative diversion points.

The technical issues associated with the decision about conveyance alternatives are explored in detail in the following chapters. CALFED recognizes that this discussion is occurring in the presence of substantial historical conflict over water use in the State (evidenced most dramatically by the divisive confrontation over the Peripheral Canal in 1982). CALFED believes that the process it has established to analyze and review water management issues (including Delta conveyance) offers the best hope for reaching consensus on these issues.

Delta Levee Improvements Interrelationships

Delta levee improvements reduce the risk that levees will fail during flood periods or as a result of earthquakes or gradual deterioration. This can protect not only lives and property of those who would otherwise have been flooded, but can also protect wildlife habitat from inundation. Strong levees also protect water quality for all who use Delta water. The land surface of Delta islands is often below the level of the water in surrounding channels, because the organic peat soils have subsided over time. When a levee fails, water rushes onto the island and draws salty water up into the Delta from the Bay. This salty water in the Delta channels may be unsuitable for irrigation of crops on lands that are not flooded, and may be unsuitable as a drinking water source for urban areas that get their water from the Delta. Regaining a suitable supply may not be possible in the short-term or the long-term.

Improvements to Delta levees can be made in ways that accommodate habitat restoration so that levees can simultaneously protect land uses, protect water quality, and support a variety of wetland, aquatic, and riparian habitats.

Ecosystem Restoration Interrelationships

Actions to restore ecosystem health are very diverse, encompassing actions that help restore ecological processes and functions and reduce the different kinks of stressors that have been placed on the Bay-Delta system. Many actions focus on the restoration of physical habitat including shaded riverine aquatic habitat along the banks of Delta channels, shallow water habitat, tidal and seasonal wetlands, and riparian forests. All of these habitat types can be compatible with levee restoration in various Delta areas. Other actions are designed to reduce fish mortality by screening diversions, both small diversions along rivers and channels and large Delta export diversions. Water flows are also important for fish and aquatic habitats. By acquiring water for the ecosystem through transfers and by using storage facilities to capture water at high flow periods, additional flows can be made available at appropriate times to meet the needs of aquatic species. Control of undesirable exotic species is also an important part of ecosystem management. Over time, these actions can lead to the Delta ecosystem being more resilient and less subject to damage from the effects of water diversions and levee maintenance resulting in less conflict and greater future flexibility.

Water Quality Interrelationships

Program actions to improve water quality focus on source control: improving the quality of water that flows through the Bay-Delta system by addressing water quality concerns at their source. In some cases, this may involve cleanup of abandoned mines that leach toxic heavy metals from mine tailings. In other cases, water quality may be improved by conserving water on a farm or an urban landscape, reducing the amount of runoff that finds its way back into streams. Modifications to Delta conveyance can improve water quality in the Delta by reducing salinity. This, in turn, can improve water supply reliability: high quality Delta water can be blended with lower quality water from other sources to stretch water supplies. Water quality improvements can also facilitate water recycling. When water is used it becomes saltier. Recycling this water may produce water with unacceptable salinity levels if source water is too salty to begin with.

Watershed Management Coordination Interrelationships

The watershed management coordination element of the Program consists of engaging local watershed organizations in planning and implementing the CALFED Program and coordinating among these organizations to more efficiently and effectively implement the CALFED Program. In the lower watershed, the focus will be on ecosystem restoration and water quality actions. In the upper watersheds, the immediate focus will be on partnership projects with local entities in the upper watershed to improve water quality and habitat, decrease erosion, and increase base flows in the tributaries to the Delta. This coordinated approach to improving the condition of watersheds can increase the reliability of predictable amounts of water flowing into the Delta during dry seasons by slowing down the rate at which water leaves the upper watershed.

Economic and Financial Interrelationships

The Program will propose extensive investments in the resources of the Bay-Delta system, to be implemented and paid for over the next several decades. Implementation will provide opportunities to economize in many ways, as single actions yield benefits in multiple resource areas. Other actions, such as water quality source control, may prove more economical than alternatives such as treatment of degraded water before use. Other aspects of the Program will be unavoidably costly. For example, if new reservoirs are included in the Bay-Delta solution, they will likely provide water at higher costs than existing projects. This is because the most economical storage sites have already been developed, and new reservoir operation would likely be more conservative and protective of the ecosystem. Thus, despite the opportunities for economy, implementation will be costly and water costs will almost certainly go up. The additional cost will be justified and the program affordable if it results in a healthy Bay-Delta system that more successfully meets the demands that we place on it.

The Program has viewed financing from the standpoint that beneficiaries will pay their proportion of the cost of actions that yield benefits for them. Adherence to such a policy, with water users being asked to pay the full cost of any expensive new supplies, would change perspectives on the cost-effectiveness of other measures such as conservation, recycling, and water transfers. The price of obtaining water determines whether storage is economically justified, whether water users decide to transfer their water, which water efficiency measures are cost effective, as well as the level of demand for water from the Delta system.

The combination of these actions and their economic effects serves to reduce the mismatch between supply and demand for water from the Bay-Delta system. There is incentive to reduce demand due to higher costs of obtaining water. The demand reduction comes in the form of increased conservation and recycling, greater incentive to use alternative supplies, including those from outside the Delta system, and as forgoing some water use. Water transfers within the Bay-Delta system, perhaps augmented with supplies from new or expanded storage, help to complete the water supply reliability picture.

Putting it All Together

John Muir said that "When we try to pick anything out by itself, we find that it is hitched to everything else in the universe." This certainly applies to solving problems and reducing conflict in the Bay-Delta system. A few examples demonstrate the interrelationships:

- Modifications in Delta conveyance provide greater channel capacity in some areas, reducing the danger of winter flooding. The modified conveyance improves the flexibility to divert more at times when fish species are less likely to be drawn to Delta pumps, and curtail pumping at times when fish are at greater risk. At these times, water users in export areas can use groundwater in conjunction with surface supplies to assure a reliable supply. Demands in the export areas are lower than previously expected due to implementation of conservation and recycling measures, further reducing the mismatch between supply and demand.

- A local conservancy along a tributary to the Sacramento River helps ranchers to modify grazing practices and fence a riparian corridor along the creek. Over time, soil erosion is reduced, which improves the quality of spawning grounds in the tributaries, and the land holds water for longer periods. Grazing conditions improve. Peak winter flows are reduced slightly, and the creek has greater base flow through the summer. Water temperatures go down, and conditions are improved for salmon.

- Delta landowners incorporate habitat improvements into a levee rehabilitation project. Farms and wildlife habitat on the Delta island are better protected from floods. There is less risk to water quality in the Delta from levee failure, so the Delta provides a more reliable water supply. Along the water side of the improved levee, habitat conditions are better for Delta fish, bird, and plant species.

- A farmer in the Sacramento Valley conserves water by capturing tailwater that runs off his field and reusing it. In the process, he takes less irrigation water out of the river and releases less runoff back into it. Fewer fish are entrained by his pumps, and downstream water quality improves.

The CALFED Program proposes actions that will be implemented throughout the watershed and export areas. We can divide the actions into those that improve water supply reliability, improve water quality, restore ecosystem health, or improve Delta levees, but this classification of actions obscures the interrelationships. Take away any action, and it is harder to meet Program objectives in two, three, or even four resource areas. It is harder to reduce conflict. This is why a comprehensive Bay-Delta solution, although challenging in scope, holds the greatest promise to improve the system for all beneficial uses.

System Variability and the Time Value of Water

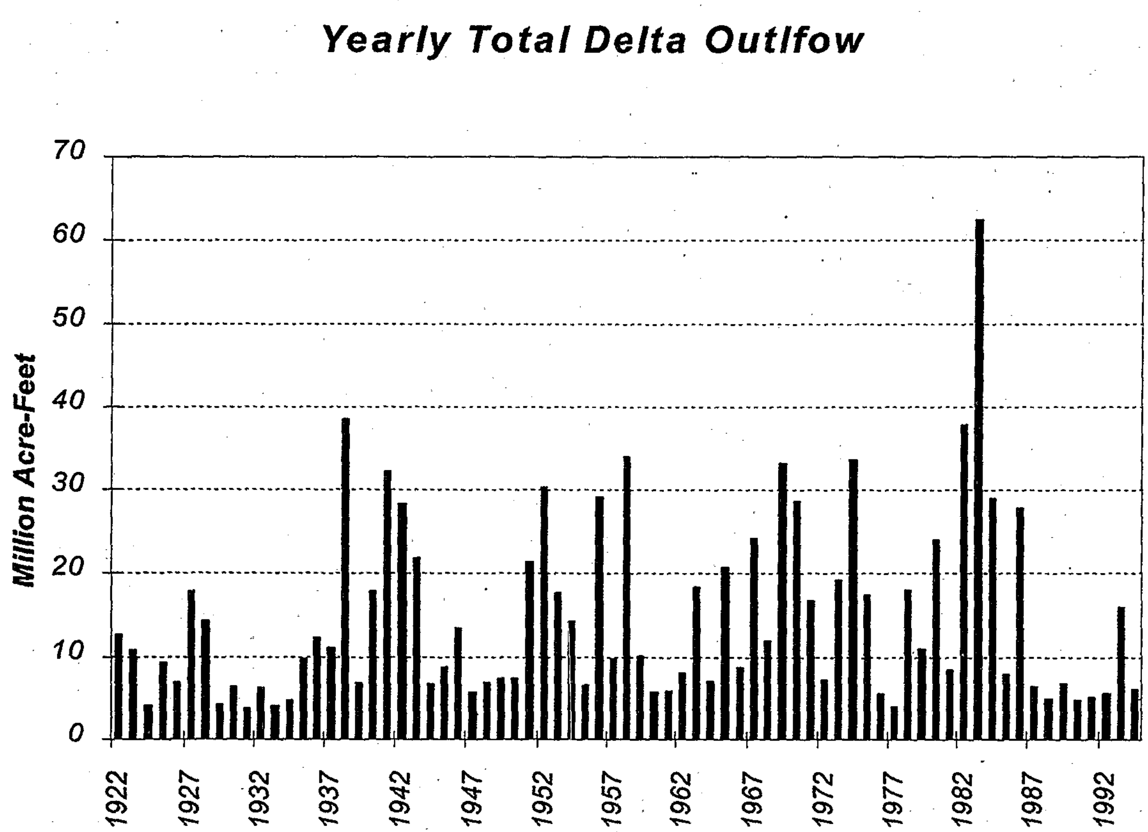
The watershed of the Bay-Delta system is subject to a highly variable rain and snowfall pattern. The total amount of precipitation and runoff in the watershed varies widely from month to month and from year to year. Year types are classified from wet to critically dry. Within any given year, whether wet or dry, most of the rain falls in the winter months, while snow pack typically melts in the late spring and early summer. In other months, water flow is typically much lower, leading to dramatically different flow levels for different months. Even within each month, flow can vary widely.

Some Examples of Flow Variation
Total Delta Inflow

- High Delta inflow: **69** MAF
- Low Delta inflow: **6** MAF
- Average Delta inflow: **24** MAF

Planners often discuss water in terms of averages that describe overall system performance-- average Delta outflow, average water project deliveries -- but there is more conflict over water management in drier years than in average years. Furthermore, average values are often misleading because they mask the incredible variability in flows in the Bay-Delta system. An increase in average outflow may have a minor beneficial effect on the environmental health of the system, but if outflow can be increased during a dry year or during a critical period within a year, the benefits may be far greater. Similarly, an increase in water supplies for urban and agricultural users may be desirable during an average year, but critically important to local economies during a drought.

The figure below shows a simulated yearly total Delta outflow for the period from 1922 to 1994. The simulated Delta outflow is based on historical hydrology, but with existing storage and conveyance facilities in place and operating to meet 1995 level of demand. The graph reflects the average annual variability that occurs from year to year. Memorable extremes, such as the drought of 1976-77, are quite apparent. It is during drought periods such as this that competition between water diverters and in-stream water needs are felt most keenly.



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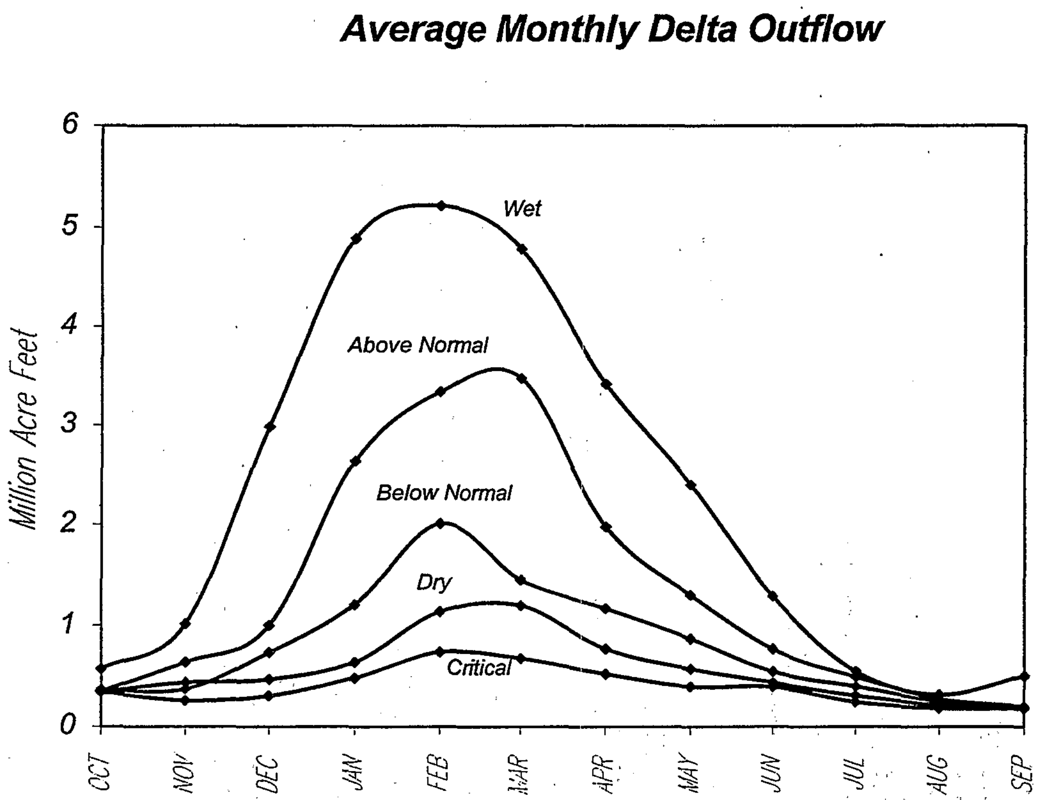
The next figure, a plot of average monthly Delta outflow for each of five water year types, illustrates both the variability among years and the variation in flows throughout the year. Late summer flows are low in all year types, but there is great variation in the magnitude of outflow during the wet winter and spring months.

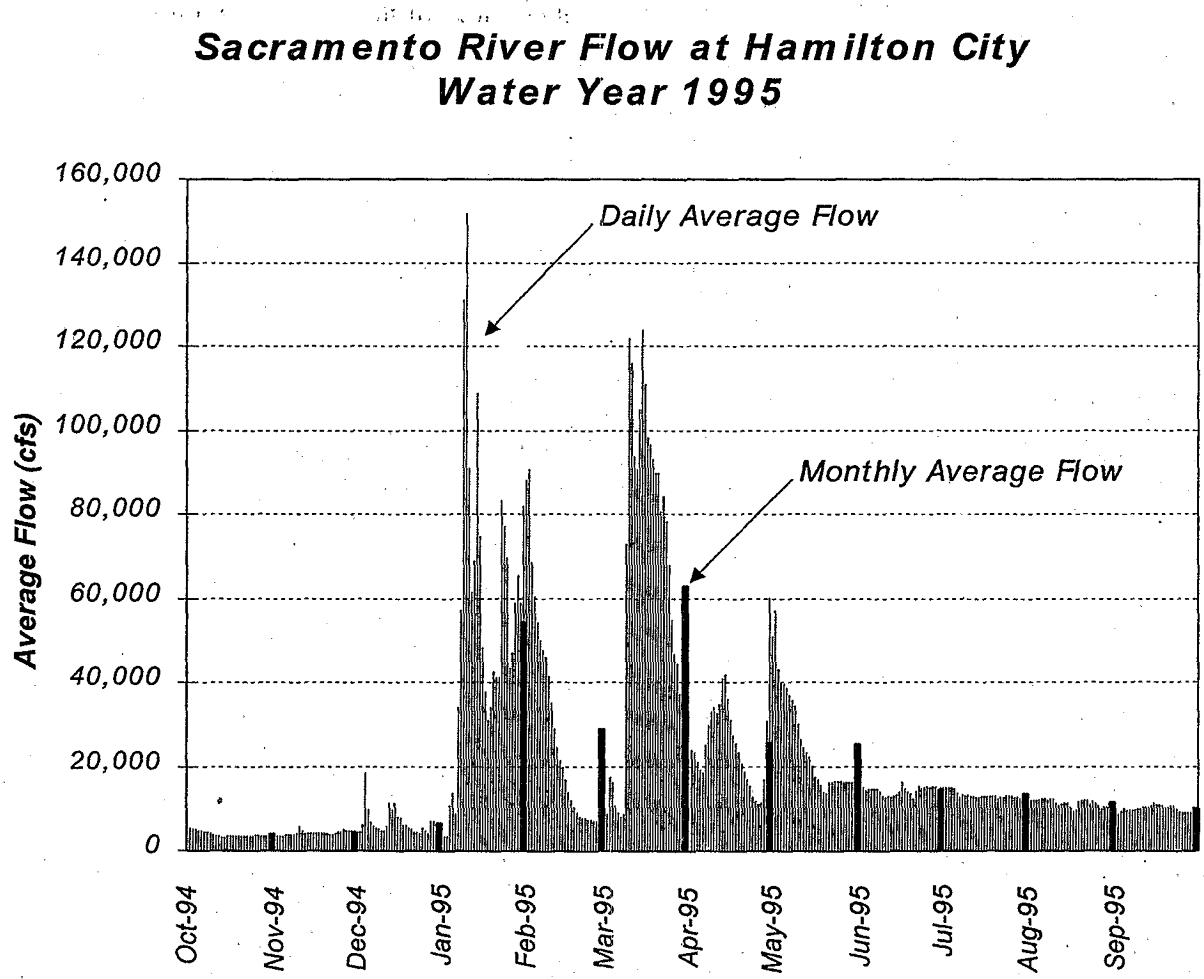


Demand for water also varies over time. Demands tend to be higher than average in dry years, because there is less natural soil moisture, and plants need more irrigation. Water demand also varies seasonally; the demand is highest in summer, when natural flows are lowest.

As these figures illustrate, while average flow data are useful for long-term water management planning, averages obscure the reasons for conflict over Delta flow and Bay-Delta water management. Conflict arises when water is scarce, and the averages do not illustrate the scarcity that occurs at the low flow levels within a given month or year. The conflicts that arise during times when water is in short supply create the need for a more effective water management strategy.

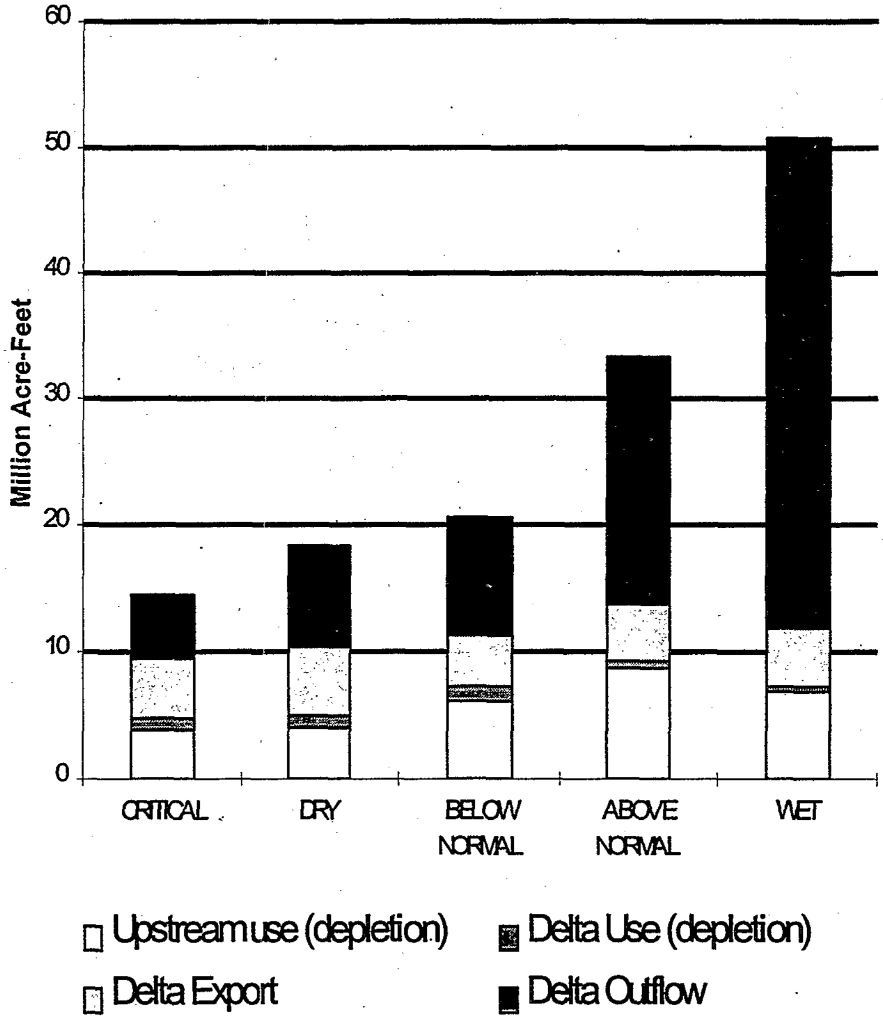
The water flow variability is most notable when daily flows are examined. The figure below presents a graph of daily flows throughout a water year. For comparison, average monthly flows are also shown (thicker black bars). The average monthly flows mask the much greater variation exhibited in daily flows that rise and fall with the passing of each major storm system. It is quite typical for winter and spring storms to produce periodic peaks in flow such as those shown in January, March, and May.

These peak flows are very important to ecosystem health; they cleanse and move gravel in riverbeds where salmon spawn, they give rivers the energy to meander and thereby sustain a host of ecological processes related to river banks and riparian vegetation, and they send behavioral cues to fish, inducing them to spawn or migrate.



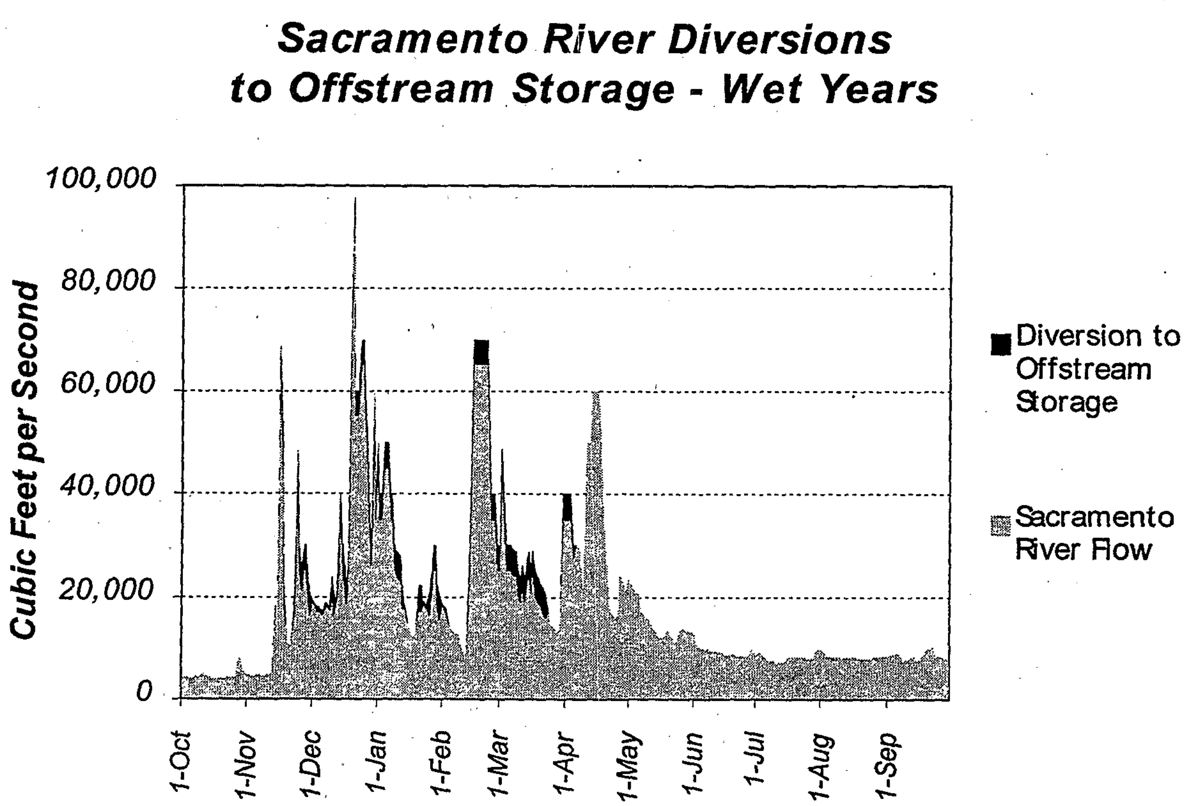
In water years that are very dry, the natural peaks in flow may not be as high as in wetter years, or some of the typical peaks may not occur at all. Water is more valuable to all users in these dry years, so the peak flows may be further reduced through the operation of reservoirs in which scarce water is captured for use later in the year. Thus, the impact of water management activities on important peak flow events is greatest during years when natural flows may be most sensitive to disturbance. The adjacent figure, based on data contained in Department of Water Resources Bulletin 160-93, illustrates this point. During wet years, approximately 20 percent of the water is diverted from the system for other uses. In a critical year, approximately 70 percent of the water is diverted, and there is considerable conflict between fisheries and diversions. During years of low outflow, and especially during periods when peak flows might typically occur, water has its highest value for all beneficial uses.

Bay-Delta System Water Use By Water Year Types



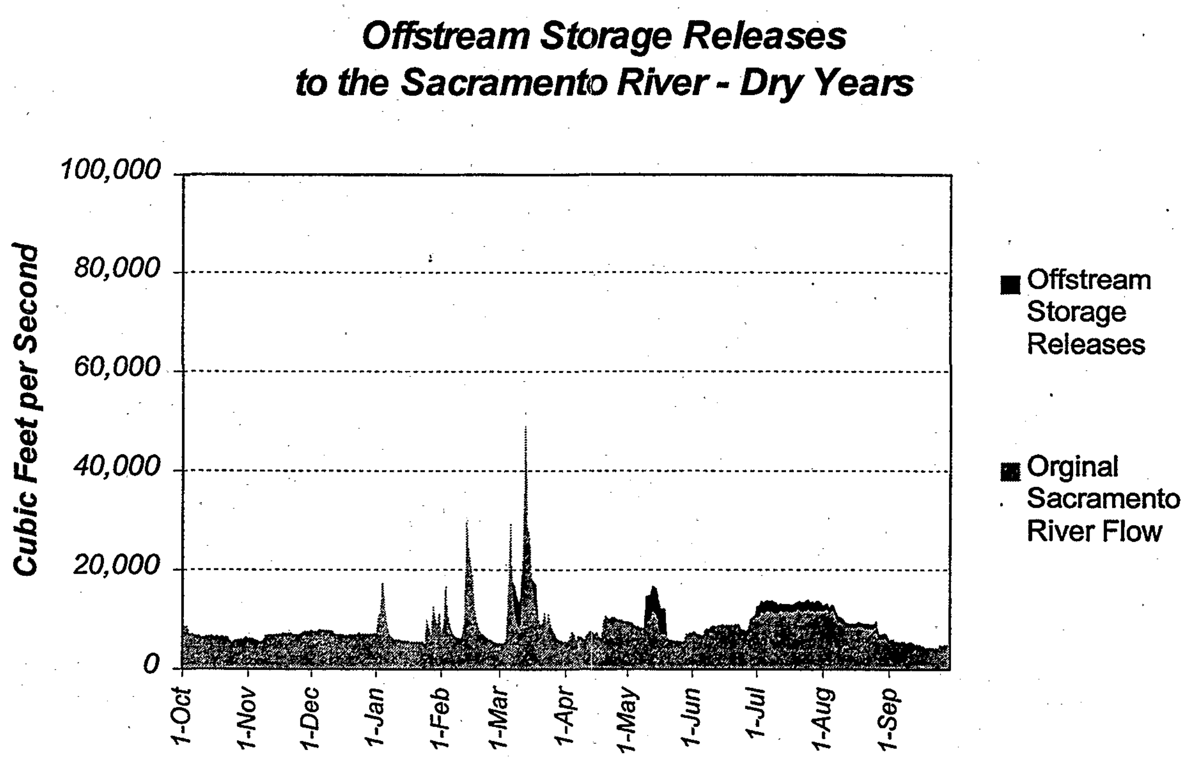
One of the greatest challenges for the Program is to reduce this conflict while simultaneously improving ecosystem quality and water supply reliability. This can be done by recognizing that the value of water varies according to its quantity and timing in the system. This recognition can be used to the advantage of both water diverters and the ecosystem. The importance of a unit of water in the system is not fixed; it varies according to the flow rate, the time of year, and the water year type. Thus, it is possible to increase the diversion and storage of water during some high flow periods (while preserving peak flows that serve important functions in the system) in order to provide water supply later for diverters and the ecosystem. Some of this stored water can be used to augment outflow peaks during dry years, when there is keen competition for water. At these times, water operations have their greatest impact on the ecosystem, and additional water is most needed by Bay-Delta species. In concept, water can be diverted from rivers upstream of the Delta into storage during high flow periods with relatively little impact on the system and can be released at other times to produce great benefit to the system. Of course, this type of diversion must be operated in a way that preserves most of the variability in the flow, ensuring that peak flows so important to ecosystem health still occur in the river.

The figures below show a hypothetical example to illustrate the concept. The first diagram shows a wet year, with the black area representing water that is diverted into storage. Runoff from upstream tributaries to the Delta usually occurs in large volumes over short periods of time in the winter and spring. New or reoperated existing storage upstream of the Delta could store a portion of these flows with relatively little impact on the ecosystem.



Diversions would need to be made according to criteria ensuring that the environmental impacts of diversion during wet periods were less than the subsequent environmental benefits of releasing some of this water during critical periods. This is a more vital consideration associated with enlarged on-stream storage compared to off-stream storage; large amounts of water can quickly be detained in on-stream storage, while due to conveyance capacity constraints, only a minor percentage of large peak river flows can be diverted to off-stream storage. The construction and operation of any new or enlarged storage facility will require much additional study during the remainder of Phase II and during Phase III of the Program to determine whether storage projects are environmentally acceptable and/or economically feasible.

The figure below shows a hypothetical dry year, and the black areas represent releases of previously stored water to augment flows for fisheries and water supply. Water could be released to meet direct needs or to provide additional benefits through exchanges. For example, water could be released from off-stream storage in the Sacramento River basin directly to local water users, reducing existing diversions from the Sacramento River during periods critical to fisheries. Water released for environmental purposes could include pulse flows that act as behavioral cues or help transport fish through the Delta. Water could also be released to provide sustained flows for riverine and shallow water habitats and improve water quality in the Delta during drier years.



The validity and appropriate role for "the time value of water" concept in California water management have not been fully discussed within the broader stakeholder and scientific communities. Additional work remains to identify and resolve controversy related to the concept, determine specific parameters (flow rates and timing), and scientifically evaluate the potential effects of this approach.

Adaptive Management

No long term plan for management of a system as complex as the Bay-Delta can predict exactly how the system will respond to Program efforts or foresee events such as earthquakes, climate change, or the introduction of new species to the system. Adaptive management, as an essential Program concept, acknowledges that we will need to constantly monitor the system and adapt the actions that we take to restore ecological health and improve water management. These adaptations will be necessary as conditions change and as we learn more about the system and how it responds to our efforts. The Program's objectives will remain fixed over time, but our actions may be adjusted to assure that the solution is durable.

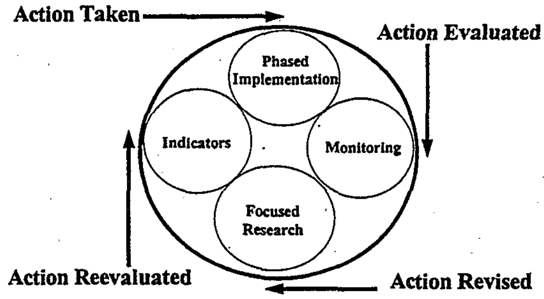
The concept of adaptive management is an essential part of every CALFED Program element, as well. In every part of the Program, new or more intensive actions are proposed. Along with these proposed actions comes uncertainty. What actions work best to achieve Program objectives? How can these actions be modified to work better, cost less, or be simpler to implement? How should the emphasis among actions change over time? Are there new or different actions that should complement or replace those that are being implemented? An adaptive management approach helps to answer these questions.

The concept of adaptive management can be illustrated as applied to the Ecosystem Restoration Program element. A critical step of the ecosystem restoration element is to construct a comprehensive adaptive management framework that includes policy and management decision-making based on existing and newly developed scientific and technical information. To be effective, this process also needs to consider the ecological, economic, and social goals of communities, agencies, and interested parties and to incorporate these distinct values into the design of the adaptive management process.

Adaptive management has a dual nature. First, adaptive management is a philosophical approach toward restoration that acknowledges we need to better understand the Bay-Delta watershed if we are to succeed in restoring ecosystem health. It acknowledges that we will proceed with restoration efforts using existing information while we gather the knowledge that we lack. Although we know much about the Bay-Delta system (its ecological processes, habitats, and species), we do not know everything we need to successfully restore ecosystem health. The adaptive management philosophy accommodates the status of knowledge and provides an avenue to obtain the necessary knowledge (and experience) through the duration of the implementation period.

Second, adaptive management is a structured decision-making process that includes important components to identify indicators of ecosystem health (indicators); a program for monitoring indicators of ecosystem health (monitoring); a program for implementing research to gather new or additional information (focused research); a process to optimize the implementation projects through time (staged implementation); a feedback process to integrate knowledge gained from monitoring and research; and the flexibility to change the program in response to new information.

Adaptive Management



Even within the area of adaptive management there are linkages among Program elements and opportunities for more effective action. This is especially true for the Ecosystem Restoration Program and the Water Quality Program. There is a lack of conclusive information about cause and effect relationships and how much restoration is needed for a "healthy" ecosystem and good water quality. An effective adaptive management program requires the continuous examination of monitoring data to measure progress and redirect activities where necessary. CALFED is currently identifying the monitoring, assessment, and research needs for CALFED-related projects, actions, and activities. A Comprehensive Monitoring, Assessment, and Research Program (CMARP) is a critical component of the CALFED adaptive management strategy. The CMARP has focused initially on ecosystem restoration but will be essential for successful implementation of other Program elements, as well.

The concept of adaptive management will be developed more fully for all program components as implementation plans are developed later in Phase II of the Program.

Adaptive Management and Assurances: A Delicate Balance

In developing its adaptive management program for different Program elements, CALFED must be aware of the potential conflict with the need for "assurances." The assurances package being developed is intended to assure that each component of the entire decades-long Program is actually implemented and operated as agreed. Although the adaptive management process must allow the Program the advantage of new information arising during the course of implementation, it cannot be so broadly flexible that agencies and stakeholders have no certainty that a Program element will be carried out effectively. To achieve a proper balance of these goals of certainty and adaptability, CALFED will need to make creative use of institutions, agreements, scientific review, and stakeholder processes.

Related Concepts

There are several other concepts that will figure prominently in any successful Bay-Delta solution, and issues that must be adequately resolved to move forward. This section provides an introduction to some of these important issues and concepts.

Common Delta Pool - The Delta is often referred to as a water supply hub. Many of the individuals and agencies that use water from the Bay-Delta system divert their water supplies directly from the Delta itself, including in-Delta agricultural users, some Bay area communities, and the state and federal water projects. This reliance by many users on a single source is sometimes called the common pool concept. Accompanying the use of a common pool is common interest: a shared interest in restoring, maintaining, and protecting Delta resources, including water supplies, water quality, levees, and natural habitat. Water users who currently have no alternative to Delta supplies and people who live and work in the Delta region believe that the maintenance of the common pool is their best guarantee of continued broad interest in maintaining and improving Delta conditions.

Under each alternative for the CALFED Program, all diverters would continue to take some or all of their water from Delta channels, maintaining the common Delta pool concept. Under any variation of Alternative 1 or 2, all Delta diverters would continue to be fully reliant on the Delta channels for water supplies they take from the system. Under Alternative 3, a dual conveyance system would allow some water users to take some of their Delta supplies from the Sacramento River upstream of the Delta. Facilities to do this would be sized so that even these diverters would continue to depend on the common pool for part of their water supplies.

Conjunctive Management Regional Concerns - Conjunctive management is the operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the groundwater basin for later use in place of, or to supplement, surface supplies. Water is stored by natural recharge or by intentionally recharging the basin during years of above-average water supply. Residents of areas where conjunctive management may occur have concerns over development and operation of facilities by entities outside the region, due to potential impacts on existing groundwater resources. CALFED is evaluating the development of additional conjunctive management and groundwater banking opportunities as one potential way to help maximize the overall water supply and protect groundwater resources. However, as noted elsewhere, CALFED has not yet determined whether any additional storage will be part of the Program.

Currently, CALFED is pursuing an outreach program to local communities to determine in which areas interest exists in participating in a locally-controlled conjunctive use program. CALFED has developed guiding principles that are designed to protect resources, help address local concerns, and avoid potential impacts prior to implementing a conjunctive management operation. The draft principles developed to date include the following:

- Funding support will be provided for local assessment of groundwater resources.
- Conjunctive management programs will be voluntary.
- Groundwater will first be used to meet local water needs.
- Transfers outside the basin will involve appropriate compensation for the resource.
- Pilot programs, in addition to computer models, will be used to evaluate local conjunctive management potential and mitigation requirements.
- Conjunctive management projects will be overseen by local agencies in partnership with other entities to assure that concerns are addressed through interest-based negotiation.
- Groundwater withdrawals must be managed to avoid land subsidence and aquifer destruction.

Conjunctive management is, by definition, the operation of a groundwater basin in combination with a surface water storage and conveyance system for more effective management of the water supply. The CALFED alternatives assume that development of any groundwater system for conjunctive management cannot be effective without access to surface storage that enables water to be retained and released as needed.

Area-of-Origin/Water Rights - Area-of-origin statutes protect the rights to water in watersheds where the water originates from uses outside these watersheds. This is an important concept for communities in the area-of-origin watershed that will grow over time and will need more water than they are currently using. CALFED supports this concept and will develop its Program consistent with the laws and regulations protecting areas of origin. Phase II analysis examined potential programmatic impacts of the proposed alternatives on areas of origin.

Coordinated Permitting - To ensure timely and successful implementation of the CALFED Bay-Delta Program, a coordinated permit process will be established. The process needs to anticipate the numerous permit requirements for all actions approved as part of the Program. Coordinated permitting cannot result in relaxation of permitting requirements, but must include good information sharing among permit agencies to make the permitting process more efficient. In 1998, the conceptual framework for the process will be developed.

It is expected that the coordinated permit process and framework will include the following components: a permit assistance team to assist the project proponents in understanding and obtaining the required permits, and a regulatory permit review team dedicated to the CALFED projects. The regulatory team (comprised of agencies responsible for permitting) would be provide timely review of environmental documentation, close interagency coordination, and development of mitigation measures and monitoring requirements. The permit coordination framework would also be designed to address broad issues to improve the efficiency of permitting such as, general and regional permits and mitigation banks.

Initially, the coordinated permit framework will be applied to the near-term ecosystem restoration projects currently being funded. As other elements of the Program are approved, those projects and actions would also benefit from the framework.

Coordinated Flood Control and Flood Plain Management - The federal government and the State of California have recognized the need for a comprehensive approach to flood plain management as described in reports such as the 1997 Governor's Flood Emergency Action Team (FEAT) Report, Federal Public Law 87-874, and the 1998 Energy and Water Development Appropriations Bill.

The U.S. Army Corps of Engineers' Sacramento and San Joaquin River Basins Comprehensive Study is addressing the general objectives of flood damage reduction and ecosystem restoration. The study will ultimately have implementation plans for long-range management of both river systems. The study will include consideration of the full range of structural and non structural flood damage reduction measures, as well as the diverse, but interrelated, water and land management objectives. Downstream of these studies, the Sacramento-San Joaquin Delta Special study is investigating the potential for future Corps ecosystem restoration and flood protection projects within the Delta region itself. In addition, the Long-Term Management Strategy (LTMS) for handling and disposal of dredged materials from San Francisco Bay could lead to availability of dredge material for levee construction and habitat restoration. Corps flood protection studies will be fully coordinated and compatible with other related programs and will contribute directly towards meeting the goals of the CALFED Long-Term Levee Protection Plan and Ecosystem Restoration Plan.

North and South Delta Flood Improvements - The CALFED Long-Term Levee Protection Plan is focused on improving levee protection within the Delta. The plan includes 1) base-level funding to provide equitably distributed funding to participating local agencies in the Delta, 2) special improvement project funding with priorities funding for special habitat improvement and levee stabilization projects to augment the base-level funding, 3) Delta island subsidence control plan, 4) emergency management plan, and 5) seismic risk assessment. The Long-Term Levee Protection Plan addresses potential island flooding for all areas of the Delta, not just the north and south Delta.

San Joaquin Drainage - San Joaquin drainage problems have been evaluated in several studies over the past two decades. Complete resolution of the San Joaquin drainage problems is beyond the scope of the CALFED Bay-Delta Program. However, some CALFED actions can reduce the San Joaquin drainage problems. For example, improved water quality (reduced salinity) to the Delta Mendota Canal would result in improved San Joaquin drainage and improved quality water in the San Joaquin River. Therefore, the CALFED Water Quality and Water Use Efficiency Programs include actions which control agricultural surface and subsurface drainage to improve water quality in the San Joaquin River region. In addition, actions included in the Water Use Efficiency Program have been effective in reducing drainage problems while simultaneously improving agronomic viability.

Recreation - CALFED seeks to plan for recreation enhancement and, if necessary, to mitigate impacts to Delta recreation resulting from CALFED activities designed to restore other Delta resources. Construction of new facilities will provide for appropriate on-site recreation development. The responsibilities and procedures for recreation development at new storage and other facilities is clearly addressed in current law. Federal and state laws and local laws and plans govern recreation developments associated with water development projects in and near the Delta. The Draft Programmatic EIS/EIR and accompanying technical reports address general impacts that CALFED Program implementation could have on recreational resources and on how the recreational resources could impact the other parts of the Program.

Within the existing CALFED framework exists the need and opportunity for recreation planning. Such planning could identify and prioritize recreation enhancement and mitigation projects for implementation once a preferred program alternative is selected. Specific recreation mitigation and enhancement actions and projects could then be selected appropriate to need. The time line of such a process should be consistent with the Phase III documentation and implementation schedule, ensuring that recreation resources are appropriately considered as part of the Bay-Delta solution.

Climate Change/Sea Level Rise - CALFED is proposing significant investments to improve water quality, ecosystem quality, water supply reliability, and levee system integrity. The long-term durability of the Program could be adversely affected by future climate changes.

The geologic record shows evidence of past substantial changes in global and regional climates with the resultant marks from flooding and droughts. Sea level changes are directly related to extremes in climate change. For example, sea levels were 2 to 6 meters higher than present levels during the last interglacial period of 125,000 years ago and approximately 120 meters below present levels during the last Ice Age, 20,000 years ago. Considering this wide range of sea level fluctuation, the Delta has likely existed with current sea levels for only small portions of the geologic history.

Future sea level changes are difficult to estimate because not enough is known about how the ice sheets in Greenland and Antarctica will react to global warming, and how much global warming may occur. Warming may cause not only melting of ice sheets and land-based glaciers, but some thermal expansion of the sea water itself. If global warming causes increased precipitation at very high latitudes and resultant storage of water in the ice sheets, sea level could actually decrease.

Estimates of current sea level rise in the neighborhood of 1.5 millimeters per year is typical in the literature. One study estimates that global warming may cause further rise of about 18 centimeters (0.7 foot) by the year 2030. Also, if current trends in greenhouse gas emissions continue, the study estimates the rise could amount to 1 meter (3.3 feet) above current levels by 2100. A similar evaluation by the U.S. Environmental Protection Agency estimates that sea levels may rise globally approximately 20 inches (range of 6 to 38 inches) by year 2100 and average global temperatures could increase by 2 degrees Celsius (range of 1 to 3.5 degrees C).

Rising sea levels could have significant adverse impacts on the Delta system (including habitat, water supply, and Delta agriculture) if levees are overtopped or if substantial future investments are required to prevent overtopping. Higher sea levels would increase salinity levels throughout the Delta and for many miles inland. This would alter the effectiveness of Program habitat restoration projects and likely alter the entire ecosystem of the Delta. Water diversions dependent on taking water from the Delta channels would likely need to be abandoned and moved inland to areas of lowered salinity. While these changes are potentially significant over the long term (hundreds or thousands of years), they are unlikely to significantly alter Program facilities or operations within the foreseeable future (20 to 50 years).

The long-term change in temperatures could result in more variability in precipitation and runoff from year to year and season to season. Higher flooding could become more common at times, and drought periods could become more frequent, increasing competition for remaining scarce water supplies. Some estimates indicate that California will experience an increase in winter runoff and a decrease in spring and summer runoff, with a resultant decrease in water supply and reliability in the Central Valley Basin.

Agricultural Land Conversion in the Delta - Agricultural land conversion in the Delta resulting from the Program is limited to that needed for implementation of levee system improvements, ecosystem restoration, and other facilities. Possible land area in the Delta affected by Program implementation could range from approximately 140,000 to 200,000 acres, depending on the alternative. Some of this land is already owned by the government, and other possibilities such as the reclamation of Franks Tract will be considered prior to converting prime agricultural land. CALFED seeks to preserve as much prime and unique agricultural land as possible during Program implementation in Phase III. To offset Delta regional agricultural production losses, CALFED is investigating the concept of supporting efforts to preserve agricultural production on a regional or statewide basis.

Agricultural Land Conversion in Service Areas - Agricultural land conversion in the service areas (areas served water by the SWP and the CVP) is included in the CALFED alternatives as a potential measure to improve water quality by reducing discharges from drainage lands with selenium problems. The CALFED policy is not to convert land to reduce water demands. However, depending on water supply and water transfer opportunities available in the various alternatives, farmers may choose to change cropping patterns, temporarily fallow land, or permanently take land out of agricultural production. Program implementation will require some land conversion to accommodate new facilities or restoration activities. Possible land area in the service areas affected by Program implementation of facilities, ecosystem restoration and water quality could range from approximately 75,000 to 140,000 acres, depending on the alternative. Third party impacts of such actions will be carefully evaluated and taken into consideration.

Needs of San Francisco Bay - Several entities have expressed concern that CALFED is not directly focusing on promoting the health of San Francisco Bay, particularly the Central and South Bay areas. It is true that the Program has not included San Francisco Bay as part of its defined problem area (which includes the legally defined Delta, Suisun Bay extending to Carquinez Strait, and Suisun Marsh). Nevertheless, because the Bay-Delta system is part of a larger water and biological resource system, solutions to address the problems in the system will include a broader geographic scope extending both upstream and downstream. This solution scope includes San Pablo Bay, San Francisco Bay, and portions of the Pacific Ocean out to the Farallon Islands. In particular, the Program will address interactions between the Delta and San Francisco Bay, such as flow or sediment, by examining the "inputs" and "outputs" from the defined problem area. Using this approach, outputs such as flow or sediments that are needed to protect the rest of the Bay are considered within the scope of the Program. At the same time, however, problems which originate and are manifest outside of the Program's problem area, such as toxic discharges into the South Bay, are not within the scope of the Program.

Elements of CALFED's Ecosystem Restoration Program will benefit the health of San Francisco Bay. Ecosystem restoration actions would include provision of additional springtime Delta outflow, habitat improvements in the North Bay, watershed management actions surrounding the Bay, and control of exotic species throughout the ecosystem. In addition, improved water quality (through implementation of the Water Quality Program) and reduced sedimentation (due to greater sediment retention in wetland, riparian and floodplain habitats) in flows from the Delta would also contribute to a healthier Bay. Finally, Bay Area water districts that receive some of their water supply from the Delta would potentially be impacted by the Water Use Efficiency Program.

In addition, given CALFED's solution principle that solutions should have no significant redirected impacts, consideration needs to be given to how each alternative might negatively affect San Francisco Bay. The Draft Programmatic EIS/EIR evaluates impacts (both adverse and beneficial) of the CALFED alternatives on the San Francisco Bay region.

Relationship to the San Francisco Estuary Project and its Comprehensive Conservation and Management Plan - The San Francisco Estuary Project (SFEP), a cooperative federal-state partnership, was established in 1987 under the auspices of the U.S. Environmental Protection Agency's National Estuary Program, to protect and restore the San Francisco Bay-Delta Estuary, while protecting its many beneficial uses. In 1993, the SFEP completed its Comprehensive Conservation and Management Plan (CCMP) for the estuary, a consensus plan developed cooperatively by over 100 government, private and community interests. The CCMP includes goals, objectives and actions in nine program areas - aquatic resources, wildlife, wetlands, water use, pollution prevention and reduction, dredging and waterway modification, land use, public involvement and education, and research and monitoring. Establishment of the CALFED Bay-Delta Program has raised questions about its relationship to the SFEP and implementation of the CCMP. CALFED has incorporated many of the goals, objectives and actions from the CCMP. In addition, CALFED ecosystem restoration funding has been awarded to several projects that implement actions from the CCMP. Many of the interests involved in development of the CCMP are also active participants in the development of the CALFED solution.

Navigation - Not all of the Delta waterways follow natural channels. Some were constructed for navigation which is an important Delta function. In addition to periodic navigational work on many Delta waterways, the U.S. Army Corps of Engineers built and maintains two commercial shipping channels through the Delta. The ports of Stockton and Sacramento are served by the Stockton Deep Water Ship Channel, completed in 1933, and the Sacramento Deep Water Ship Channel, completed in 1963. Most of the length of these channels have since been deepened to 35 feet. It is possible that changes in flow patterns may result in changed operation and maintenance requirements of the channels.

Effects on Hydropower Generation - The CALFED Program has no specific objectives for hydropower generation. However, CALFED does seek to minimize negative impacts on other resources, such as hydropower generation, during and after implementation. The Program may result in temporary or long-term changes in river and reservoir operations, which may affect the quantity, timing and value of hydropower produced within the Bay-Delta system. Also, additional pumping may increase the amount of Project Energy Use, that is, power consumed by the CVP and the SWP to move water through the system. An increase in Project Energy Use can reduce the amount of surplus hydropower that might otherwise be available for sale from the CVP (necessary to repay Project debt), and may increase the amount of power that must be purchased from outside sources to meet SWP Project Energy Use. Replacement for reduced availability of renewable hydropower would likely come from fossil fuel or other thermal generation. CALFED is coordinating with the Western Area Power Administration to assure that issues are identified and properly framed, so consequences and options are clear to stakeholders, the public, and the CALFED decision-makers.

3. PROGRAM ALTERNATIVES

Phase II is focusing on evaluating variations to alternatives developed in Phase I and preparing a Programmatic EIS/EIR for twelve of these variations. These alternatives are programmatic in nature, intended to help agencies and the public make decisions on the broad methods to meet Program objectives. The alternatives are not intended to define the site specific actions that will ultimately need to be designed. For example, the alternatives are not intended to define the precise size and location for surface water storage. They are intended to provide the decision makers enough information on whether or not storage within a certain a size range is warranted, for example, in the Sacramento River watershed.

> Alternatives are intended to provide information on broad programmatic issues, not site specific issues.

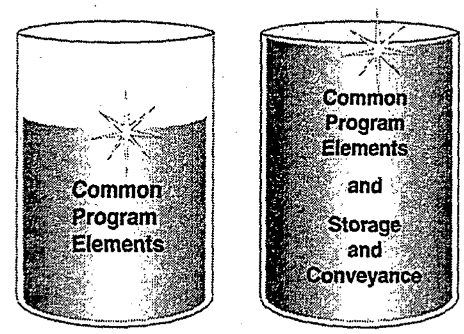
The alternatives are comprised of building blocks referred to as Program elements. The basic structure from Phase I contained **common** and **variable** Program elements which were used to build the Phase II alternatives and variations. Common Program elements included levee system integrity, water quality, ecosystem restoration, and water use efficiency and variable elements included storage and conveyance. During Phase II, it was recognized that two additional common Program elements (water transfers and watershed management) were needed because of their multi-objective impact. Using the six Program element descriptions more accurately characterizes the nature of the actions, even though all the actions in each of the programs were evaluated in the environmental analyses.

The common or foundational Program elements resulted from a realization during Phase I that some categories of actions were so basic in addressing Bay-Delta system problems that they should not be optional nor be made to arbitrarily vary in level of implementation. These common Program elements are also distinguished from the variable storage and conveyance elements in that each consists of hundreds of individual actions which can be implemented over a twenty to thirty year period. They will be guided by specific policy direction and an ongoing adaptive management framework and require local partnerships, coordination and cooperation. The storage and conveyance Program elements are different in that they generally require a more classic "yes" or "no" decision with respect to the need for new or modified facilities (e.g. off-stream storage or Delta conveyance facilities).

The six common Program elements provide the foundation for overall improvement in the Bay-Delta system. These Program elements represent a significant investment in and improvement (reduction) of the resource conflicts in the system. Each of the individual elements is a major program of its own. For example, the ecosystem Program element represents the largest, most complex restoration ever undertaken. The levee element in isolation will result in significantly improved system integrity by strengthening levees throughout the Delta. The water quality element will dramatically lower toxicants in the system. Water use efficiency is expected to avoid over 3 MAF of water demand annually by year 2020. A more effective and protective water transfer market will provide critical ecosystem flows without regulatory action and will result in a reduction of drought-induced economic damage. The watershed management strategy is a long-term effort to coordinate the planning and implementation of the CALFED Program with and among local watershed management organizations in order to achieve a more efficient, effective and integrated approach.

However, the performance of each common element is enhanced when developed together as part of the total Program. Additionally, the total performance is enhanced (or the risks reduced) by the range of modifications under consideration in the storage and conveyance Program elements.

A significant part of the overall performance of the CALFED Bay-Delta Program is attributable to the common Program elements. The variable Program elements further enhance performance, provide greater operational certainty and Program balance, and reduce potential redirected impacts.



This chapter first provides an overview of the common and variable program elements. Included in this overview are sidebar discussions of the principle issues that have been raised by agencies and stakeholders about the particular program elements. Further discussion of how CALFED intends to address these issues is included in Chapter 5, below.

The remainder of this chapter describes the 12 alternative variations built from these Program elements, and shows the process CALFED used to evaluate and revise these 12 alternative variations into three refined alternatives.

Common Program Elements

The alternatives for the CALFED solution are assembled from hundreds of programmatic actions. To help organize the discussion of alternatives, the actions are summarized below under each of the major Program elements introduced above. The common program elements remain relatively unchanged from one alternative to another:

- **Long-Term Levee Protection Plan** - Provides significant improvements in the reliability of the Delta levees to benefit all users of Delta water and land
- **Water Quality Program** - Makes significant reductions in point and non-point

pollution for the benefit of all water uses and the Bay-Delta ecosystem

- **Ecosystem Restoration Program** - Provides significant improvements in habitat for the environment, restoration of some critical flows, and reduced conflict with other Delta system resources

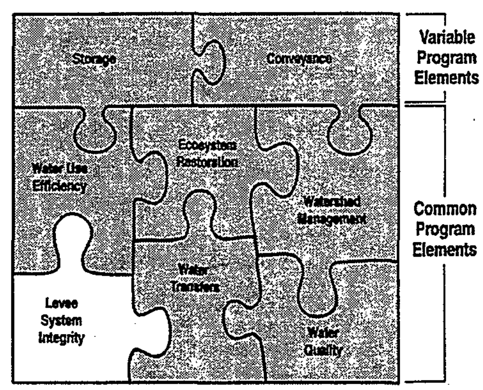
- **Water Use Efficiency Program** - Provides policies for efficient use of water in agricultural and urban settings and environmental purposes which is essential to using existing water supplies wisely and assuring efficient use of any new supplies developed through the Program

- **Water Transfer Policy** - Provides a policy framework to facilitate and encourage a properly regulated water market to move water between users, including environmental uses, on a voluntary and compensated basis

- **Watershed Management Coordination** - Encourages locally-led watershed management activities that benefit all Delta system resources

These Program elements remain relatively the same for all alternatives. They are supplemented with various Delta conveyance configurations and options for storage in assembling into alternatives.

Long-Term Levee Protection Plan



The Sacramento-San Joaquin Delta is an area of great regional and national importance, which provides a broad array of benefits including agriculture, water supply, transportation, navigation, recreation and fish and wildlife habitat. Delta levees are the most visible man-made features of this system. Historically, the levee system has been viewed as a means of protecting other resources. However, levees are an integral part of the Delta landscape and are key to preserving the Delta's physical characteristics and processes including definition of the Delta waterways and islands.

Given the numerous public benefits protected by Delta levees, the focus of the Long-Term Levee Protection Plan is to improve levee stability. There are five main parts to levee protection plan:

1. Base-Level Protection Plan - Base-level funding provides equitably distributed funding to participating local agencies in the Delta. One of the primary goals of the CALFED Program is to reconstruct all Delta levees to a particular standard. CALFED

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has tentatively selected the U.S. Army Corps of Engineers PL 84-99 standard. This standard provides criteria to reconstruct levees to 1.5 feet above the Federal Emergency Management Agency's (FEMA) 1986 Flood Hazard Mitigation Plan 100-year flood level and is a prerequisite for requesting post-flood disaster assistance. However, the selection of any levee standard must be compatible with available funding. If the selected levee standard is too low then many of the benefits the levees provide will be lost. If the levee standard is too high then reconstruction becomes too expensive for most local agencies and implementation is not uniform.

Long-Term Levee Protection Plan
Issues and Concerns

- There is concern that the cost of implementation may exceed the benefits; Program goals must be clear and alternative forms of risk management should be considered.
- Proper integration of the Levee, Water Quality, and Ecosystem program elements is essential and may require a specific management entity to assure integration. In particular, levee and ecosystem restoration objectives may be challenging to achieve simultaneously.
- Levee strengthening and the proposed design of setback levees results in the conversion of productive agricultural land. Government land acquisition and continued private land ownership must be evaluated.
- There is concern that support for the levee restoration program would wane if an isolated facility were built.
- There is concern that levee system integrity cannot be sustained if Delta land uses continue to cause subsidence; subsidence reversal should be a more prominent part of this program element.
- A major levee improvement program may require substantial dredging in the Delta and rivers, and this dredging may adversely affect water quality and sensitive fish and wildlife resources.
- The long term sustainability of levee maintenance and associated agricultural activities needs to be evaluated with particular emphasis on areas with peat soils and identification of financial and policy incentives and disincentives to maintain levees.

2. Special Improvement Projects - The special improvement project funding establishes a funding mechanism for special habitat improvement and levee stabilization projects to augment the base-level funding. Under the special improvement projects, flood protection would be enhanced for key islands that provide statewide benefits to the ecosystem, water supply, water quality, economics, and the infrastructure. Special improvement project funding is based on the benefit to the public , not solely on the need for improvement.

3. Delta Island Subsidence Control Plan - Interior island subsidence due to oxidation of Delta peat soils increases the effective height of the levees. As the island soils disappear, the levee needs additional fill material to hold back the same water level. This rebuilding is a substantial required maintenance cost. Continued subsidence can directly jeopardize the long-term viability of the Delta levee system. The plan focuses on reducing the risk to levee stability from subsidence by funding grant projects to develop best management practices.

4. Emergency Management Plan - The most recognizable threat to Delta islands and resources in the Delta is inundation due to winter flood events. In addition, other potential disasters can be caused by high tides and high winds, earthquakes, burrowing animals whose actions can cause levees to fail, toxic spills, failure of Delta levees during low flow periods, and fire. Approximately 20 islands have flooded since the 1960s, including repeated flooding of some islands. The emergency management plan will build upon existing state, federal, and local agency emergency management programs to improve protection of Delta resources in the event of a disaster.

5. Seismic Risk Assessment - Earthquakes can cause levees to fail by slumping or liquefaction of underlying soils. To date, there have been no known Delta island inundations as a result of seismic events. However, there are several active faults located sufficiently close to the Delta to present a threat to Delta levees. The seismic risk assessment will evaluate the potential performance of the existing levee system during seismic events.

Long-Term Levee Protection Plan Facts and Figures

- Helps protect land uses, water quality, and water supply reliability.
- Provides new opportunities for habitat.
- Remains relatively unchanged between alternatives.
- **Meets Program objectives for reducing vulnerability to the Delta system.** However, seismic risk is uncertain.
- Requires additional research on seismic vulnerability.
- Could exceed $ 1 billion over 20-30 years or more. However, an affordable annual investment rate a critical issue that will require prioritization given the extent of eligible areas (e.g. if only $1 billion is funded some standards for some areas may need to be relaxed). Annual investment rates may exceed $30 to $35 million.

The levee plan will remain relatively unchanged among the alternatives. Delta channel modifications for conveyance may require setback levees along the alignment or a different levee cross section depending on channel flow velocities. The levee cross sections in places may vary depending on locations selected for levee-associated habitat.

Overall potential benefits of the Delta Long-Term Levee Protection Plan include:

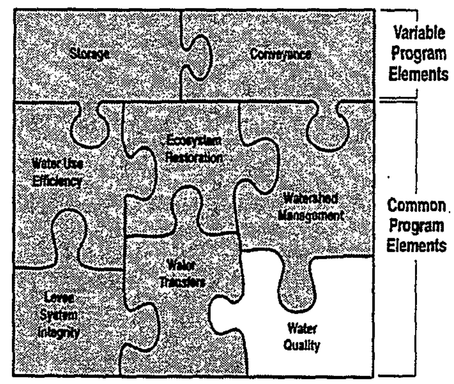
- Provides funding for

continued maintenance of levees to protect Delta functions

- Ensures suitable funding, equipment and materials availability, and coordination to rapidly respond to levee failures
- Subsidence reduction helps long-term Delta system integrity
- Increased reliability for water supply needs from the Delta and in-Delta water quality
- Increased reliability for in-Delta land use
- Increased reliability for in-Delta aquatic and wildlife habitat

For more information see the *Long-Term Levee Protection Plan Appendix* to the Draft Programmatic EIS/EIR.

Water Quality Program



The draft Water Quality Program currently includes 25 programmatic actions to further the Program's goal of providing good water quality for environmental, agricultural, drinking water, industrial, and recreational beneficial uses of water. The majority of these actions rely on comprehensive monitoring and research to improve our understanding of effective water quality management and on the ultimate control of water quality problems at their sources.

Determining impairment to a water quality beneficial use is always a difficult and complicated matter. For some beneficial uses, such as drinking water use and agricultural water use, water quality impacts on use are generally well known. For other beneficial uses such as ecosystem use, water quality impacts on species are not understood as well. As a result, the program has relied on the technical expertise of a variety of stakeholders representing beneficial uses. The 25 water quality actions include a combination of research, pilot studies, and targeted activities. This approach allows actions to be taken on known water quality problems and sources of those problems, while allowing further research of potential problems and solutions. Actions will be adapted over time to ensure the most effective use of resources.

Further research is needed for some water quality problems.

For example, for some parameters of concern, such as mercury, not enough is understood about its sources, the bioavailability of mercury to various species, factors contributing to its bioavailability, and the load reductions needed to reduce fish tissue concentrations necessary for human consumption.

In summary, the draft Water Quality Program element includes the following broad categories of programmatic actions:

- **Mine drainage** - Reduce heavy metals, such as cadmium, copper, and zinc, by source control or treatment of mine

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drainage at inactive and abandoned mine sites.

- **Urban and Industrial Runoff** - Reduce heavy metals, pesticides, nutrients, and sediment and subsequent turbidity. Evaluate loadings of total organic carbon (TOC), salinity, and pathogens in urban runoff and assess the need for source control measures to reduce these parameters of concern to drinking water beneficial uses.

Water Quality Program
Issues and Concerns

- There are differing opinions regarding the most effective program approach: a regulatory framework to enforce the objectives versus an incentive-based or "safe harbor" approach to encourage voluntary partnerships to reduce non-point sources.
- This element needs to be better integrated with other parts of the Program, including ecosystem restoration and water use efficiency.
- There is concern that this program element is not sufficiently aggressive or adequately developed to accomplish more than current water quality efforts.
- There are differing views on the specific drinking water quality targets as well as on the means to achieve drinking water quality objectives (providing the highest quality source water versus relying upon treatment methods). A cost comparison is also needed.
- There is disagreement over whether the program should include dilution-oriented actions.

- **Wastewater and Industrial Discharge** - Reduce pathogens (from boat discharges), oxygen depleting substances, selenium, and ammonia. Evaluate the loadings of TOC, salinity, and pathogens from wastewater and industrial treatment plant discharges and assess the need for source control measures to reduce these parameters of concern to drinking water beneficial uses.

- **Agricultural Drainage and Runoff** - Reduce selenium (agricultural subsurface drainage), salinity, pesticides, sediment, TOC (discharges from Delta islands), nutrients and ammonia, and pathogens (controlling inputs from rangelands, dairies, and confined animal facilities).

- **Water Treatment** - Reduce formation of disinfection by-products by controlling TOC, pathogens, turbidity, and bromides.

- **Water Management** - Use water management techniques and improved outflow patterns and water circulation in the Delta region to control salinity levels.

- **Human Health** - Reduce impairment of recreational beneficial uses within the Delta due to human health concerns associated with consumption of fish and shellfish containing elevated levels of DDT, chlordane, toxophene, mercury, and PCBs and their derivatives by research/monitoring and source control.

- **Toxicity of Unknown Origin** - Through research/monitoring identify parameters of concern in the water and sediment within the Delta, Bay, Sacramento River and San Joaquin River regions and implement actions to reduce their toxicity to aquatic organisms.

The water quality program will remain relatively unchanged among the alternatives but its performance can vary significantly depending on the other Program elements. Storage can help timing for release of pollutants remaining after source control efforts. Improved conveyance to south Delta export pumps will improve water quality for those diversions but may decrease quality for in-Delta diversions. Water use efficiency measures can improve water quality entering the Delta by reducing some agricultural drain water containing pollutants.

Water Quality Program Facts and Figures

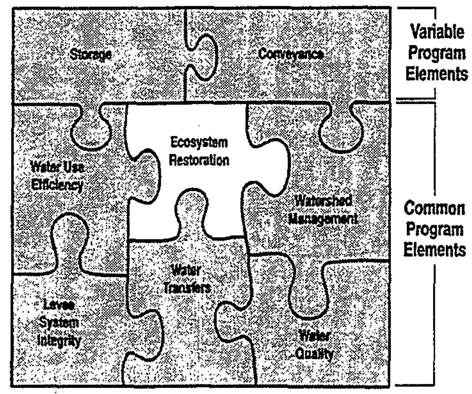
- Remains relatively unchanged between alternatives.
- Provides critically needed reduction of toxics for fisheries and an important reduction in organic carbon to improve drinking water.
- **Does not address health concerns associated with bromide without other Program elements.**
- Could exceed $0.75 billion over 20-30 years. May require annual investment exceeding $25 million.

Potential benefits of the water quality program include:

- Improves Delta water quality by reducing the volume of urban and agricultural runoff/drainage and concentration of pollutants entering the Delta
- Improves water quality for the ecosystem by reducing toxicants as a limiting factor
- Improves drinking water quality and public health benefits
- Reduces concentration of compounds contributing to trihalomethane formation potential and degradation of drinking water supplies

For more information see the *Water Quality Program Appendix* to the Draft Programmatic EIS/EIR.

Ecosystem Restoration Program



The draft Ecosystem Restoration Program (ERP) currently includes over 700 programmatic actions that, in combination with the Program elements for storage and conveyance and the other common Program elements, are expected to result in greatly improved ecological health for the Bay-Delta system. Adaptive management, scientific oversight, and program review will guide implementation of the ERP over the 20 to 30 year implementation period.

The ERP is designed to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta to support sustainable populations of diverse and valuable plant and animal species. A foundation of this program element is the restoration of ecological processes associated with streamflow, stream channels, watersheds, and floodplains. These restored processes can create and maintain habitats essential to the life history of species dependent on the Delta and can help the system function in a more sustainable way.

The ERP also focuses on Delta species. Major elements of the ERP are directed at recovering endangered species, implementing ecosystem improvements to eliminate the need for additional species listings, and providing increased abundance of valuable sport and commercial fishes. In addition, the ERP will improve population abundance and the distribution of many other aquatic and terrestrial plants and animals within the entire Bay-Delta watershed.

Some of the actions that are important for ecosystem health are already being implemented at the local level. CALFED will support and work with local conservancies engaged in restoration projects and will foster collaborative programs with local watershed groups to protect and manage watersheds in the Bay-Delta system.

In summary, the draft ERP will include the following types of actions:

- Restore, protect, and manage important habitat types, including tidally influenced fresh and brackish water marsh habitat; seasonal, fresh emergent, and nontidal perennial aquatic habitat; perennial grasslands; agricultural lands managed using "wildlife friendly" techniques; stream meander corridor and riparian land along the Sacramento River; and riparian woodland and shaded riverine aquatic habitat.

- Restore critical instream flows and Delta outflow in key springtime periods (an average of about 100,000 to 300,000 acre-feet of increased flow depending on year type, ranging from almost zero to approximately 500,000 acre feet, depending on actual year). Flow augmentation could come from water developed from new storage or from water acquisitions from willing sellers (water purchases on this scale are unprecedented).

- Develop floodways along the lower Cosumnes and San Joaquin rivers.

Ecosystem Restoration Program
Issues and Concerns

- The implementation strategy for ecosystem restoration must integrate resource priorities, scientific oversight, and collaborative decision-making involving local entities.
- There is concern that adaptive management decision making is essential but creates unique and difficult assurance issues. Some stakeholders believe these issues may be addressed best by new institutional structures.
- Habitat restoration actions require significant agricultural land conversion, particularly in the Delta. Efforts to reduce and avoid impacts should be included at the program and, subsequently, the project level.
- There are differing views on the likely success of restoring habitat in leading to recovery of fish populations without significant reductions in diversion effects at the export facilities and the restoration of natural delta flow patterns.
- There are differing views on the extent to which restoration priorities should include the San Francisco Bay area.
- The relative importance of toxics as an ecosystem stressor must be better understood.
- Better understanding and validation of conceptual ecosystem models will be necessary for success of ecosystem restoration measures and adaptive management.
- There is disagreement over the need for, and availability of, water to meet ecosystem restoration flow objectives.
- Further assessment is needed of the flows required for ecosystem restoration, and the variety of options to obtain these flows (including new storage, reoperation of existing storage and changes in diversion patterns, transfers, and regulatory measures).

- Construct setback levees to increase floodplain interactions and provide seasonal aquatic and riparian habitats.
- Develop prevention and control programs for invasive species.
- Protect sediment sources that feed streams and rivers in the Bay-Delta system.
- Support local watershed planning and management programs.

- Install state-of-the-art fish screens.
- Implement or expand fish marking programs at hatcheries and fish production facilities in the Bay-Delta system.
- Modify barriers that temporarily impair fish passage.
- Evaluate and reduce adverse effects of contaminants (addressed by Water Quality Program).
- Implement a strong ecosystem monitoring program to evaluate short- and long-term trends in ecosystem health.
- Implement a well-funded research program to provide information needed for future solutions and decisions.

The ERP will remain relatively unchanged among the alternatives. However, its performance can vary with the other Program elements. Storage can improve the timing of instream flows and Delta outflows, and can allow modification of timing of diversions. Improved conveyance to the south Delta export pumps can improve timing of diversions to reduce impacts on fish. Modified conveyance can reduce adverse Delta flow circulation issues and can also reduce the entrainment effects on fisheries. Water quality improvements through source controls and timing of remaining pollutant releases improves water quality and reduces toxicity for the ecosystem. Improvements of levees and channels for improved system integrity can also incorporate new habitat features. Reduced diversions associated with water use efficiency measures helps reduce diversion effects on fisheries.

Ecosystem Restoration Program Facts and Figures

- Remains relatively unchanged between alternatives.
- Provides critically needed habitat and reduction of other stressors to the environment.
- Supports restoration of important ecological processes.
- **ERP alone may not provide for the recovery of listed species; recovery rates of listed species will also be influenced by the selected water storage and conveyance features..**
- Could exceed $1.5 billion over 20-30 years. Annual investments exceeding $50 million may be required.

Potential benefits of the Ecosystem Restoration Program include:

- Reverses the decline in ecosystem health by reducing or eliminating factors that degrade habitat, impair ecological functions, or reduce the population size or health of species

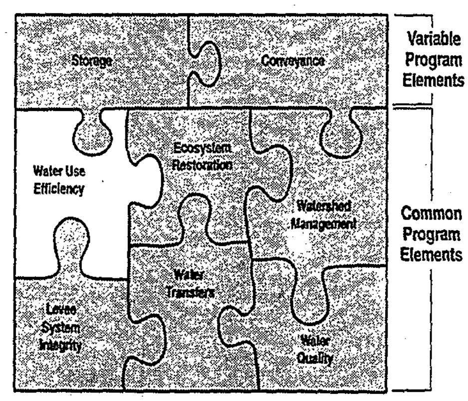
- Supports a healthy Bay-Delta ecosystem that provides for the needs of plants, animals, and people using the system

- Supports sustainable production and survival of plant and wildlife species, including resident species and migrants such as the waterfowl that use the Pacific Flyway each winter

- Reduces the conflict between fisheries and water supply opportunities

For more information see the *Ecosystem Restoration Program Plan Appendix* to the Draft Programmatic EIS/EIR.

Water Use Efficiency Program



The CALFED Water Use Efficiency Program builds upon the fact that implementation of efficiency measures occurs mostly at the local and regional level. The CALFED policy toward water use efficiency is a reflection of the State of California legal requirements for reasonable and beneficial use of water: existing water supplies must be used efficiently; any new water supplies that are developed by the Program must be used efficiently as well.

The role of CALFED agencies in Water Use Efficiency will be twofold. First, they will offer support and incentives through expanded programs to provide planning, technical, and financial assistance. Second, the CALFED agencies will provide assurances that cost-effective efficiency measures are implemented. Some potential water use efficiency benefits, such as water quality improvements, may be regional or statewide rather than local. These are situations in which CALFED planning and cost-share support may be particularly effective.

Based on a more detailed analysis provided in the *Water Use Efficiency Program and Water Transfers Appendix* to the Draft Programmatic EIS/EIR, estimates of potential conservation and water recycling are summarized in the following table. Values represent water savings expected to occur for future conditions regardless of the outcome of a CALFED solution (termed no-action) as well as the incremental savings expected from a CALFED solution. Representative values shown in this summary table are all midpoints in value ranges contained in the *Water Use Efficiency Program and Water Transfers Appendix*.

	Net Water Savings [1] (1,000 acre-feet annually)		
	Urban Conservation	Agriculture Conservation	Urban Recycling
CALFED No Action (occur as future trends in absence of a Bay-Delta solution)	1,480	230	1,170
CALFED Program (result of CALFED Program actions)	740	160	300
Total	2,220	390	1,470
		Grand Total	4,080

1. "Net water savings" is water available for reallocation to other water supply uses. Reductions in applied water would be greater.

With respect to urban and agricultural conservation, CALFED proposes to rely largely on locally-directed processes to provide endorsement or certification of urban and agricultural water suppliers that are properly analyzing conservation measures and are implementing all measures that are cost-effective and feasible. Organizations composed of water suppliers and public interest or environmental groups already exist that may be able to serve this function. Endorsement or certification of water suppliers will enable CALFED agencies to target assistance programs and other measures to assure reasonable and beneficial use.

The draft Water Use Efficiency Program includes the following actions.

Conservation related actions include:

- Work with the California Urban Water Conservation Council and the Agricultural Water Management Council to identify appropriate urban and agricultural water conservation measures, set appropriate levels of effort, and certify or endorse water suppliers that are implementing cost-effective feasible measures.
- Expand state and federal programs to provide sharply increased levels of planning, technical, and financing assistance and develop new ways of providing assistance in the most effective manner.
- Help urban water suppliers comply with the Urban Water Management Planning Act.
- Help water suppliers and water users identify and implement water management measures that can yield multiple benefits including improved water quality and reduced ecosystem impacts.

- Identify and implement practices to improve water management on wildlife refuges.

Water Use Efficiency Program
Issues and Concerns

- The program does not include a strong component of direct demand management actions such as agricultural land conversion to reduce water diversions or reduce and delay the need for storage facilities. The analysis of alternatives should include varying ranges of demand management, including reclamation, conservation, pricing, and land retirement/fallowing.
- The program must expand conservation implementation to include measures that are cost-effective from a statewide perspective but not from the local perspective; an open and active water market will do this, but only in areas where conserved water may be transferred.
- There is some disagreement over the current program approach, which emphasizes incentives and markets more than a regulatory framework.
- Processes to demonstrate efficient use through certification or endorsement by stakeholder councils will need additional refinement, stakeholder consensus, and continuing CALFED financial assistance to succeed.
- There is concern that the Agricultural Water Management Council does not provide adequate assurance of efficient use because it lacks broad stakeholder support, and the process for endorsement of agricultural water management plans is untested.
- The program is considering two water management practices -- measurement of water deliveries and volumetric pricing -- as conditions of receiving new or transferred water made available through CALFED.
- There must be assurance of strong CALFED support for programs to provide assistance with planning, financing, and implementation of local water use efficiency measures.
- Analysis that shows greater potential for urban water conservation than agricultural water conservation is counterintuitive and should be supported by water balance studies.

Water recycling actions include:

- Help local and regional agencies comply with the water recycling provisions in the Urban Water Management Planning Act.
- Expand state and federal recycling programs in order to provide sharply increased levels of planning, technical, and financing assistance, and develop new ways of

providing assistance in the most effective manner.

- Provide regional planning assistance that can increase opportunities for use of recycled water.

Assurances will play a critical role in the Water Use Efficiency Program element. The assurance mechanisms are structured to ensure that urban and agricultural water users implement the appropriate efficiency measures. As a prerequisite to obtaining CALFED Program benefits (receiving "new" water, participating as a buyer or seller in a water transfer, receiving water from a drought water bank) water suppliers will have to show that they are in compliance with the applicable urban or agricultural council agreements and applicable State law. This requirement will result in serious analysis and implementation of conservation measures identified in those agreements. In addition, CALFED is considering a requirement that recipients of "new" or transferred water meet water measurement and volumetric pricing requirements developed under the Central Valley Project Improvement Act (CVPIA).

A high level of water use efficiency may also be assured through the concept of linked implementation. Widespread demonstration of efficient use by local water suppliers and irrigation districts could be a prerequisite to CALFED implementation of other Program actions for water supply reliability. This concept will be developed further as CALFED considers staging of Program actions.

Economic analyses are underway that will compare water use efficiency options (including conservation, recycling, and transfers) and new facilities and identify least-cost ways of meeting CALFED objectives. These analyses are expected to better define the mix of demand management options and water supplies from new facilities. CALFED will work with stakeholders on technical and implementation issues as these analyses proceed.

The draft Water Use Efficiency Program remains relatively unchanged among the alternatives. However, depending on the alternative, more or less implementation of water use efficiency measures may occur at the local level as water suppliers integrate efficiency measures into their integrated resources planning. The effectiveness of water use efficiency methods can be enhanced by storage of the saved water for later use. For example, the groundwater banking and conjunctive use programs in Delta export areas such as the San Joaquin Valley and the Tulare Lake Basin and in the Sacramento Valley could enable water users to bank conserved water for use in times of shortage. The extent of feasible water recycling is affected

Water Use Efficiency Program Facts and Figures

- Remains relatively unchanged between alternatives.
- Is an essential part of overall water management.
- Emphasis is on providing technical, planning, financing assistance.
- Could exceed $0.75 billion over 20-30 years. May require annual investment exceeding $25 million.

by efforts to maintain and improve water quality. Source water that is high in salinity may not be suitable for subsequent recycling.

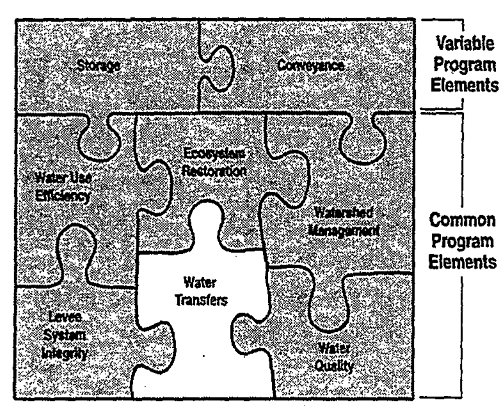
Potential benefits of the water use efficiency program include:

- Reduces demand for Delta exports and reduces related entrainment effects on fisheries
- Can help in timing of diversions for reduced entrainment effects on fisheries
- Could make water available for transfers to water users and for environmental flows
- May improve overall Delta and tributary water quality
- Could reduce the total salt load to the San Joaquin Valley

For more information see the *Water Use Efficiency Program and Water Transfers Appendix* to the Draft Programmatic EIS/EIR.

Water Transfer Framework Policy

Water transfers are currently an important part of water management in California and offer the potential to play an even more significant role in the future. An open and active water transfers market will improve the economic efficiency of water use and will provide an incentive for water users to implement cost-effective conservation measures that yield transferable water. A viable transfers market will help ensure realistic evaluation of the cost-effectiveness of any new supply development, helping to avoid premature investment or over-investment in supply facilities, such as surface storage. The Program is addressing water transfers from both a technical and policy perspective. Technical considerations related to conveyance and storage are discussed later in this report. A water transfer policy framework is being established to resolve many of the issues that currently constrain transfers or raise concerns when transfers do occur.



The policy framework is expected to provide an effective means of moving water between users on a voluntary and compensated basis, as well as a means of providing incentives for water users to implement management practices that will improve water use efficiency. Transfers can also

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provide water for environmental purposes in addition to the minimum instream flow requirements if there is adequate accounting and tracking of instream transfers.

Water transfer policy must also provide a means of ensuring that water transfers do not merely improve short-term water supply reliability at the expense of local communities or groundwater resources. Reductions in groundwater can occur when users of surface water transfer this water to others and switch to groundwater instead. Local communities can be affected when agricultural land is taken out of production to transfer the water that would have been used for irrigation. All of those dependent on an agricultural economy -- from farm workers to farm equipment mechanics -- can be adversely affected. Strong mechanisms to avoid or mitigate water transfer impacts to third parties and groundwater resources will be essential elements of a CALFED water transfer policy.

There are many technical issues related to water transfers over which there is disagreement or insufficient resolution. Examples of these issues include the definition of transferable water and access to conveyance facilities. Resolution of each technical issue will allow an incremental increase in water market activity. CALFED is working to resolve these issues.

Water Transfer Framework Policy
Issues and Concerns

- In regions where conserved water may be transferred, the existence of an open and active water transfer market will provide a critical economic incentive for water conservation.
- The program must implement effective measures to protect rural economies and lifestyles from unintended transfer impacts, protect groundwater resources from transfer impacts, and facilitate and encourage instream flow transfers. This may be difficult but will be essential.
- An independent transfers clearinghouse may be necessary to provide adequate public review of transfers so they are properly regulated. There are varying opinions on the degree and type of restrictions that should be imposed on a water transfer market.
- Additional water transfers, including transfers across the Delta, may have many of the same environmental effects as existing water conveyance and diversion. Transfers policy should encourage transfers that are environmentally beneficial or benign and discourage others.
- There must be a process to examine and recommend resolution of the many technical and institutional issues currently limiting a water transfers market.

The CALFED water transfer element will propose a policy framework for water transfer rules, baseline data collection, public disclosure, and analysis and monitoring of water transfers, both short and long-term. The element, in its final form, may also identify areas where additional regulation or statutory changes are desirable. Such modifications to existing policy are expected to facilitate the water transfer market, although the annual volume of transfers will still be dependent on locally developed agreements and assurances.

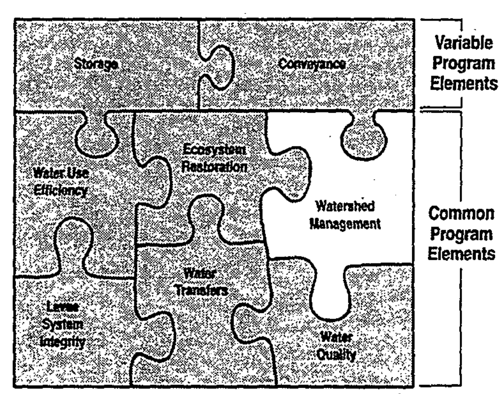
Development and refinement of the water transfers policy framework will be guided by several criteria that form the basis of California transfers policy:

- Water transfers must be voluntary.
- These transactions must result in the transfer of water that truly increases supply, not the transfer of "paper water" such as water that a transferor has never used, or water that would have been available for downstream use even in the absence of the transfer.
- Water rights of sellers must not be impaired.
- Water transfers must not harm fish and wildlife resources and their habitats.
- Transfers must not cause overdraft or degradation of groundwater basins.
- Entities receiving transferred water should be required to show that they are making efficient use of existing water supplies.
- Water districts and agencies that hold water rights or contracts to transferred water must have a strong role in determining how transfers are conducted.
- The impact on the fiscal integrity of the districts and on the economy of small agricultural communities cannot be ignored.

For more information see the *Water Use Efficiency Program and Water Transfers Appendix* to the Draft Programmatic EIS/EIR.

Watershed Management Coordination Plan

Watershed management is a broad term used to describe diverse actions that maintain or improve environmental conditions and resource management throughout a watershed. There are many potential watershed management actions in the Bay-Delta system that are consistent with the CALFED mission and can contribute to meeting CALFED objectives for ecosystem quality, water quality, water supply reliability, and levee and channel system integrity.



CALFED's approach and level of involvement in watershed management actions will vary according to the location where these actions take place. The Bay-Delta watershed can be divided into two distinct areas that reflect differing physical characteristics of the watershed:

- The upper tributary watershed above reservoirs and major fish passage obstructions

- The lower watershed, generally below those major fish passage obstructions

In the lower watershed, CALFED proposes hundreds of programmatic actions that are included in the various Program elements. CALFED and the CALFED agencies will be actively involved in these actions. In the upper watershed, the Program proposes relatively few actions. CALFED will support the efforts of others in the upper watershed primarily by helping to coordinate these activities. Coordination is important throughout the upper and lower watershed because there are so many entities working on watershed management: individuals, local conservancies and other non-governmental organizations, and government agencies at the local, regional, state, and federal levels.

Watershed Management Issues and Concerns

- There is concern that the Program's draft watershed management strategy is not adequately developed and does not define clear goals and objectives for CALFED.
- Watershed management efforts must emphasize partnerships among the public, local watershed organizations, and governments at all levels.
- There is concern that the program focuses too much on the lower watershed; efforts below and above the major dams must be integrated and there needs to be a long-term commitment to upper watershed investment.
- The watershed management strategy should be fully integrated with all program elements, especially those addressing water quality and ecosystem restoration.

The following are examples of watershed management projects that can make improvements in each CALFED resource area:

- Ecosystem Quality - Watershed projects that improve riparian habitat along streams, increase or improve fisheries habitat and passage, restore wetlands, or restore the natural stream morphology affecting downstream flows or species may benefit ecosystem quality.
- Water Quality - Watershed management activities may benefit water quality in the Delta by helping to identify and control nonpoint sources of pollution and identify and implement methods to control or treat contaminants. Watershed projects which reduce the pollutant loads in streams, lakes, or reservoirs could measurably improve downstream water quality.

- Water Supply Reliability - Meadows and riparian corridors in the upper watershed tend to slow the rate of runoff and allow more percolation of water into aquifers. When meadows erode and riparian corridors are degraded, runoff during storms can occur at higher rates. This makes flood management more difficult and reduces the opportunities to capture runoff in downstream reservoirs. Watershed management projects to restore meadows and riparian corridors can attenuate the peak flows that occur during storms and allow more of this water to be absorbed into aquifers of the upper watershed. This water can contribute to increased stream base flow later in the season which improves water supply reliability and provides environmental benefits for fish and wildlife.

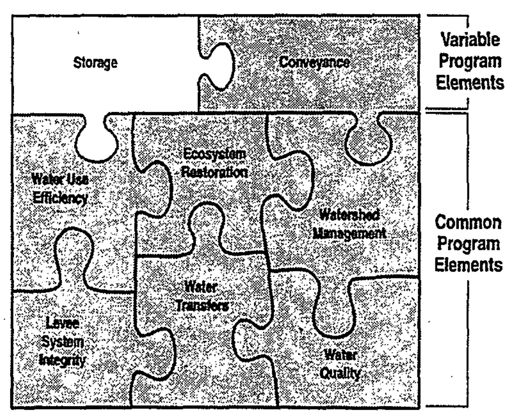
- Levee and Channel Integrity - Attenuation of flood flows coming from the upper watershed can provide benefits far downstream in the system. Delta levees are most vulnerable during high winter flows, so watershed management that reduces these flows can help maintain the integrity of Delta levees.

For more information see the *Watershed Management Coordination Appendix* to the Draft Programmatic EIS/EIR.

Variable Program Elements

In addition to the common program elements described above, some of the alternatives include provisions for new or expanded water storage. Each alternative includes modification of Delta conveyance. The variable program elements of storage and conveyance are described below.

Storage



Storage may or may not be included in the CALFED alternatives. Storage of water in surface reservoirs or groundwater basins can provide opportunities to improve the timing and availability of water for all uses. The benefits and impacts of surface and groundwater storage vary depending on the location, size, operational policies, and linkage to other Program elements. As described in more detail in Chapter 2, by storing during times of high flow and low environmental impact, more water is available for release for environmental and consumptive purposes during dry periods when conflicts over water supplies are critical. Properly managed, storage turns low value water into high value water for all uses.

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Surface storage can often provide other important benefits including flood control, power generation and regulation, and recreational opportunities. However, construction of surface storage reservoirs can result in significant terrestrial and aquatic impacts and is generally very costly. Groundwater storage, in general, has fewer terrestrial and aquatic impacts and is less costly than surface storage, but is limited in flexibility due to slower rates of storage and withdrawal compared to surface storage. Other issues such as adverse effects on third parties and fish and wildlife, land subsidence, costs of electric power for pumping, and degradation of water quality in aquifers must be addressed before implementing any groundwater storage program.

A significant amount of storage exists in the Sacramento – San Joaquin system today. Beginning in the 1920s, large reservoirs were built in Northern California for hydroelectric power, flood control, and to provide a more reliable source of water supply. There are now over 30 major reservoirs within the Sacramento – San Joaquin system with a combined gross capacity of over 25 MAF. Average annual unimpaired runoff (the amount of runoff that would occur in the absence of dams and diversions) in the two river basins is about 27 MAF.

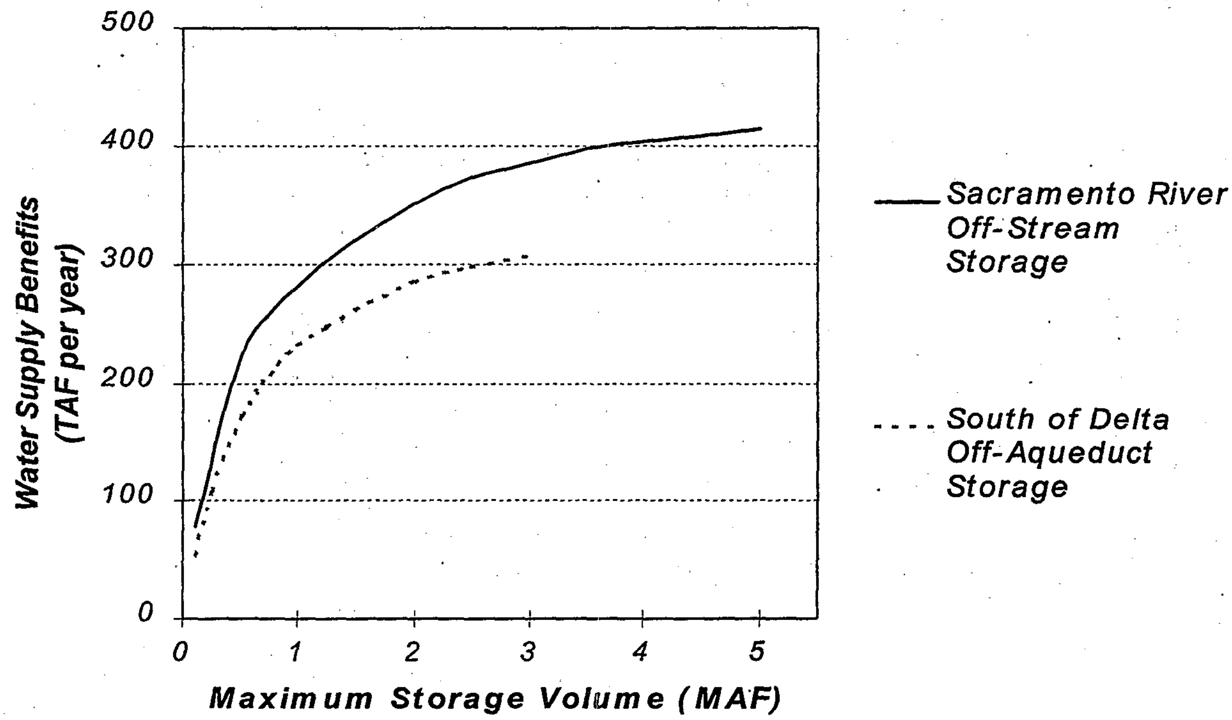
Storage
Issues and Concerns

- Some stakeholders view surface storage as a physical assurance to avoid groundwater impacts of conjunctive management programs.
- There are concerns that storage must be financed on a strict "beneficiaries pay" basis because subsidizing the cost of water from storage would undermine a transfer market and limit implementation of water use efficiency measures.
- Some stakeholders believe that surface storage should only be considered as part of a staged alternative or in the context of linked implementation: storage would not be constructed until certain milestones had been achieved (such as in transfers and water use efficiency).
- Additional economic and environmental analysis must be completed to compare marginal costs and determine the appropriate balance among new storage, water use efficiency, and water transfers.
- Some stakeholders view new storage as essential to improving water supply reliability. Strong assurances must be developed for water suppliers due to the long lead time to develop new storage.
- Environmental or operational concerns have been raised about specific potential storage sites which may make these sites infeasible or cost-prohibitive.
- The "time value of water" concept for operating reservoirs to yield net environmental and water supply benefit must be analyzed carefully under different scenarios of operation and water year type to confirm feasibility.
- Some stakeholders believe the Program's water supply objectives should be quantified.

During Phase II, CALFED evaluated various types of new storage components for their potential to contribute to an overall approach to meeting Program objectives. Different types of storage components would provide different kinds of benefits. Storage upstream of the Delta would function differently than storage adjacent to export canals downstream of the Delta. Off-stream surface storage provides different benefits and generally fewer environmental impacts than on-stream surface storage. Groundwater banking and conjunctive use programs could enhance benefits provided by surface storage. Descriptions and examples of the various types of storage components evaluated during Phase II of the Bay-Delta Program are provided below.

A preliminary evaluation was performed early in Phase II to determine an appropriate range of storage to be examined at a programmatic level. A rough approximation of water supply benefits for various storage volumes was made for both Sacramento River off-stream storage and south of Delta off-aqueduct storage. Results of this evaluation are summarized in the following chart.

Water Supply Benefits of Surface Storage



This preliminary evaluation indicates that most water supply benefits of Sacramento River off-stream storage are achieved with about 3 MAF of storage, while most water supply benefits of south of Delta off-aqueduct storage are attained with about 2 MAF of storage. Of course, the relationship of water supply benefits to storage volume is highly dependent on operating assumptions. Much more detailed information about specific locations of new storage, potential allocation of storage benefits, and operational goals and constraints would be necessary to determine an optimal volume of storage from a water supply perspective.

Other types of surface storage considered in Phase II include San Joaquin River tributary storage and in-Delta storage. Relatively smaller volumes of storage are practical for these types of storage facilities due to engineering considerations. Groundwater banking and conjunctive use in the Sacramento and San Joaquin Valleys was also considered in Phase II. The practical storage capacity available for groundwater storage in these areas will be determined only after detailed study of specific projects and full consideration of local concerns. For study purposes, groundwater storage volumes of 250 TAF in the Sacramento Valley and 500 TAF in the San Joaquin Valley were considered.

Based on this preliminary evaluation of potential water supply benefits and practical consideration of acceptable levels of impacts and total costs, the range of total new storage considered for evaluation in Phase II was from zero up to about 6 MAF. This amount of new storage was considered a reasonable range for study purposes; much more detailed study and significant interaction with stakeholders will be required before specific locations and sizes of new storage are proposed. For the purposes of the Phase II evaluation, an inventory of potential new storage projects was compiled. Those projects that appeared most feasible were evaluated to provide representative information on costs and benefits. A more complete screening process, taking into account potential environmental impacts, engineering feasibility, costs, and benefits, will proceed over the coming months.

A fundamental principle of the CALFED Program is that the costs of a program should be borne by those who benefit from the program. That principle is especially relevant in the decision about new storage facilities. In principle, public money will be used to finance storage projects only to the extent that the storage creates public benefits; user money should be used to finance the portion of storage that generates user benefits. This "user pays" principle is critical to the overall CALFED goal of increasing the efficiency of water utilization in California. CALFED is performing economic analyses evaluating new facilities and other approaches (such as conservation, recycling, and transfers) to identify cost-effective pathways to meeting CALFED objectives. These economic analyses will be especially useful in assisting all potential users of new storage to evaluate the relative costs and benefits of particular storage options.

Following are summaries of different types of storage being considered for the Program.

Upstream Surface Storage

Runoff from upstream tributaries to the Delta usually occurs in large volumes over short periods of time in the winter and spring. New storage upstream of the Delta could store a portion of these flows in excess of instream flow requirements and water supply needs. While detaining water in storage, care must be taken to maintain periodic peak flow events in rivers that provide for natural fluvial geomorphological processes, including the moving and cleansing of gravels, which are important to aquatic ecosystems. This is a more vital consideration associated with enlarged on-stream storage compared to off-stream storage; large amounts of water can quickly be detained in on-stream storage, while due to conveyance capacity constraints, only a minor percentage of large peak river flows can be diverted to off-stream storage.

Water could be released from upstream surface storage when needed to supplement instream flows and water supply. Water could be released to meet direct needs or to provide additional benefits through exchanges. For example, water could be released from off-stream storage in the Sacramento River basin directly to local water users, reducing existing diversions from the Sacramento River during periods critical to fisheries. Water released for environmental purposes could include pulse flows to help transport fish through the Delta. Water could also be released to provide sustained flows for riverine and shallow water habitats and improve water quality in the Delta during drier years. Examples of potential upstream surface storage include:

Enlargement of Shasta Reservoir. This additional on-stream storage on the Sacramento River could provide water for instream and consumptive use purposes, flood control, instream water temperature control, and hydropower.

Sites-Colusa Reservoir. Storage in this new off-stream storage reservoir in the Sacramento Valley would be limited by conveyance capacity from the Sacramento River to the reservoir. The reservoir could be filled during periods when diversions from the river would have low impacts on fisheries. Water stored in the reservoir could be used to supply Sacramento Valley agriculture, thereby reducing agricultural diversions from the river during times more critical to fisheries. Water from the reservoir could also be released back into the river, directly or through exchange, to increase flows at critical periods.

Enlargement of Millerton Reservoir. This additional storage on the San Joaquin River could be used to store supplies during high flow periods and provide some flood control benefits. Stored water could be released for increased environmental flows during drier periods, directly to water users, or to enhance groundwater conjunctive use operations in the San Joaquin Valley.

Montgomery Reservoir. Water stored in this facility could be used to increase environmental flows during drier periods, directly to water users, or to enhance groundwater conjunctive use operations in the San Joaquin Valley.

In-Delta Surface Storage

In-Delta surface storage could be developed by converting one or more Delta islands into reservoirs. Existing levees would be reconstructed and screened facilities for diverting water into the islands would be provided. In-Delta storage would be filled during high flow periods when potential harm to fisheries would be lowest. Water could be released directly into the Delta during drier periods for environmental, in-Delta water supply, or water quality needs. A direct connection to State Water Project (SWP) and Central Valley Project (CVP) export facilities might also be provided to allow stored water to be exported during periods when curtailing south Delta diversions could benefit fisheries.

Several concerns regarding in-Delta storage must be resolved. If the stored water is to be used for drinking water purposes, there may be a need to evaluate sealing or removing the naturally occurring peat soils from the islands to avoid the release of organic carbons (organic carbons in a drinking water source contribute to the formulation of undesirable byproducts when treated with chlorine). This could add significant expense to any in-Delta storage project. Foundation and slope stability concerns associated with Delta levees could limit the rate of water removal from in-Delta storage, thereby reducing operational flexibility and potential benefits.

Examples of potential in-Delta surface storage include:

Bacon, Woodward, and Victoria Islands. These Delta islands might be converted to in-Delta storage by reconstructing the surrounding levees, providing a screened inlet facility, and connecting the islands to one another and to Clifton Court Forebay with inverted siphons. Together, these three islands might provide about 200 thousand acre feet (TAF) of storage. Real-time monitoring might guide operations to determine when species of concern are not present and water may be diverted into storage and when to release water from storage and curtail south Delta CVP and SWP diversions.

An alternative to inundation of prime Delta agricultural acreage would be to develop storage facilities near the Delta (such as an expanded Los Vaqueros as described below) that would, like in-Delta storage, provide the ability to store water while enabling maximum flows during wet periods.

South of Delta Off-Aqueduct Storage

A version of off-stream storage, south of Delta off-aqueduct storage could be filled by diversions through the Delta Mendota Canal or the California Aqueduct. Examples of existing off-aqueduct storage include San Luis Reservoir and Castaic Lake. New or enlarged existing off-aqueduct storage would be filled by increasing Delta exports during periods of high flows and least potential harm to Delta fisheries. Water stored in new off-aqueduct storage could be released to meet export needs while curtailing export pumping from the Delta during times of heightened environmental sensitivity in the Delta. Filling of off-aqueduct storage is limited by the capacity of export facilities. However, water stored in off-aqueduct storage is of great value to export water users, since it can be delivered directly for use without Delta operational constraints.

Examples of south of Delta off-aqueduct storage include:

Enlarged Los Vaqueros Reservoir. This off-stream storage reservoir, currently under construction with a planned capacity of 100 TAF, could be expanded to store about 1 MAF of water supply. Because of its proximity to the Delta, Los Vaqueros could provide greater flexibility and water supply benefits than other south of Delta off-aqueduct reservoirs. While filling of other off-aqueduct reservoirs is limited by capacity in the California Aqueduct and Delta-Mendota Canal, a direct intake could be constructed from the Delta to Los Vaqueros. This would allow greater diversion capacity during high flow periods in the Delta.

Los Banos Grandes Reservoir. This reservoir would be filled with water exported through the California Aqueduct during periods of high flow, allowing water to be released for use while exports are curtailed from the Delta during times most sensitive to fisheries. Los Banos Grandes has received extensive study over the past two decades, including detailed surveys of biological resources. While the project appears to be among the most economical of prospective surface storage reservoirs, some CALFED agencies do not think environmentally significant impacts associated with the project can be mitigated.

Garzas Reservoir. Garzas Reservoir would also be filled with water exported through the California Aqueduct during times of high flow, allowing curtailment of exports from the Delta during times most sensitive to fisheries. The reservoir would be located on Garzas Creek in southwestern Stanislaus County, about 57 miles south of Clifton Court Forebay. The damsite is about three miles west of the California Aqueduct. Garzas Reservoir, with a potential capacity of about 340 TAF, was among a group of 13 alternative south of Delta off-stream reservoir sites studied by the Department of Water Resources in the 1980s.

Groundwater Storage

Groundwater storage can take the form of direct groundwater banking operations or groundwater conjunctive use operations. Under a groundwater banking program, water is stored in depleted groundwater aquifers through spreading grounds or direct injection and withdrawn from storage by pumping, similar in operation to a surface storage reservoir. Operations are limited by percolation or injection rates and pumping withdrawal rates, which are generally much slower than intake and outlet rates from surface storage reservoirs. For these reasons, groundwater banking programs can be enhanced if surface storage is available to store high flows more quickly and release them for groundwater storage at lower rates.

Under a groundwater conjunctive use operation, surface water is diverted for agricultural or urban use during wet years, allowing underlying groundwater aquifers to recharge naturally and from percolation of excess applied water. During dry years, water is pumped from groundwater storage to meet the identified agricultural or urban needs, allowing reduced diversion of surface water from rivers.

Groundwater banking and conjunctive use operations range in scope and formality. For decades growers in parts of the Central Valley have practiced informal conjunctive use operations by using surface water supplies when available and then turning to groundwater during dry periods. Recently, more formal programs such as the Semitropic Water Storage District's water banking agreement with Metropolitan Water District of Southern California have become more common place. While groundwater storage operations are an important water management tool, significant issues such as adverse effects on third parties and fish and wildlife, land subsidence, and degradation of water quality in aquifers must be addressed on a case by case basis before implementing any groundwater storage program. Guiding principles to address these issues were discussed in Chapter 2.

Examples of potential groundwater storage operations include:

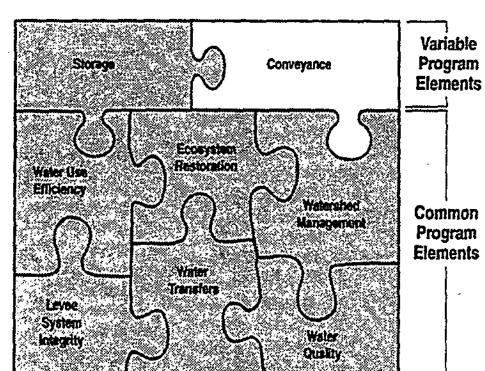
American Basin Conjunctive Use Project. This project, located in western Placer County and southwestern Sutter County, is currently under investigation by the California Department of Water Resources (DWR) in cooperation with a group of local agencies. State Water Project water would be delivered for agricultural use in this area in wet and above normal years, reducing groundwater pumping and providing "in-lieu" recharge during those years. In dry and critical years, these agricultural users would pump groundwater to meet local demands, foregoing diversion of surface water supplies that would be made available to the SWP.

Kern Water Bank. The Kern Water Bank was implemented by DWR during the 1990s. The Kern Water Bank consists of a Kern Fan Element and several conjunctive use elements operated in cooperation with local agencies. The Kern Fan Element, consisting of conveyance facilities, spreading grounds, and extraction wells, is currently operated by a local authority. Surplus flows from the Kern River are recharged when available, as well as SWP supplies delivered through the California Aqueduct in wet years. Additional recharge and extraction facilities could allow expansion of storage in the Kern Water Bank.

Madera Ranch Project. The proposed Madera Ranch project is located near the of the City of Madera. As currently envisioned, CVP water, CVP acquired (purchased) water, and any new CVP water (e.g. obtained rights to San Joaquin flood flows) would be diverted from the Mendota Pool on the San Joaquin River and pumped into an eight mile long canal for delivery into recharge areas that allow percolation of the water into the aquifer. Water would be extracted from the aquifer for delivery to the Mendota Pool to meet CVP related agricultural and wildlife refuge needs. The U. S. Bureau of Reclamation is currently evaluating the details of the proposal with the San Luis & Delta-Mendota Water Authority and the private land owner. Any project partners would provide their own "supply" for banking.

Conveyance

The Delta conveyance element of the Program describes the various configurations of Delta channels for moving water through the Delta and to the major export facilities in the southern Delta. While there are countless combinations of potential modifications to Delta channels, three primary categories of Delta configuration options, as described below, are being studied in Phase II of the Program. These Delta conveyance options were the primary distinguishing features among the three broad categories of alternatives studied in Phase II.



Conveyance
Issues and Concerns

- Objective consideration of a new Delta channel (or isolated facility) may not be possible due to the political stigma resulting from the peripheral canal debate in the early 1980s.
- Consideration of major conveyance modifications requires significant assurances.
- There is concern over potential deterioration of in-Delta water quality if an isolated facility is built. A more thorough evaluation of in-Delta water quality impairments of each conveyance configuration is needed. In particular, there are unknowns related to reduced inflows into the northern Delta.
- The analysis on the impacts of each conveyance configuration on fish entrainment, Delta flow circulation, and drinking water needs further refinement.
- There is concern that support for the levee restoration program would wane if an isolated facility were built.
- Some stakeholders believe that an isolated facility should only be considered as part of a staged alternative or in the context of linked implementation; the facility would not be constructed until certain milestones had been achieved (such as in transfers and water use efficiency).
- Some stakeholders view an isolated facility as essential to improving water supply reliability. Strong assurances must be developed for water suppliers due to the long lead time to develop new storage.

Additional exports are expected from the Delta in the future as statewide demands for water increase. Currently, the combined physical capacity of SWP and CVP export facilities in the southern Delta is approximately 15,000 cfs. However, a U.S. Corps of Engineers permit limits exports through the SWP export facility to 6,680 cfs, except during some winter months when marginal increases are allowed. The CVP has a capacity of 4,600 cfs.

Because of the potential impact on flow patterns and Delta water quality, the Delta conveyance configuration of an alternative can greatly affect the performance of other Bay-Delta Program elements. The three primary Delta conveyance configurations evaluated in Phase II of the program are:

> **Alternative 1: Existing System Conveyance.** The Delta channels would be maintained essentially in their current configuration. One significant variation would include some selected channel improvements in the southern Delta together with flow and stage barriers at selected locations to allow for increasing the permitted pumping rate at the SWP export facility to full existing physical capacity of 10,300 cfs. These physical

changes in the existing system include many of the features contained in the proposed Interim South Delta Project. Other variations that address the same needs are also being evaluated.

Alternative 2: Modified Through Delta Conveyance. Significant improvements to northern Delta channels would accompany the southern Delta improvements contemplated under the existing system conveyance alternative. Variations include a wide variety of channel configurations, designed to improve flow patterns to benefit fisheries throughout the Delta, provide flood control, and improve water quality in many parts of the Delta.

Some Delta flow Statistics

Flow patterns through the Delta channels are influenced by tidal actions and export operations. For the period of 1980 to 1991, average annual inflow to the Delta was 27,900 TAF, with the Sacramento River contributing about 62 percent and the San Joaquin River contributing about 16 percent. The remaining 22 percent came from other Delta tributaries. Of this total inflow, about 18 percent was exported at the SWP and CVP export facilities in the southern Delta, while about 76 percent went to outflow to the San Francisco Bay. Delta inflow, export, and net outflow rates are dwarfed by tidal flows in the Delta. During the 1980 to 1991 period, winter outflow in the Delta averaged about 32,000 cfs and summer outflow averaged about 6,000 cfs, compared to average tidal flow (ebb or flood) through the Golden Gate of 2,300,000 cfs and at Chipps Island in the western Delta of 170,000 cfs.

Alternative 3: Dual Delta Conveyance. The dual Delta conveyance alternative is formed around a combination of modified Delta channels and a new canal or pipeline connecting the Sacramento River in the northern Delta to the SWP and CVP export facilities in the southern Delta. Capacities for this new isolated conveyance facility in the range of 5,000 cfs to 15,000 cfs were evaluated in Phase II of the Program. The new facility would siphon under all major waterways to minimize aquatic impacts.

12 Alternative Variations

At the beginning of Phase II, 17 alternative variations (later reduced to 12) were developed around the three broad alternatives resulting from the Phase I work. These are described in detail in the *Phase II Alternative Descriptions* (May 1997) and are summarized below. They represented a reasonable range of different configurations of Delta conveyance and storage assembled with the common program elements for levee system integrity, water quality, ecosystem quality, water use efficiency, water transfers, and watershed management coordination.

Alternative 1A - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination without adding new storage and conveyance facilities to supplement the status quo.

Alternative 1B - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with select south Delta improvements. Alternative 1B builds upon Alternative 1A by adding fish screens at the Banks and Tracy pumping plants and an intertie between the Tracy pumping plant and Clifton Court Forebay. All common programs fit together as they did in Alternative 1A.

Alternative 1C - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with select south Delta improvements and storage. It builds on Alternative 1B by adding new conveyance to provide for increasing in the permitted south Delta pumping capacity to the full physical capacity. Alternative 1C is the same as Alternative 1B except that it includes new surface and groundwater storage facilities throughout the watershed.

Alternative 2A - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed to improve water conveyance. Alternative 2A is the "minimal" alternative to achieve improved through Delta conveyance. It provides for more efficient water conveyance from the Sacramento River through Snodgrass Slough, North Fork Mokelumne River, and Old River near Clifton Court Forebay. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and operable barriers or equivalent in the south Delta. The alternative does not provide additional water storage.

Alternative 2B - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed for water conveyance and new surface and groundwater storage. The alternative is the same as Alternative 2A except it adds new water storage facilities.

Alternative 2C - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with three new diversion locations for Tracy and Banks pumping plants. The new diversions could be use separately or in combination to provide increased operational flexibility. New in-Delta water storage would receive water from one of these new diversions. The alternative also includes new fish screens at the Tracy and Banks pumping plants, and an intertie between the pumping plants.

Alternative 2D - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with system modifications in the north and south Delta designed to improve water conveyance, to provide habitat restoration integrated with the conveyance improvements and new aqueduct storage south and downstream of the Delta. The alternative provides for more efficient water conveyance from the Sacramento River through Snodgrass Slough, South Fork Mokelumne River, and Old River near Clifton Court Forebay. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and an operable barrier or equivalent at the Head of Old River.

Alternative 2E - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with modifications in the north and south Delta designed to improve for water conveyance, to provide significant habitat restoration and additional surface and groundwater storage. The conveyance and habitat portions are the similar to those in Alternative 2D with the exception of the addition of conveyance and habitat on Tyler Island and the elimination of the 10,000 cfs intake at Hood.

Alternative 3A - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed to improve water conveyance and a small (5,000 cfs) open channel isolated facility. This alternative is considered the "minimal" option for the dual Delta conveyance Alternative. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and operable barriers or equivalent in the south Delta. The alternative provides no new water storage.

Alternative 3B - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed for water conveyance, a small (5,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage. The alternative is the same as Alternative 3A except for the new water storage.

Alternative 3C - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed for water conveyance and a small (5,000 cfs) isolated facility constructed as a pipeline. It also includes new fish screens at the Tracy and Banks pumping plants, an intertie between the pumping plants, and operable barriers or equivalent in the south Delta. The alternative provides no new water storage. **This alternative is identical to Alternative 3A except for the facilities associated with the pipeline configuration.**

Alternative 3D - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination elements with north and south Delta channel modifications designed for water conveyance, a small (5,000 cfs) isolated facility constructed as a pipeline, and surface and groundwater storage. **This alternative is identical to Alternative 3B except for the facilities associated with the pipeline configuration.**

Alternative 3E - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north Delta channel modifications designed to improve water conveyance, a large (15,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage. The alternative is similar to Alternative 3B except for the size of the isolated facility, and the elimination of Old River enlargement and barrier at Head of Old River.

Alternative 3F - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with a combined isolated storage and conveyance facility to transfer Sacramento River flow across the Delta to Clifton Court Forebay. A connected chain of up to 8 lakes, created by flooding Delta islands, would convey water via siphons and pumps beneath Delta channels.

Alternative 3G - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with north and south Delta channel modifications designed for water conveyance, a 5,000 cfs Deep Water Ship Cannel, a western Delta conveyance tunnel and channel, and surface and groundwater storage.

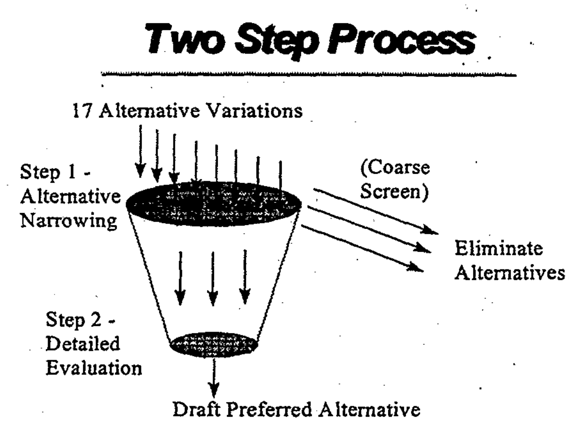
Alternative 3H - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with modified conveyance in the north and south Delta designed for water conveyance and significant habitat restoration, a small (5,000 cfs) isolated facility constructed as an open channel, and surface and groundwater storage.

Alternative 3I - Combines and integrates the Program elements for levee system integrity, water quality, ecosystem restoration, water use efficiency, water transfers, and watershed management coordination with three new diversion locations for Tracy and Banks pumping plants and surface and groundwater storage. The new diversions could be use separately or in combination to provide increased operational flexibility. One new in-Delta water storage would receive water from one of these new diversions. The alternative also includes new fish screens at the Tracy and Banks pumping plants, and an intertie between the pumping plants. This Alternative is similar to Alternative 2C, with one diversion extended to Hood and new surface and groundwater storage.

The first activities undertaken by CALFED to refine these alternatives were to modify or eliminate the ones that had technical problems, and to reduce the number of alternatives that achieved the same Delta conveyance function. The following activities were followed during this narrowing of the number of alternatives (depicted as "Step 1" in the adjacent figure):

Identify and eliminate technical problems (technical problems not evident when the alternatives were formulated and which severely limit an alternative's success):

- Identify alternatives with engineering/technical problems that must be resolved for the alternative to proceed.
- Modify each alternative, if possible, to remove the technical problems.
- If modifications to the alternative cannot solve the problem, the alternative is not practicable and will be eliminated.



Reduce the number of alternatives (that achieve the same Delta conveyance function):

- Identify alternatives that meet program objectives approximately the same and achieve the same Delta conveyance function.
- Use engineering/technical and cost evaluations to compare Delta conveyance. Consider adverse impacts of each alternative. If one alternative has significantly higher costs for conveyance and/or greater adverse impacts, it is not practicable and will be eliminated from further consideration.

Five alternative variations were eliminated during this alternative narrowing process. These were:

- **Alternative 2C** - The intent of the alternative is to provide operational flexibility by permitting multiple points of intake to enable pumping to be discontinued at locations where sensitive species are present in significant numbers, in order to avoid entrainment. Analysis of the alternative indicated similar operational flexibility could be achieved through other alternatives at less cost. The multiple intake concept was still represented in Alternative 3I.

- **Alternative 3C** -Alternative 3A and 3C differ only in that the isolated facility would be an open channel with alternative 3A and a pipeline in 3C. The pipeline has potential advantages in the degree of protection against toxic spills and other advantages, but is much more expensive. CALFED decided to analyze a pipeline as a potential minor variation of 3A, as opposed to a stand-alone alternative.

- **Alternative 3D** -Alternative 3B and 3D differ only in that the isolated facility would be an open channel with alternative 3B and a pipeline in 3D. The pipeline has potential advantages in the degree of protection against toxic spills and other advantages, but is much more expensive. CALFED decided to analyze a pipeline as a potential minor variation of 3B, as opposed to a stand-alone alternative.

- **Alternative 3F** -Under this alternative, six major Delta islands would be converted to reservoirs connected with siphons and pumps to act as a conduit of water supply through the Delta. This alternative would result in large scale loss of prime agricultural lands, would have significant potential for degrading the quality of export water supplies, and would be very expensive, compared to other alternatives for transporting water through the Delta with fewer water quality risks and with reduced impact on prime agricultural acreage.

- **Alternative 3G** -This isolated facility alternative would take water from the Sacramento River in West Sacramento, use the existing ship channel to its southern terminus, then connect with a pipeline conveying water to Clifton Court. This alternative would require facilities to enable ship passage through the water supply conduit, and would require a tunnel under the Sacramento River. The alternative was rejected because the biological and functional characteristics of this alternative are similar to other alternatives, the cost of this facility would be much higher than for other alternatives, and its engineering feasibility with respect to tunneling under the Sacramento River is untested.

The twelve remaining alternative variations are shown in summary form on the following page. The twelve cover the broad range of potential solutions surrounding the three alternatives. The Draft Programmatic EIS/EIR focuses on the potential consequences of the three alternatives (with the twelve variations). See the main document of the Draft Programmatic EIS/EIR for discussion of these consequences.

		Programs						Storage						Conveyance: South Delta					Conveyance: North Delta					Conveyance: Isolated Facilities		
		Water Quality	Water Use Efficiency	Ecosystem Restoration	Levee System Integrity	Water Transfers	Watershed Coordination	surface storage on Sac R. tributaries (in MAF)	surface storage on San Joaquin R. (in TAF)	groundwater storage in Sac Valley (in TAF)	groundwater storage in San Joaquin Valley (in TAF)	surface storage off-aqueduct (in MAF)	In-Delta storage (in TAF)	Tracy/CCF intertie and new fish facility	new CCF intake structure	operable Old R. barrier (or equivalent)	flow & stage control measures installed (or equivalent)	channel enlargement along Old R.	screened intake at Hood	North Delta Channel Modifications	Mokelumne River Floodway (East)	Mokelumne R. Floodway (West) and Tyler Island Aquatic Habitat	East Delta Habitat	3 isolated conveyance channels	5,000 cfs open channel/pipeline from Hood to CCF	15,000 cfs open channel from Hood to CCF
Existing Through Delta Channels	Alt 1 A	X	X	X	X	X	X																			
	B	X	X	X	X	X	X							X		X	X									
	C	X	X	X	X	X	X	3		250	500	1		X	X	X	X	X								
Modified Through Delta	Alt 2 A	X	X	X	X	X	X							X	X	X	X	X	X	X						
	B	X	X	X	X	X	X	3	500	250	500	2		X	X	X	X	X	X	X						
	D	X	X	X	X	X	X					2		X	X	X		X	X		X		X			
	E	X	X	X	X	X	X	3	500	250	500	2		X	X	X		X				X	X			
Dual System	Alt 3 A	X	X	X	X	X	X							X	X	X	X	X	X	X					X	
	B	X	X	X	X	X	X	3	500	250	500	2	200	X	X	X	X	X	X	X					X	
	E	X	X	X	X	X	X	3	500	250	500	2	200	X	X	X			X	X						X
	H	X	X	X	X	X	X	3	500	250	500	2		X	X	X		X	X			X	X		X	
	I	X	X	X	X	X	X	3	500	250	500	2	100	X	X				X	X				X		X

The 18 Distinguishing Characteristics

Looking simultaneously at all the information on how well the alternatives meet the objectives and how well they satisfy the solution principles would be nearly impossible due to the large amount of information. Furthermore, many aspects of the alternatives do not vary from one alternative to another. They all include common program elements that make significant progress toward meeting program objectives and reducing conflict in the system.

On the other hand, there are aspects that do differ among the alternatives and it is these aspects, or distinguishing characteristics, that guided the evaluation. These characteristics are important when assessing the performance, impacts and overall merits of each alternative. Following are the 18 identified distinguishing characteristics:

- **In-Delta Water Quality** - provides a measure of **salinity** and **flow circulation** for four areas of the Delta. The measure focuses on water quality for in-Delta agricultural uses.

- **Export Water Quality** - provides a measure of **salinity, bromide**, and **total organic carbon** for four export diversion location from the Delta. The measure focuses on municipal/industrial uses for the North Bay Aqueduct and Contra Costa Intake and for agricultural and municipal/industrial uses for the SWP and CVP export pumps.

- **Diversion Effects on Fisheries** - intended to include only the **direct effects on fisheries due to the export diversion intake and associated fish facilities.** These will vary depending on diversion location, size, type, method of handling bypassed fish, and annual volume of water diverted. The effects on flow patterns in the Delta as a result of the diversion are addressed in the distinguishing characteristic for "Delta Flow Circulation". The loss of fish due to diversion to another route is covered in this effect.

- **Delta Flow Circulation** - is intended to include the **direct and indirect effects of water flow circulation on fisheries due to the export diversions and changes in cross-Delta water conveyance facilities.** These will vary depending on diversion location, size, type, and operation of conveyance facilities, and annual volume of water diverted.

- **Storage and Release of Water** - provides a measure of the environmental benefit or adverse effects of storing water in a new Program storage facilities and releasing that water at a later time of need. Storing the water will generally result in some degradation of environmental conditions and releasing that water, for whatever use, will generally result in some environmental benefits.

- **Water Supply Opportunities** - is a measure of the change provided by the alternatives for water supply for the environment and for agricultural and urban uses.

- **Water Transfer Opportunities** - is an estimate of how well each alternative can carry water that may be generated through market sales or trades at different locations in the system.

- **Operational Flexibility** - provides an indication of how well each alternative can shift operations as needed from time to time to provide the greatest benefits to the ecosystem, water quality, and water supply reliability.

- **South Delta Access to Water** - is a measure of how the alternatives affect local access to water due to changes in water levels in the channels.

- **Risk to Export Water Supplies** - is intended to provide a measure of which alternatives best reduce the risk to export water supplies from a catastrophic earthquake.

- **Total Cost** - will include the initial capital costs for the Program as well as annual costs. Initial costs will include study, design, permitting, construction, mitigation, acquisition, and other first costs of the Program. Annual costs will include operation and maintenance, monitoring, reoccurring annual purchases, and other annual costs.

- **Assurances Difficulty** - is an estimate on how hard an assurance package will be to formulate and get consensus among agencies and stakeholders. It is not an assessment on the perceived effectiveness of the assurance package.

- **Habitat Impacts** - is an assessment of the adverse habitat impacts due to implementation of the storage and conveyance facilities.

- **Land Use Changes** - is a measure primarily of the amount of agricultural land that would change to other uses by implementation of the Program.

- **Socio-Economic Impacts** - include adverse and beneficial impacts such as commercial and recreational fishing, farm workers, power production, and other third party impacts.

- **Consistency with Solution Principles** - provides a qualitative measure of how well the alternatives meet the Program solution principles. Alternatives which violate the solution principles are not likely to be practicable or implementable.

The solution principles provide insight in considering tradeoffs among the other distinguishing characteristics in a balanced manner.

- **Ability to Phase Facilities** - provides an indication on how easy it will be to phase (stage) implementation of storage and conveyance facilities over time.

- **Brackish Water Habitat** - In the Bay-Delta system there is a salinity gradient between fresh and salt water. The western Delta is an area of important aquatic habitat with salinity levels of approximately 2 parts per thousand. The location of this salt concentration, known as X2, is an indicator of changes in brackish water habitat among the alternatives.

Moving Toward a Preferred Program Alternative

The twelve alternative variations addressed in the Programmatic EIS/EIR cover the broad range of potential consequences of implementing a CALFED solution. CALFED will continue evaluation of the alternatives, with the help of the public, and will select a preferred program alternative prior to the Final Programmatic EIS/EIR in late 1998.

As a tool in moving towards a preferred program alternative, CALFED sought to develop the best alternative for each of the three main categories:

- **Alternative 1** (existing system conveyance)
- **Alternative 2** (modified through Delta conveyance)
- **Alternative 3** (dual Delta conveyance)

The process began by examining how each of the twelve alternative variations performed for the preliminary evaluations of the distinguishing characteristics. This assessment provided information on where alternatives performed particularly well and where there were significant deficiencies. CALFED then looked for modifications, including operational changes, that would resolve the major deficiencies and enhance the overall performance of alternatives in each of the three categories.

Considerations for the Fisheries and Diversion Conflict

One of the primary problems presently encountered in the Delta is the conflict between the need to maintain water deliveries and the sensitive fish species in the Delta which are drawn into the pumps of the State Water Project, Central Valley Project and, to a lesser extent, the Contra Costa Water District intakes in the southern and western-central Delta. Currently, there are requirements for pumping activities to be curtailed during periods when sensitive species are present in the Delta. Future evaluations may indicate the need for further restrictions. This is the most important factor causing conflict presently and, left uncorrected, is likely to produce greater conflict in the future. This conflict can be reduced in four basic ways:

- By utilizing best available technology to construct improved fish screening facilities to physically avoid fish entrainment in an operating export facility;

- By providing storage in or near the Delta or off-aqueduct storage south of the Delta to enable export deliveries to be continued while pumping is curtailed when sensitive species are present;

- By relocating intakes and/or developing multiple intakes to enable pumping to occur from alternate locations in the Delta. This approach would provide flexibility for enabling pumping to continue from one location while a pumping restriction exists on another location because of the presence of sensitive species; or,

- By reducing demand. For example, depending on water supply and water transfer opportunities, farmers may choose to change cropping patterns, temporarily fallow land, or permanently take land out of agricultural production. Also, urban conservation and recycling in export service areas could substitute for some demands for Bay-Delta supplies.

Combinations of these approaches can be applied to achieve more benefit than would be achieved by any measure by itself. CALFED made the following considerations to help move towards the "best" Alternatives 1, 2 and 3.

Considerations on Screening - CALFED formed an Interagency Fish Facilities Technical Team composed of experts on the subject. This group has concluded that construction of advanced screen facilities were feasible to at least 15,000 cfs, although no facilities of comparable size exist. Like the current screens, the new screen designs will still be unable to successfully screen eggs and larvae of all species.

All life stages of salmon and steelhead that occur in the lower Sacramento River, lower San Joaquin River and Delta can be successfully screened with currently available positive barrier fish screen technology. Survival rates at existing state-of-art screens for salmon and steelhead, including facilities in the Central Valley, approach 100 percent. All fish screen facilities at a tidally-influenced location will require fish collection (salvage) and hauling (trucking) to an off-site, downstream location. Within the 3 CALFED alternatives under consideration, the only non-tidally influenced fish screen facility is the Hood diversion site in Alternatives 2 and 3.

In considering the option of upgrading SWP and CVP intake screen facilities in the south Delta separately or as a single project, technical team and engineering experts agree there are advantages to developing a combined screen facility at the head of Clifton Court to support both projects, including potential cost savings. Another advantage of a combined screen facility is that it utilizes an intertie between the SWP and CVP conveyance channels. This intertie is generally recognized as a desirable feature to increase operational flexibility, and is included in all three alternatives.

As envisioned, screen facilities in the south Delta would include low lift pumps on the downstream side of the screens. This feature allows the use of fish screens over the complete tidal cycle and reduces velocities and scour rates in the supply channels. However, such pumping during low tidal heights may exacerbate problems with water elevations in the channels supplying Delta agricultural users. Thus, the use of such screens will require tidal gates, or other measures to protect Delta agricultural water supplies.

Considerations on Relocating Intakes and Multiple Intakes - Having a choice of Delta export locations offers the potential to avoid peaks in fish abundance near one intake while continuing operation of the water projects at another intake. In general, the more widely the points of intake are separated, the more likely sensitive species can be avoided while exports are continued. However, relocating intake points and developing multiple points of intake are generally expensive, and in the case of alternatives that would require significant disruption of Delta lands, will have significant environmental impacts.

An intake on the Sacramento River would differ from an intake in the south Delta in three significant ways:

- Fewer species reside year-round in the area of the upstream diversion and therefore are much less exposed to entrainment there.

- The Sacramento River would provide sufficient bypass flows at the Hood diversion point to keep screened fish moving downstream in the river. This would eliminate the need for a fish salvage and trucking operation: fish salvage and trucking operations pose additional source of stress that can result in injury, predation, or mortality.

- Migratory fish of the Sacramento Valley will all be exposed to screens at Hood, whereas some proportion of these fish are not directly exposed to the export facilities in the south Delta. For some species, particularly striped bass, the new screens cannot screen the vulnerable life stage and will therefore represent a relocation of screening mortality from the south Delta to the Sacramento River stock of these species. However, operational modifications can minimize the losses of the most vulnerable life stages.

The San Joaquin River (near Stockton) has been proposed as a potential point of intake. This possibility was evaluated with the result that water yield and water quality associated with this point of intake would be inadequate in relation to the cost ($450 million) of constructing an intake on the San Joaquin River.

Avoidance of Disrupted Delta Flow Patterns - In the absence of export pumping, the Sacramento and San Joaquin Rivers would normally flow downstream through the Delta towards the ocean. Some observers believe that a major problem currently affecting fishery resources and general aquatic productivity in the Bay-Delta estuary is net reversal of normal flows in the Delta caused by export operations in the southern Delta. Such flow disruptions cause damage to fishery resources by complicating or confusing fish movement which ultimately results in reduced reproductive success in sensitive species. The alternatives being evaluated vary significantly in their effectiveness in addressing this problem.

Use of Storage to Enable Export Curtailments - Storage in the Delta, near the Delta, or off-aqueduct south of the Delta (including groundwater storage) offer the potential to maintain water deliveries while diversions from the Delta are curtailed. This can also be facilitated with upstream of Delta storage.

In-Delta storage (created by reinforcing levees on one or more islands and converting them into reservoirs) and near-Delta storage (created in a location near the Delta, such as the Los Vaqueros reservoir site) would be functionally equivalent with respect to the capability to respond very quickly to changing flow requirements needed to reduce fishery impacts at critical times. The two are different in the respect that in-Delta storage would take prime agricultural lands out of production producing shallow reservoir facilities with a lengthy perimeter that would have to be maintained. Also, in-Delta storage could present significant water quality problems because of the peat soils present at central and southern Delta locations. Near-Delta storage could be made deeper and with a higher volume for the same acreage, as compared to storage within the Delta, but cost will be an important factor. Both forms of storage would have higher yield than off-aqueduct storage south of the Delta, because this storage could be filled directly from the Delta without using aqueduct capacity needed to fill other reservoirs during wet periods. Water quality, environmental impact, and redirected impact considerations, along with cost information will determine the choice between these approaches.

Off-aqueduct storage south of the Delta could be used to temporarily curtail south Delta pumping without interrupting deliveries. A range of facility sizes would be possible, but the yield of such facilities would be lower. Off-aqueduct storage would have to be filled from the existing aqueduct capacity.

Based on these considerations and the need to reduce the fishery/diversion conflict, CALFED identified the following features of the twelve alternative variations that are undesirable and should be modified to improve performance:

Existing Screens at Existing Banks and Tracy Pumping Plants - Fish entrainment in the water project intakes, along with predation that occurs in Clifton Court, are major sources of fish losses in the system.

New Screens at Existing Clifton Court Location - Currently, predation in Clifton Court is believed responsible for major fish losses. While an improved screen at the existing location (which is inside the forebay just before the canal leading to Banks Pumping Plant) would significantly reduce entrainment, it would not affect predation in Clifton Court. The effectiveness and cost of constructing screens at the current location would not provide nearly the ecological benefit as other alternatives. One proposed solution to this problem is to construct a new intake facility at the head of Clifton Court and to construct screens at that location, largely eliminating fish from Clifton Court, and thereby eliminating predation there.

Shallow Channel Integrated with Snodgrass Slough - The ecology of Snodgrass Slough could be significantly affected by channel modifications. Construction of a separate intake channel would avoid these impacts and is, therefore, the preferred approach.

Tyler Island Aquatic habitat and Andrus Island Levee Setback - This feature would involve removing a major Delta island from agricultural production, and would create a major change in the Delta hydraulic system. However, the physical and biological consequences of this action are uncertain and would be known only after years of operating and evaluating the system. Thus, the value of this investment would be subject to considerable risk. Similar water conveyance and flood control benefits can be obtained through other, better understood alternatives, with reduced impacts on Delta agriculture.

Mokelumne River Floodway and Conversion of Bouldin Island to Habitat - This feature would involve removing a major Delta island from agricultural production, and would create a major change in the Delta hydraulic system, having unknown physical and biological consequences. Similar water conveyance and flood control benefits can be obtained through other, better understood conveyance configurations, with reduced impacts on Delta agriculture.

Unscreened intakes on San Joaquin River, East Delta, and West Delta - The benefits to fisheries associated with the flexibility of intake location that would be provided by multiple unscreened intakes are thought by CALFED fishery experts to be minimal as compared to the in-Delta construction impacts and costs that would be associated with this option. Other alternatives exist to accomplish similar operational objectives.

Alternatives 1A, 1B, 2D, 2E, 3H and 3I contain one or more of the less desirable features described above. Alternatives 2A, 2B, and 2D contained the feature of an intake channel from the Sacramento River integrated with Snodgrass Slough. Modification of the plan to isolate the intake channel from Snodgrass Slough in Alternative 2 would eliminate the environmental impact that would be caused to Snodgrass Slough and would make the alternatives viable from that perspective.

The following alternatives were then subjected to additional analysis:

Alternative 1 - Version C - With and without additional storage

Alternative 2 - Version A without additional storage, and Version B with additional storage.

Alternative 3 - Version A - 5000 cfs isolated facility, without additional storage
Version B - 5000 cfs isolated facility, with additional storage
Version E - 15,000 cfs isolated facility, with and without additional storage

Following these evaluations, CALFED included storage in each alternative for planning purposes. Storage from zero up to 6 MAF (including groundwater storage) was considered a reasonable range for planning purposes for each of the three alternatives. This figure of 6 MAF additional storage represented a maximum volume for planning purposes, not a storage target. CALFED also evaluated these alternatives with zero additional storage.

CALFED also considered potential staging of the alternatives. It may be possible to sequence the development of storage to assure an appropriate amount is implemented.

Description of the Three Alternatives

Based on the analyses described above, CALFED developed the three alternatives to help move towards a preferred program alternative. They represent the "best" alternatives for each of the three main categories. Each alternative includes the six common Program elements plus storage and conveyance. The three alternatives fall within the range of the twelve alternative variations evaluated in the Programmatic EIS/EIR.

The operation of storage and conveyance facilities in the Bay-Delta system has a significant effect on all CALFED Bay-Delta Program resource categories, including water supply reliability, ecosystem health, water quality, and levee system vulnerability. These existing facilities include numerous reservoirs upstream of the Delta, diversion facilities for local and export water use on the Sacramento and San Joaquin River systems, the Delta Cross-Channel, and the Delta export facilities of the SWP and CVP.

The following brief overview of operating criteria considerations applies to each of the three alternatives. Each alternative description later in this chapter includes information on operating criteria used in the analyses.

Operating Criteria

A variety of protective measures, implemented under authorities such as the State Water Resources Control Board Bay-Delta Water Quality Control Plan and the federal Endangered Species Act Biological Opinions for Winter-Run Salmon and Delta Smelt, govern operation of storage and conveyance facilities that affect the Bay-Delta system. Together, these protective measures are known as the Bay-Delta standards.

Bay-Delta standards are not static -- as the health of the Bay-Delta has declined over the past several decades and the demand for water supplies from the Bay-Delta system has grown, progressively more protective standards have been implemented. Existing Bay-Delta standards were developed to provide environmental and water quality protection with today's levels of demand for Bay-Delta water supplies in mind. The expected increases in demand for water over the next twenty to thirty years will undoubtedly trigger changes in standards to maintain adequate protections. If new storage and conveyance facilities were constructed as a component of the CALFED Bay-Delta Program, new protective measures would be implemented to address their operation.

Many factors could affect future conditions in the Delta, including population growth and land use changes, technological developments affecting water use and water treatment, advancements in scientific understanding of biological processes, introduction and incursion of exotic species in the Bay-Delta system, and ocean conditions for anadromous fish. All of these factors could affect the ultimate performance or the time required to achieve a high level of success of the integrated Bay-Delta Program elements under any alternative. Ultimately, the health of the Bay-Delta will drive changes in Bay-Delta standards.

CALFED recognizes the critical role of the regulatory framework in the overall "assurances" package associated with this program. Given the importance of the regulatory regime to parties on all sides, it is important to clarify that CALFED is not proposing changes to Bay-Delta standards. Assumptions for operating new storage and conveyance facilities considered in the Program alternatives were made only to aid in the evaluation of the alternatives – no specific changes in Bay-Delta standards are proposed or endorsed by CALFED agencies through this evaluation. As information is developed during the course of implementing the Program, this information will be provided to regulatory agencies for appropriate consideration. Changes in Bay-Delta standards will be made, if at all, by the appropriate agencies in accordance with applicable laws and consistent with any agreements in the CALFED assurances package.

In modeling the three alternatives described below, CALFED first evaluated operations using existing regulations, modified only to account for operations of the new storage and conveyance facilities considered in each alternative. Specific assumptions regarding operating criteria are included in the following descriptions of the Program alternatives. For analytical purposes only, and in recognition of the potential for changes in Bay-Delta standards over the term of the Program, CALFED performed a "sensitivity analysis" of the three alternatives with respect to hypothetical changes in the regulatory regime. This was not a formal "sensitivity analysis" in a technical sense, but was simply a rough consideration of how the modeled water supply results changed when applicable standards changed. These hypothetical changes were chosen in part for modeling simplicity, and are not intended to represent a consensus as to whether or how standards could be strengthened or relaxed in the future. For purposes of this sensitivity analysis, CALFED evaluated changes in two Bay-Delta standards that are generally recognized as the major regulatory "controls" on the operations of Delta export facilities – the "Export-Inflow Ratio" requirement and the Delta "X2" outflow requirement. Discussion of this sensitivity analysis, as it pertains to different aspects of alternative performance, is included as a sidebar in Chapter 4.

Additional details on operating assumptions *Modeling Assumptions and Results Appendix* to the Draft Programmatic EIS/EIR.

Existing System Conveyance Alternative (Alt. 1)

Ecosystem Restoration - The Ecosystem Restoration Program Plan, as discussed earlier, would be implemented with the following refinements:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- Aquatic habitat restoration identified for the south Delta area would be relocated to the northern and western Delta. This change would provide for intensive habitat restoration to be located prudently distant from the south Delta pumping facilities.
- Incorporate a portion of identified south Delta wildlife habitat with the setback levees along Old River.

Water Quality - The Water Quality Program, discussed earlier, would be implemented with the following refinements:

- Increased emphasis on control of Delta Island drainage will be necessary to achieve improvements in organic carbon concentrations in export water treated for drinking. Potential approaches include treatment and rerouting drainage.

Levee System Integrity - The Long-Term Levee Protection Plan would be implemented as described earlier.

Water Use Efficiency - The Water Use Efficiency Program would be implemented as described earlier.

Water Transfers Policy Framework - The Water Transfer Policy Framework would be implemented as described earlier.

Watershed Management Coordination - Watershed Management Coordination would be implemented as described earlier.

Storage Facilities - The ranges of storage included in Alternative 1 are as follows:

Sacramento Valley
- 0 to 3.0 MAF Surface Storage
- 0 to 250 TAF Groundwater Storage

San Joaquin Valley
- 0 to 500 TAF Surface Storage

- 0 to 500 TAF Groundwater Storage

In-Delta, Near-Delta, or off-aqueduct south of Delta
- 0 to 2.0 MAF Surface Storage

An option for extension of the Tehama-Colusa Canal could provide multiple benefits to the Program by providing conveyance to potential off-stream reservoir sites and serving water to areas currently supplied by the North Bay Aqueduct. This would allow elimination of the North Bay Aqueduct diversions in an area of sensitive habitat and providing the service area superior water quality compared to that from the current diversion. As with the extension of the Tehama-Colusa Canal, relocation of the North Bay Aqueduct diversion to another point on the Sacramento River provide ecosystem and water quality benefits. Relocation would allow elimination of the current North Bay Aqueduct diversions in an area of sensitive habitat and providing the service area superior water quality compared to that from the current diversion. These will be evaluated in Phase III of the Program.

Delta Conveyance - Delta channels would remain in their existing configuration except that Old River would be enlarged in the reach north of Clifton Court to reduce channel velocities and associated scouring. These improved hydraulic conditions could enable the fish screen facility to operate more effectively.

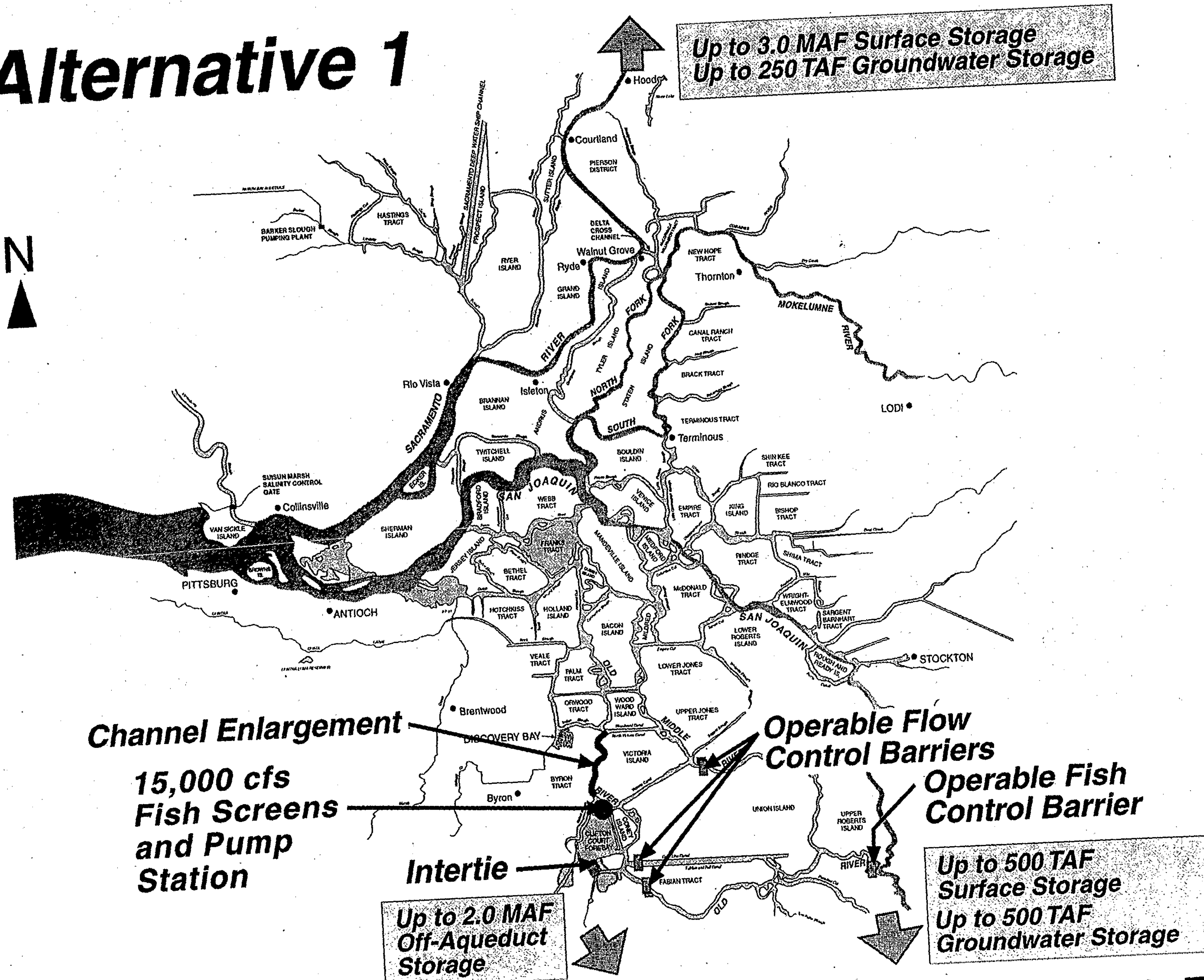
South Delta Intake Facilities - A new 15,000 cfs screened intake with low lift pumps would be constructed at the head of Clifton Court and the SWP and CVP would be connected (intertied) to consolidate these intakes through a single screen facility.

Fish Protection and Flow Control Barriers - To overcome problems with misdirection of San Joaquin River fish, an operable fish control barrier would be constructed at the head of Old River, and operable flow control barriers or their equivalent would be constructed in south Delta channels to alleviate the problem with reduced water levels that would be caused by the fish control barrier and export operations. An alternative to barriers might be to develop overland supply to south Delta islands that were affected by water levels or water quality problems. Another might be a combination of barriers and overland supplies.

Operating Criteria - Existing Bay-Delta standards were used as a starting point to evaluate the performance of Alternative 1. Some additional assumptions were necessary to account for new facilities, as described below:

- Improvements in south Delta channels and the SWP and CVP export facilities would result in allowable use of full capacity of the SWP Delta export facility, Banks Pumping Plant, when all Bay-Delta standards are met.
- SWP export facilities may be used to deliver water to CVP users.
- Delta Cross-Channel gates are closed except for the months of July through October.

Alternative 1



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Modified Though Delta Conveyance Alternative (Alt. 2)

Ecosystem Restoration -The Ecosystem Restoration Program Plan would be implemented with the following refinements:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- The modification of the Mokelumne River Floodway with setback levees, conversion of Bouldin Island to aquatic habitat, and construction of the East Delta Wetlands Habitat will create about 5,000 to 10,000 acres more habitat than identified in the ERPP.
- Incorporate a portion of identified south Delta wildlife habitat with the setback levees along Old River.

Water Quality - The Water Quality Program, discussed earlier, would be implemented with the following refinements:

- Evaluate relocating the water supply intake for North Bay Aqueduct to avoid salts and organic carbon that reduce the ability to recycle water, complicate disinfection, and are sources of disinfection byproducts. Alternative 2 would not, overall, result in improvement of North Bay Aqueduct export water quality, and a change of intake location would be necessary for North Bay Aqueduct water users to benefit from the Delta solution.
- Relocate Delta island drainage discharges away to channels other than those identified for conveyance modifications.

Levee System Integrity - The Long-Term Levee Protection Plan would be implemented as described earlier.

Water Use Efficiency -The Water Use Efficiency Program would be implemented as described earlier.

Water Transfers - The Water Transfer Policy Framework would be implemented as described earlier.

Watershed Management Coordination - Watershed Management Coordination would be implemented as described earlier.

Storage Facilities - Construction of storage facilities would be authorized on the Sacramento and San Joaquin River systems, in or near the Delta and off-aqueduct storage south of the Delta would be provided through this alternative. Storage would include both surface water impoundments and groundwater conjunctive use.

The ranges of storage included in Alternative 2 are as follows:

Sacramento Valley
- 0 to 3.0 MAF Surface Storage
- 0 to 250 TAF Groundwater Storage

San Joaquin Valley
- 0 to 500 TAF Surface Storage
- 0 to 500 TAF Groundwater Storage

In-Delta, Near-Delta, or off-aqueduct south of the Delta
- 0 to 2.0 MAF Surface Storage

As described for Alternative 1, an option for extension of the Tehama-Colusa Canal and/or relocation of the North Bay Aqueduct diversion to another point on the Sacramento River will be evaluated in Phase III of the Program.

Delta Conveyance Facilities - Draft Alternative 2 is based on Alternative 2B. Its major structural features include a screened intake on the Sacramento River near Hood. The capacity of this new diversion facility would be on the order of 10,000 cfs.

With this alternative, a new isolated channel would be constructed from Hood to McCormack Williamson Tract to preserve the existing warm water fishery habitat in Snodgrass Slough. A fish ladder or equivalent would be constructed to convey fish upstream past the pumps and screens to the Sacramento River. Consideration would be given to including turnouts to provide flow for Stone Lake Refuge and a Sacramento County groundwater conjunctive use operation. The McCormack Williamson Tract levee would be breached and the island flooded to provide shallow water habitat and improve water conveyance.

The Mokelumne River channel would be widened to improve water conveyance and flood control in the northern Delta. A 600-foot-wide alignment would be purchased along the Mokelumne River from I-5 to the San Joaquin River. Existing levees on one side of the existing channel would be replaced with new setback levees approximately 500 feet back from the existing channel. Existing levees would be removed where they obstruct the new channel with the remaining portions converted to channel islands. Existing improvements would be relocated or replaced where displaced by the widened channel. The new setback levees would be constructed in stages over several years. When the foundations of the new levees consolidate (over a 5+ year period), existing levees would be breached.

A new 15,000 cfs capacity screened intake with pumps would be constructed at the head of Clifton Court, and an interconnection of the CVP and SWP at Clifton Court would consolidate the project intakes through a single screen facility.

Old River would be enlarged in the reach north of Clifton Court to reduce channel velocities and associated scouring, and to enable the fish screen facility to operate more effectively.

An operable barrier would be provided at the head of Old River to maintain a positive flow down the San Joaquin River and keep San Joaquin River fish in the river channel. If needed, flow and stage control measures would be included on Middle River, Grant Line Canal, and Old River. Alternatives to these barriers will also be explored.

Discussion of Phase II Conveyance Options

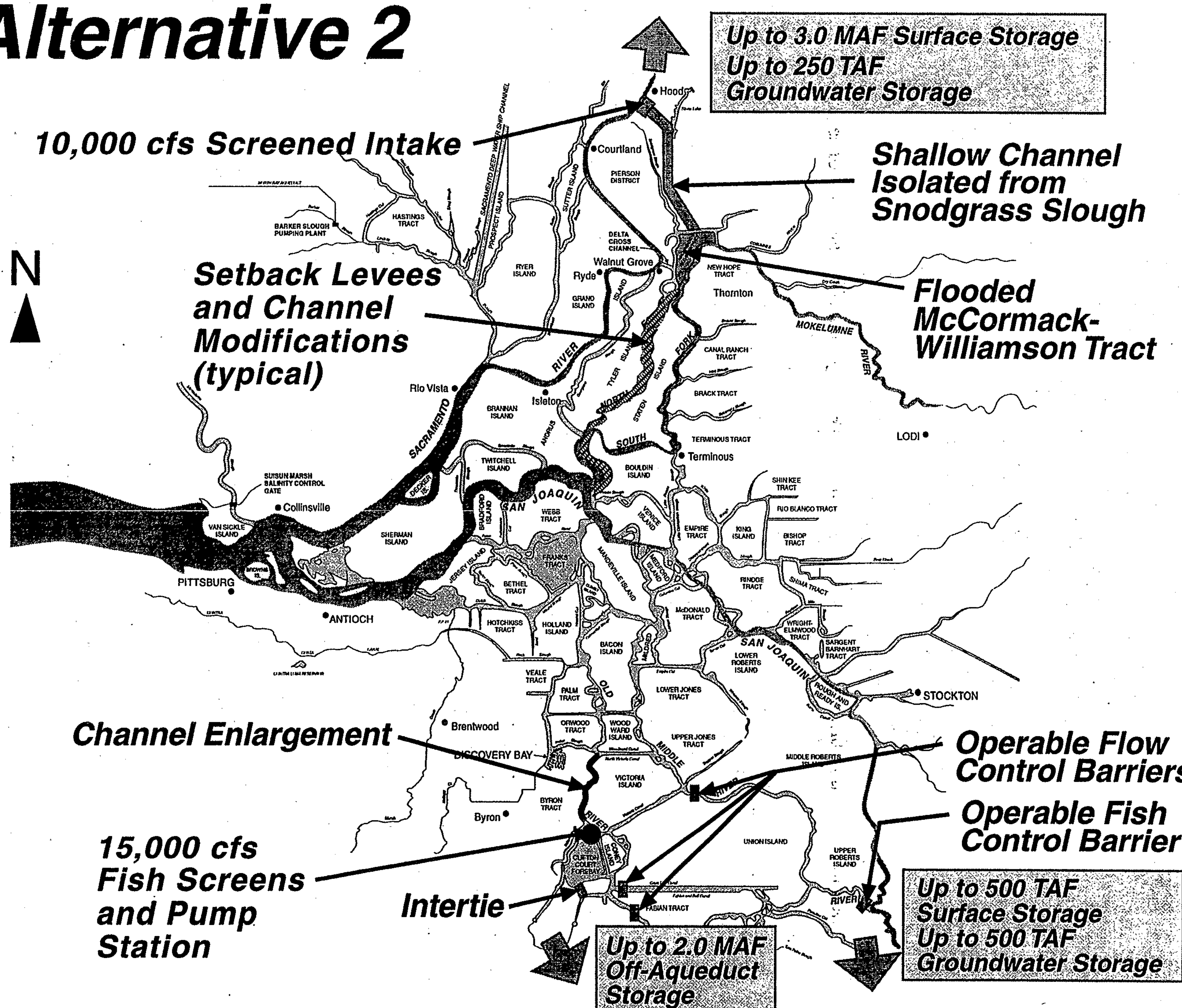
The primary decision in refining a through-Delta alternative centers on the choice of which Mokelumne River channel to widen and use as the primary water conduit. As currently conceived, the North Fork would be the main conduit; however, it has also been suggested that the South Fork be used. Proponents of the South Fork option suggest that this choice would improve water quality and the ability to repel salinity intrusion from the Bay and ocean. The current concept of using the North Fork is based on the belief that the South Fork has important habitat value that would be lost if the channel was enlarged. This region of the Delta supports Swainson's Hawk, wintering waterfowl, greater sandhill cranes, and migrating shorebirds, which all rely on the region's large open expanses of rich agricultural lands for resting and foraging. Also, the South Fork would provide important opportunities for habitat enhancement as an element of the Ecosystem Restoration Program element. A final decision on this option will be made after further study during Phase III of the program, if Alternative 2 should become the preferred program alternative.

Operating Criteria - Existing Bay-Delta standards were used as a starting point to evaluate the performance of Alternative 2. Some additional assumptions were necessary to account for new facilities, as described below:

- Improvements in south Delta channels and the SWP and CVP export facilities would result in allowable use of full capacity of the SWP Delta export facility, Banks Pumping Plant, when all Bay-Delta standards are met.

- SWP export facilities may be used to deliver water to CVP users.
- Delta Cross-Channel gates are closed except for the months of July through October.

Alternative 2



Dual Delta Conveyance Alternative (Alt. 3)

Ecosystem Restoration -The Ecosystem Restoration Program Plan would be implemented with the following refinements:

- Changes in environmental water flows would be met through purchase of existing water from willing sellers and use of the new storage allocated to environmental water supplies.
- Habitat improvements along the North Fork Mokelumne River would be limited to establishing a riparian tree corridor associated with levees possibly set back for modified channel conveyance.
- Shallow water habitat identified for the Delta would be located in the eastern Delta by breaching select portions of the east levee along the South Fork Mokelumne River and protecting interior levee slopes.

Water Quality -The Water Quality Program, discussed earlier, would be implemented with the following refinements:

- Evaluate relocating water supply intakes (such as North Bay Aqueduct, Tracy, and Contra Costa Water District intakes) to avoid salts and organic carbon that reduce the ability to recycle water and that complicate disinfection and are sources of disinfection byproducts.
- Actions to reduce contributions of organic carbon from Delta islands through treatment or drainage rerouting may be unnecessary.

Levee System Integrity - The Long-Term Levee Protection Plan would be implemented as described earlier.

Water Use Efficiency -The Water Use Efficiency Program would be implemented as described earlier.

Water Transfers - The Water Transfer Policy Framework would be implemented as described earlier.

Watershed Management Coordination -Watershed Management Coordination would be implemented as described earlier.

Storage Facilities - The ranges of storage included in Alternative 3 are as follows:

Sacramento Valley
- 0 to 3.0 MAF Surface Storage
- 0 to 250 TAF Groundwater Storage

San Joaquin Valley
- 0 to 500 TAF Surface Storage
- 0 to 500 TAF Groundwater Storage

In-Delta, Near-Delta, or off-Aqueduct south of Delta
- 0 to 2.0 MAF Surface Storage

Delta Conveyance Facilities - Under this alternative, an isolated facility of 10,000 ± 2,000 cfs capacity would be constructed. An open channel is recommended over a pipeline because the two appear to have similar degrees of environmental impacts and a pipeline will not significantly improve insurance against future increases in diversion capacity. Though a pipeline would effectively prevent accidental contamination over the reach of the pipeline, its cost would be much higher. (Note: A pipeline was originally considered for a 5,000 cfs conveyance; a pipeline for a 10,000 ± 2,000 cfs capacity is considered impractical from a construction and cost viewpoint.)

The intake to the isolated facility would be in the Freeport-Hood vicinity, and may include dual points of intake. The intake(s) would be screened. The isolated facility would be placed along the eastern side of the Delta and connected to Clifton Court.

Operation of an isolated facility can be expected to cause salinity of the central and south Delta waters to increase. Accordingly potential connection of south Delta islands could eliminate the need for the south Delta flow and stage barriers and would significantly improve water quality. Potential connection of Contra Costa and Tracy would significantly improve water quality. Potential connection of portions of San Joaquin County to the new canal would provide a new source of high quality water and significantly improve water supply reliability to this area of current groundwater overdraft. The feasibility of including these options will be evaluated during Phase III of Program.

A new 5,000 ± 2,000 cfs screened intake with pumps would be constructed at the head of Clifton Court, its size determined by the size of the isolated facility and the manner in which the dual facilities would be operated. Enlargement of Old River north of Clifton Court or enlargement of other channels may or may not be needed, depending on the amount of flow to be exported through the south Delta. The same is true of the fish and flow control barriers.

COMPARISON OF OPEN CHANNEL AND PIPELINE OPTIONS FOR ISOLATED FACILITY

Conveyance Types and Environmental Impacts - The 44-mile canal would generally consist of a trapezoidal section with gentle side slopes and a top width of around 600 feet and a depth 27 feet. The pipeline facility would consist of side-by-side buried concrete pipelines. The total distance of the pipeline route disturbed acreage is approximately the same as the canal alignment. The construction activities to bury the pipeline would disturb similar acreage as the canal. However, the buried pipelines would allow easier terrestrial access from one side of the alignment to the other.

Pumping Plants - Pumping plants would lift up to 10,000 ± 2,000 cfs into the conveyance facility. An open channel would utilize a single low operating head (10 feet) pumping plant and the pipeline would require a pumping plant with operating head of 150 feet. The increased operating lift would substantially increase operating and energy cost from around $2 million per year for the canal option to around $24 million per year (based on a power rate of 40 mills) for the pipeline option. Given that the site acreage for the two pumping plants are about the same there would little differences in environmental impacts between the two plants.

Water Crossings - In order to convey water across rivers and sloughs, the open canal would require 11 inverted siphons. The siphons would cross under four major rivers and seven sloughs. The pressurize buried pipeline would cross under the same waterways. The environmental impacts of these crossings would be similar for both alternatives.

Bridge and Utility Relocations - For the open canal, bridges would be constructed over the canal for all county roads, state highways, and railroad crossings. The pipeline will cross under the same facilities. The construction impacts of the two methods would be similar; however, the elevated bridges across the canal would have more visual impact than the buried pipeline.

Water Quality Protection - The buried pipeline is less vulnerable than an open canal to introduction of pollutants, such as those introduced by spills, storm water and agricultural runoff, and sabotage. Given that there is many miles of open water above the intake and miles of open water from the pipelines exit into Clifton Court Forebay to the point of use, the added benefit of this protection appears minor.

Safety - Both facilities would be designed to current safety standards and the safety components included in the project cost. There would be substantially less safety measures needed along the route of the buried pipeline than the open canal.

Seepage Protection - There would be insignificant, if any, seepage from the pipeline. Monitoring wells along the route of the canal would be installed to identify areas that may have excess and facilities such as seepage interception wells would be installed to protect adjacent lands from seepage problems.

Seismic - Both the canal and the pipeline would be designed to the California design code for seismicity. The cost for design and construction for seismicity are included in the cost estimate.

Right-of-Way - The right-of-way width for both conveyance methods is similar.

Costs Comparison - Preliminary capital cost for the canal conveyance is around $1.4 Billion. The pipeline conveyance would be about $2.4 Billion. In addition, the pipeline energy requirement is $22 Million more per year that the canal.

Comparing the 1982 Peripheral Canal and CALFED Alternative 3

CALFED Alternative 3 includes dual Delta conveyance, using modified Delta channels and an isolated facility to convey water from the Sacramento River to the SWP and CVP pumping plants in the south Delta. How does this alternative compare to the 1982 proposal for a peripheral canal? Both include a new facility to move water around the eastern edge of the Delta, but that's where the similarity ends. The main differences include the scope of the programs, conveyance capacity and method, strategy to maintain in-Delta water quality, and impacts on local resources.

A big difference between the old peripheral canal and any of the CALFED alternatives is their scope. Each of the CALFED alternatives offers a comprehensive program to solve problems in the Bay-Delta system related to water supply reliability, water quality, ecosystem quality, and levee system integrity, with flood control improvements integrated with ecosystem restoration in both the north and south Delta. The peripheral canal was primarily intended to increase water project exports and reduce fish entrainment caused by these exports.

The old peripheral canal had a proposed capacity of 23,000 cfs. Among the variations of Alternative 3, only 3e approaches this magnitude of isolated conveyance with a 15,000 cfs diversion on the Sacramento River. The main benefits of the isolated facility in Alternative 3 are improvement in export water quality and a reduction in fish entrainment caused by Delta exports, rather than an increase in export water supply.

The CALFED alternatives would improve water quality with a broad range of actions that emphasize point and non-point source control. The through-Delta conveyance included in Alternative 3 would help maintain in-Delta water quality, although salinity levels would increase in some areas. The peripheral canal included a feature to discharge Sacramento River water from the canal into Delta channels to improve in-Delta water quality. This feature is not included in Alternative 3 because these releases could cause anadromous fish to stray from the Sacramento River into the Delta, a very serious environmental impact.

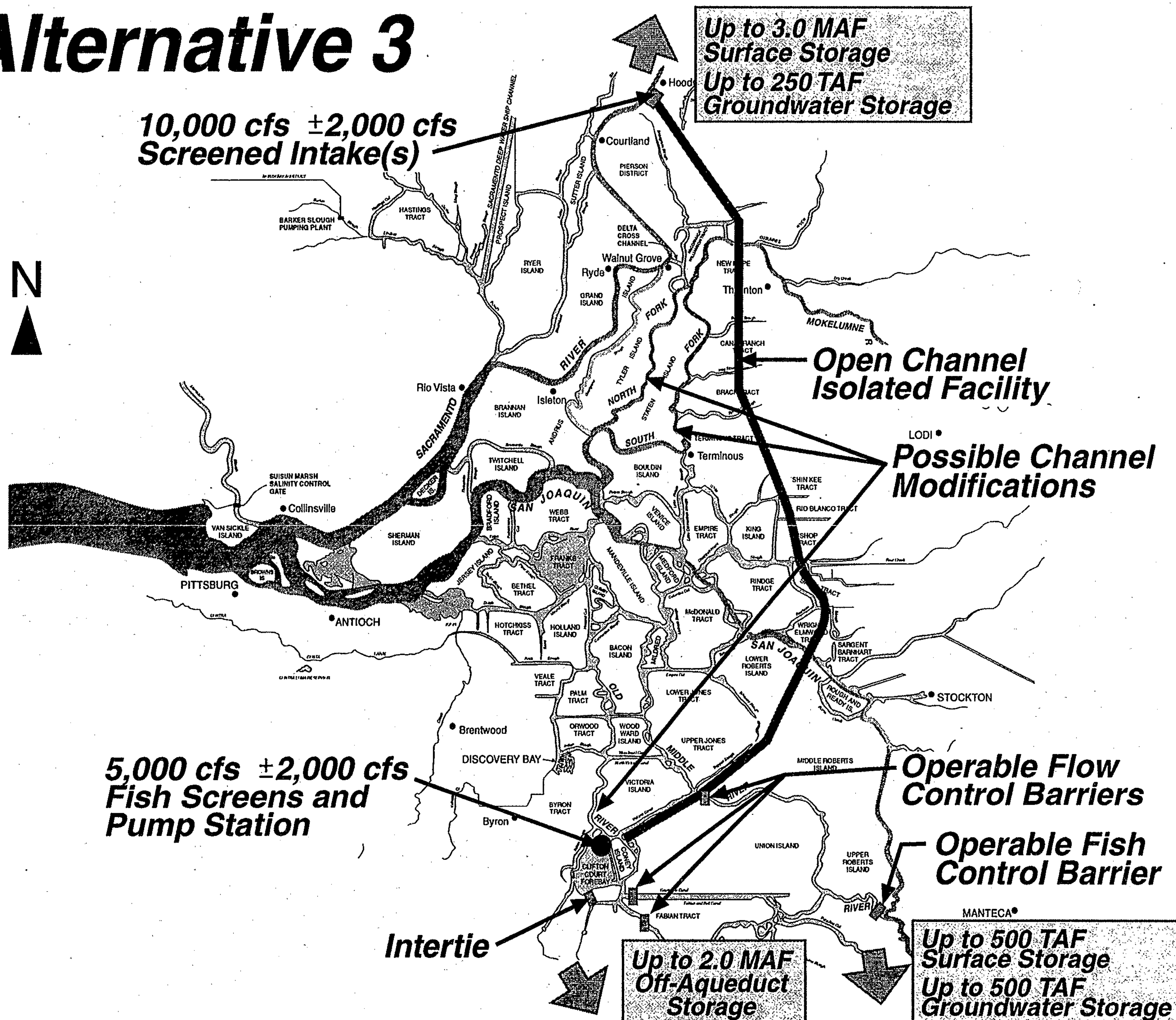
A final difference between CALFED's Alternative 3 and the old peripheral canal is the impact on local resources related to the way any new canal would cross existing Delta streams and channels. Construction of the peripheral canal would have blocked several existing waterways in the eastern Delta. This could have caused local drainage problems during high flows, and would have separated valuable habitat in the eastern Delta from the rest of the Delta ecosystem. Alternative 3 would prevent local drainage problems and maintain the connection of the aquatic ecosystem by using siphons to carry water in the isolated facility underneath existing Delta channels.

Fish Protection and Flow Control Barriers - Operable barriers would be installed if necessary at the head of Old River and elsewhere in the southern Delta to improve fish migration pathways and to reduce the salinity of south Delta water and raise water levels. Whether these barriers will prove necessary depends on how much and when export pumping is continued from the south Delta. During Phase III of the process, studies would be conducted to determine the need to supply good quality water to south Delta islands to mitigate any adverse effects resulting from implementing this alternative. Studies must also be conducted to determine the necessity of relocating the points of diversion to Contra Costa County to mitigate any negative water quality effects of implementing this alternative on that agency.

Operating Criteria - Existing Bay-Delta standards were used as a starting point to evaluate the performance of Alternative 3. Some additional assumptions were necessary to account for new facilities, as described below:

- Improvements in south Delta channels and the SWP and CVP export facilities would result in allowable use of full capacity of the SWP Delta export facility, Banks Pumping Plant, when all Bay-Delta standards are met.
- SWP export facilities may be used to deliver water to CVP users.
- Delta Cross-Channel gates are closed except for the months of July and August October.
- SWP and CVP diversions through the isolated conveyance facility are not subject to E-I ratio restrictions, but total project exports, including isolated conveyance facility diversions, are limited to 5,000 cfs in May.
- A minimum export of 1,000 cfs is required from south Delta SWP and CVP facilities during July through March to provide for in-Delta water quality, while no diversions from south Delta facilities are allowed April through June to protect fisheries.
- After minimum south Delta diversions are met (1,000 cfs July through March, zero cfs April through June), diversions through the isolated conveyance facility must be maximized before any additional exports are made from south Delta facilities.
- The minimum flow requirement for the Sacramento River at Rio Vista for July and August is 3,000 cfs.

Alternative 3



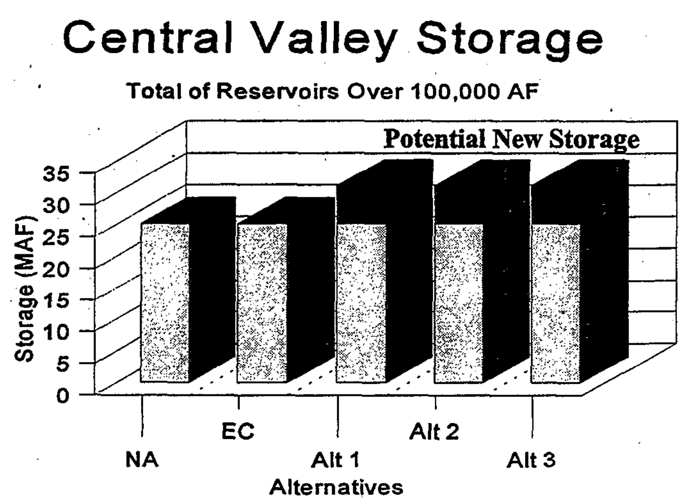
4. ALTERNATIVES EVALUATION

The evaluations in this chapter focus exclusively on the characteristics that vary between alternatives. For that reason, the potential beneficial effects of the common program elements (the ecosystem restoration program, water quality program, water use efficiency program, levee protection plan, water transfer policy framework, and watershed management coordination) are not reflected in this discussion. Although this focus is probably unavoidable given the need to contrast the variable aspects of the alternatives, the reader should bear in mind that a significant part of the overall performance of the CALFED Bay-Delta Program is attributable to the common program elements.

Applying the distinguishing characteristics to the alternatives required a significant amount of analytical work. Details of the modeling work are provided in the *Summary of Modeling Assumptions and Results Appendix* to the Draft Programmatic EIS/EIR.

Significance of Distinguishing Characteristics

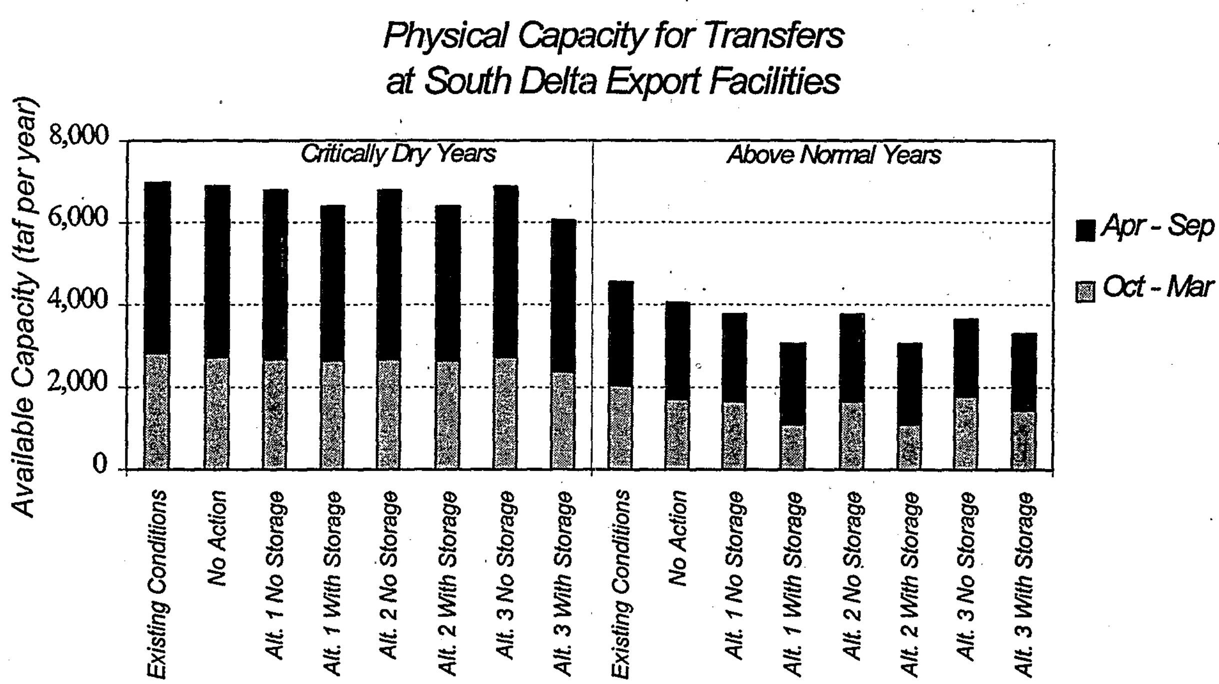
Of the 18 characteristics originally identified as distinguishing among the alternatives, some were found not to vary greatly between the alternatives. These included:



Storage and Release of Water - Storage of water in Program facilities will take place during the winter periods of high river flows when potential adverse effects on the environment are at a minimum. Release of the water for environmental uses will take place during lower flows when they provide the most benefit. Release of water for other uses will generally take place during lower flow periods when the additional flows can provide some indirect benefits to instream flows. The amount of water stored and released through any potential Program storage facilities is relatively small compared with other ongoing flow. In addition, proposed storage ranges from zero to 6 MAF in all three alternatives. Accordingly, the overall effects of the storage and release is very similar between the alternatives.

Water Transfer Opportunities

Preliminary evaluations indicate that under each alternative, physical capacity exists in SWP and CVP export facilities to accommodate well over 2 MAF of water transfers in all year types. As the following figure illustrates, much more available capacity exists in these facilities in drier years than in wetter years, since less project water is generally moved through these facilities in drier years. The figure also shows that more capacity for transfers exists in alternatives without new storage compared to alternatives with new storage. This results from an assumption that new storage would provide additional water to SWP and CVP water users, and that this water would receive higher priority of use of available conveyance capacity. Institutional arrangements could be implemented to change the priority of use of export facilities to increase conveyance capacity available for transfer water.



The chart shows physical capacity for transfers for two periods of the year.

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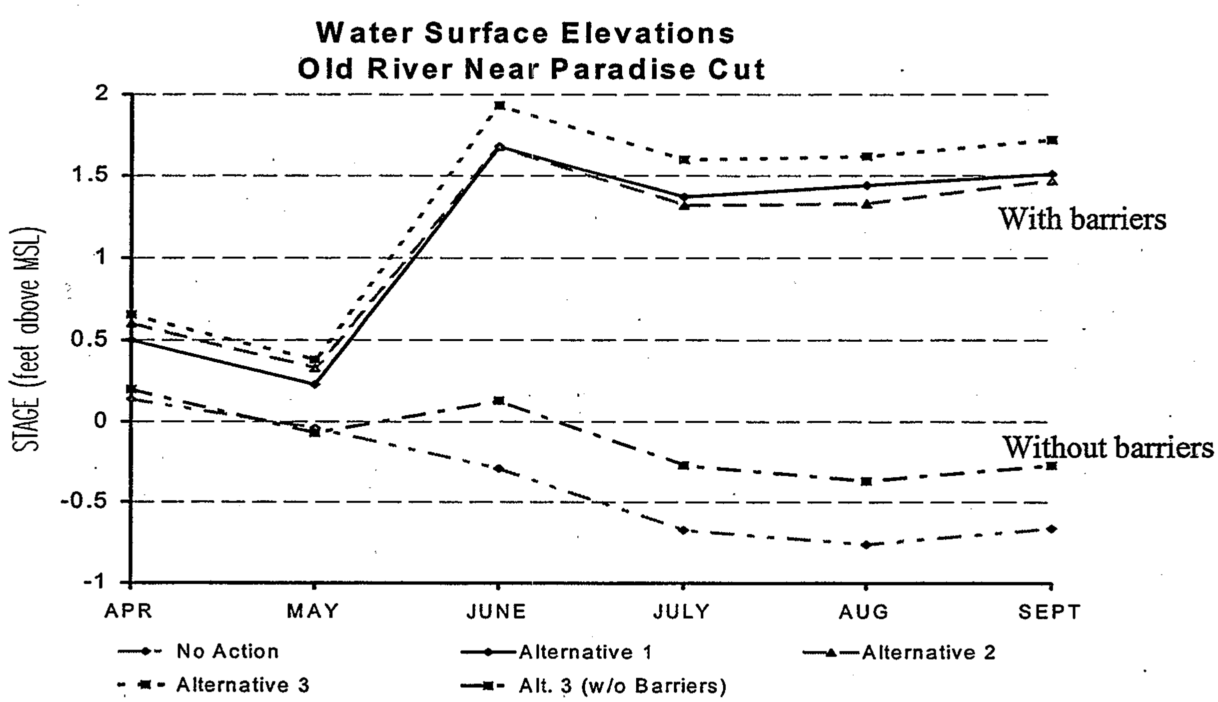
Physical capacity of the export facilities can only be used when exports are allowable under Bay-Delta standards. Preliminary evaluations indicate that under operating criteria based on existing standards (described previously), the ability to export transfer water does not vary significantly between the alternatives. Under these operating criteria, at least 600 TAF per year of transfer water could be exported from the Delta during critically dry years under each alternative.

Transfer Opportunities Vary with Operational Criteria

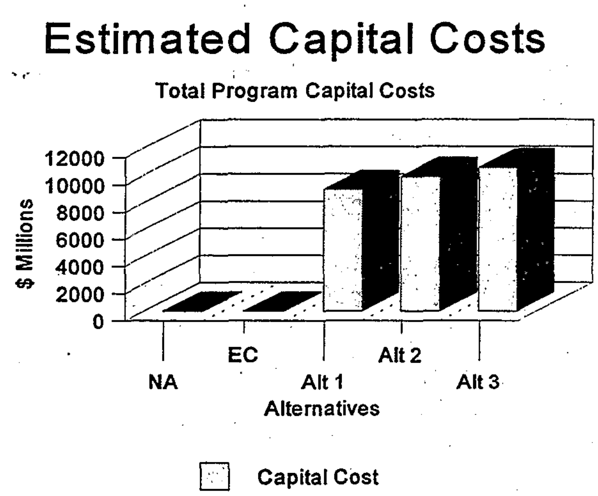
A sensitivity analysis on export-inflow ratio requirements (described later under Water Supply Opportunities) indicates that if more protective E-I ratios are necessary to provide adequate protection to fisheries, the flexibility to export transfer water from the Delta would be significantly diminished under Alternatives 1 and 2 .

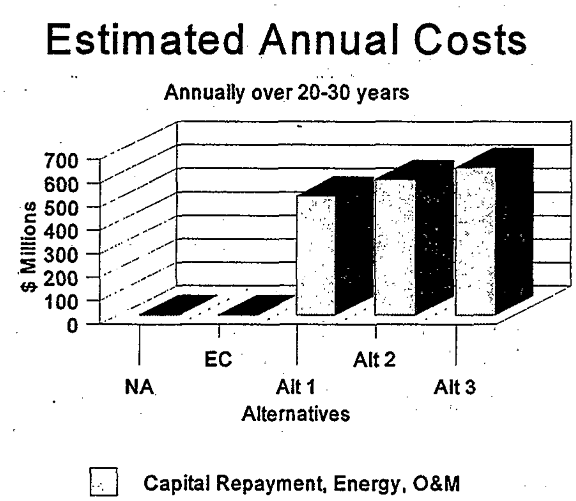
It must be kept in mind that there are many other policy and technical considerations that will affect water transfer opportunities. In particular, water transfer policy must include strong mechanisms to avoid or mitigate impacts to third parties and groundwater resources. These essential aspects of a CALFED water transfer policy will place similar limitations on water transfer opportunities for all the alternatives.

South Delta Access to Water - Delta Simulation Modeling indicated that in-Delta flow barriers or functional equivalent would be effective in raising south Delta water levels, essentially independent of the selection of an alternative. The chart below shows that Alternative 3 (with or without the barriers) results in slightly higher stages than the other alternatives.



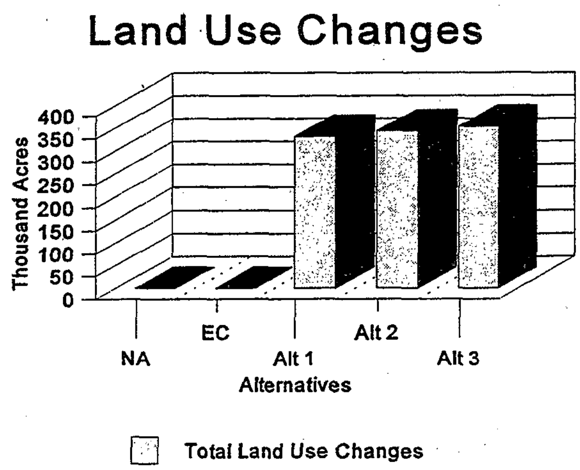
Total Cost - There are relatively minor differences in cost among the alternatives. The total cost differential among the alternatives is on the order of $1.5 billion, whereas total program cost will be on the order of $10 billion including the upper range (6 MAF) of storage analyzed. The left chart below shows that total Program capital costs range from about $9 billion to $10.5 billion including the common program elements, storage, and conveyance. Approximately $4 billion of this cost is for the common program elements. Approximately $5 billion of this cost is for storage if included. Annual investment is a critical issue for each alternative. The right chart below shows annual costs including capital repayment, energy and operation and maintenance of about $500 to $600 million.





Habitat Impacts - Alternative 1 would have lower construction impacts than would Alternatives 2 and 3 because, except for storage, only minimal construction would occur. The construction impacts of Alternatives 2 and 3 would be dwarfed by land conversions for habitat improvement that would be constructed as part of the common programs in all alternatives. For example, channel modifications and setback levees could be constructed to provide significant additional channel island habitat composed of old levees, and shallow water habitat over and above that included in the ERP. The impacts on habitat will probably be similar overall for the three alternatives. Also, considering that the magnitude of land use changes (see the next distinguishing characteristic) are basically the same for each alternative, habitat impacts would also be similar between the alternatives.

Land Use Changes - There are relatively minor differences in the acres of land use changes required among the alternatives. Ecosystem restoration will require up to 200,000 acres of change in each alternative. Some of this is already in government ownership but most is agricultural land in private ownership. Levee changes could require up to 35,000 acres in each alternative. Water quality actions could affect approximately 40,000 acres. Storage could affect approximately 60,000 acres in each alternative. Conveyance could impact approximately 5,000 acres more land in Alternative 3 than Alternatives 1 and 2. Land use change is not, therefore, a major distinguishing characteristic between the alternatives.



Socio-Economic Impacts - The choice among alternatives will not significantly change socio-economic impacts. Most such impacts will be a result of economic displacement from land and water use changes from water transfers, water conservation, water reclamation, land retirement for water quality improvement, and land use change for habitat enhancements. These features are included in all three alternatives.

Ability to Phase Facilities - Each alternative includes hundreds of programmatic actions that could be implemented over 20 to 30 years. Alternative 3 has more physical features than Alternative 2 which, in turn, has more features than Alternative 1. Therefore, Alternatives 2 and 3 could have more complex phasing (staging) plans than for Alternative 1. However, each alternative provides ample opportunity for staging over the implementation period.

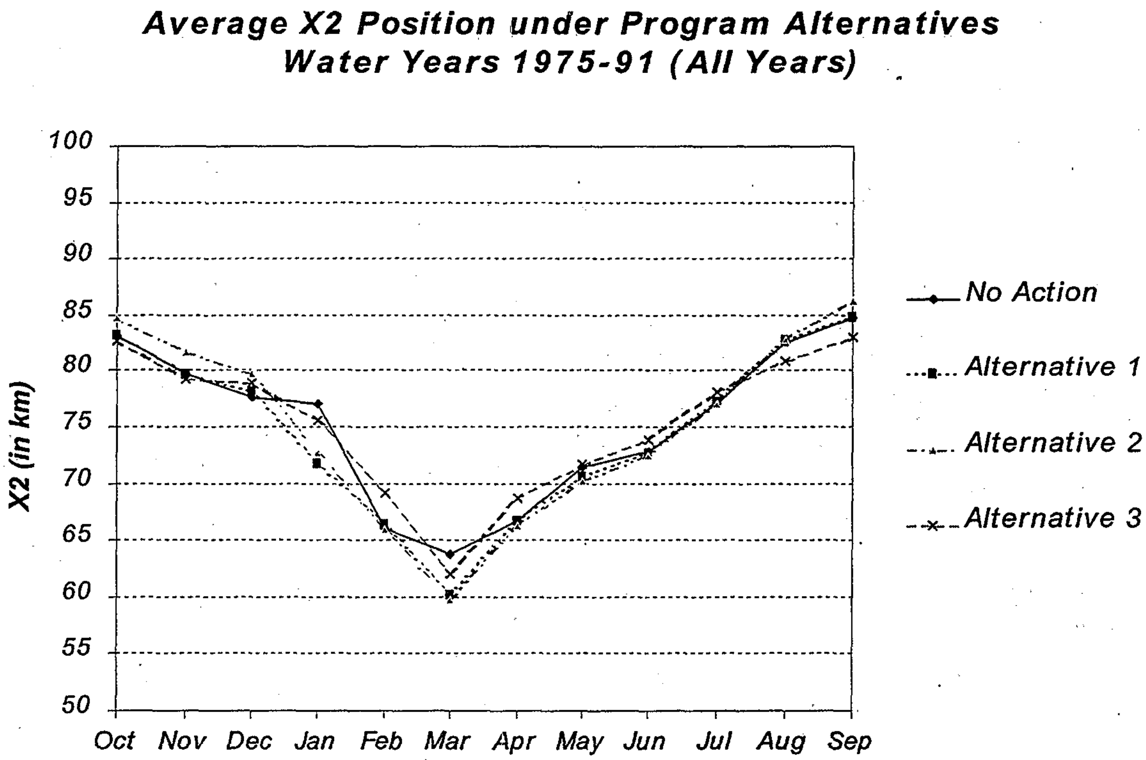
Brackish Water Habitat - This characteristic refers to the capability of the alternatives to control salinity intrusion into the Delta from the Bay and ocean and, thereby, to maintain important brackish water habitat in the Western Delta and Suisun Bay. An indicator of the location of this brackish water habitat is the location of 2,000 parts per million total dissolved solids or X2 (measured in kilometers upstream from the Golden Gate Bridge). Hence, X2 is currently used as the primary indicator in managing Delta outflows.

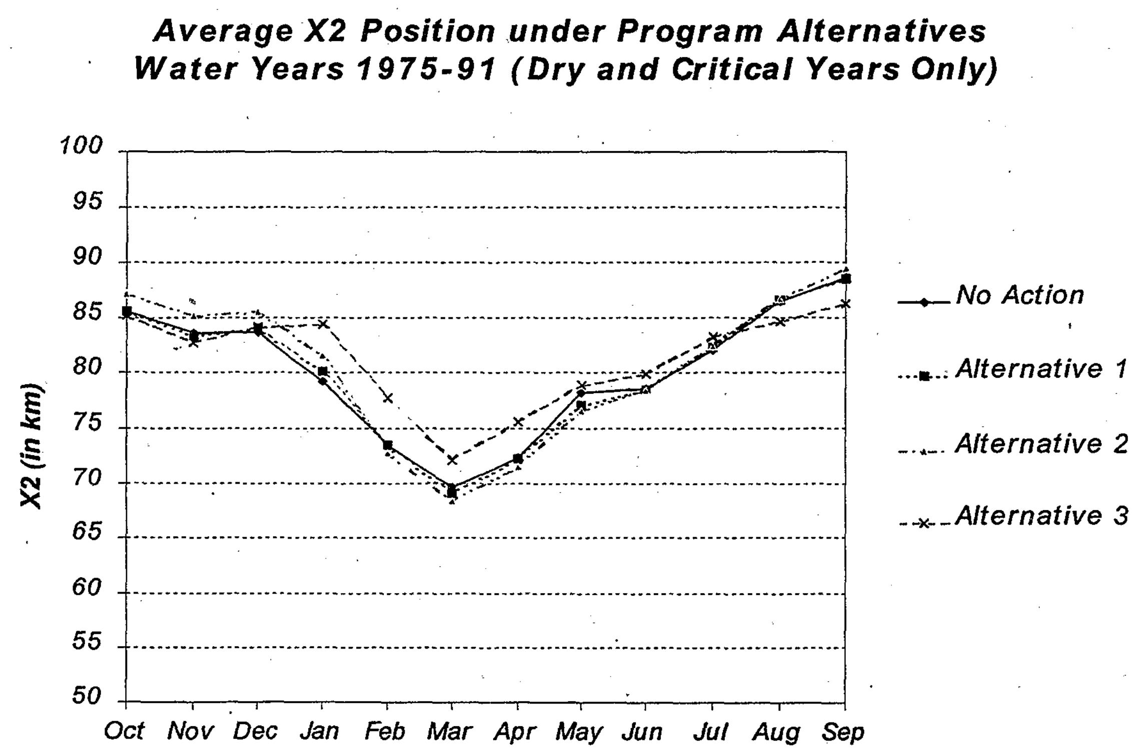
The X2 indicator is used to reflect a variety of biological consequences related to the magnitude of fresh water flowing downstream through the estuary and the upstream flow of salt water in the lower portion of the estuary. The outflow that determines the location of X2 also affects both the downstream transport of organisms such as delta smelt and striped bass, and the upstream transport of others such as bay shrimp and Dungeness crabs. The abundance of some species is positively related to the magnitude of downstream flow during the late winter and spring. These include bay shrimp, longfin smelt and starry flounder. The evidence of such relationships led to the existing standards concerning X2. Many people believe that this evidence indicates that reduced freshwater flows in the estuary resulting from consumption of water in the basin and exports from the basin have degraded habitat quality for aquatic resources.

Existing Bay-Delta standards set minimum Delta outflow by requiring X2 to be maintained at set locations for set time periods during the months of February through June. Delta simulation modeling for the 1975 through 1991 period indicates the average difference in location of X2 for November through June between no-action and Alternative 3 with new storage (the Program alternative with the greatest effect on X2 position) is about 1.1 km. For dry and critical years during the 1975 through 1991 period, the average difference in location of X2 for November through June between no-action and Alternative 3 with storage is about 2.4 km. The charts on the following page show the average monthly X2 position for no-action and the three Program alternatives with storage for both the full 1975 through 1991 period and the dry and critical years of the same period.

Comparing Alternative 3 to no-action, average X2 increases by as much as 5.1 km during the month of January and decreases by about 2.5 km in the month of September. This result is due to operating assumptions and modeling simplifications associated with the isolated conveyance facility. Changes in operating assumptions could shift exports under Alternative 3 from winter and spring months to summer and fall months and maintain compliance with assumed operating rules, if that type of operation was deemed more favorable for achieving Program objectives. This change in operation would result in X2 positions similar to those displayed for Alternatives 1 and 2.

Given this potential for changes in operating assumptions under Alternative 3, the expected variation in the salinity gradient among the Program alternatives would be so small that any biological consequences are expected to be minimal.


Average X2 Position under Program Alternatives
Water Years 1975-91 (All Years)
100
95
90
85
80
75
70
65
60
55
50
X2 (in km)
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
No Action
Alternative 1
Alternative 2
Alternative 3


Average X2 Position under Program Alternatives
Water Years 1975-91 (Dry and Critical Years Only)
100
95
90
85
80
75
70
65
60
55
50
X2 (in km)
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
No Action
Alternative 1
Alternative 2
Alternative 3

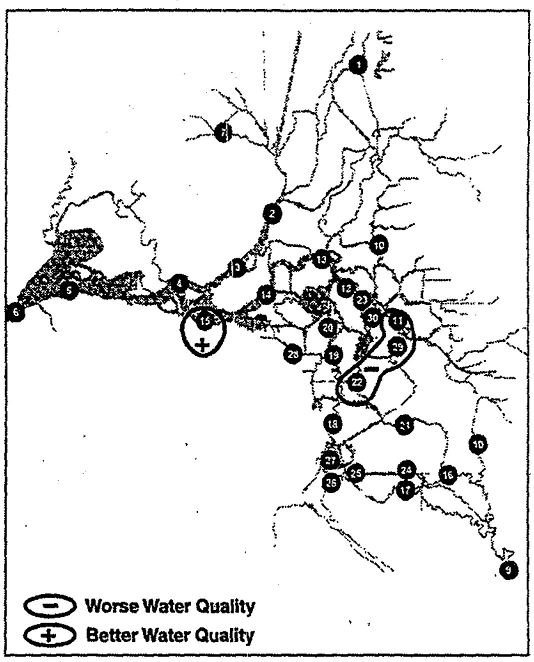
Most Significant Distinguishing Characteristics

The remaining characteristics were found to distinguish the alternatives:

In-Delta Water Quality

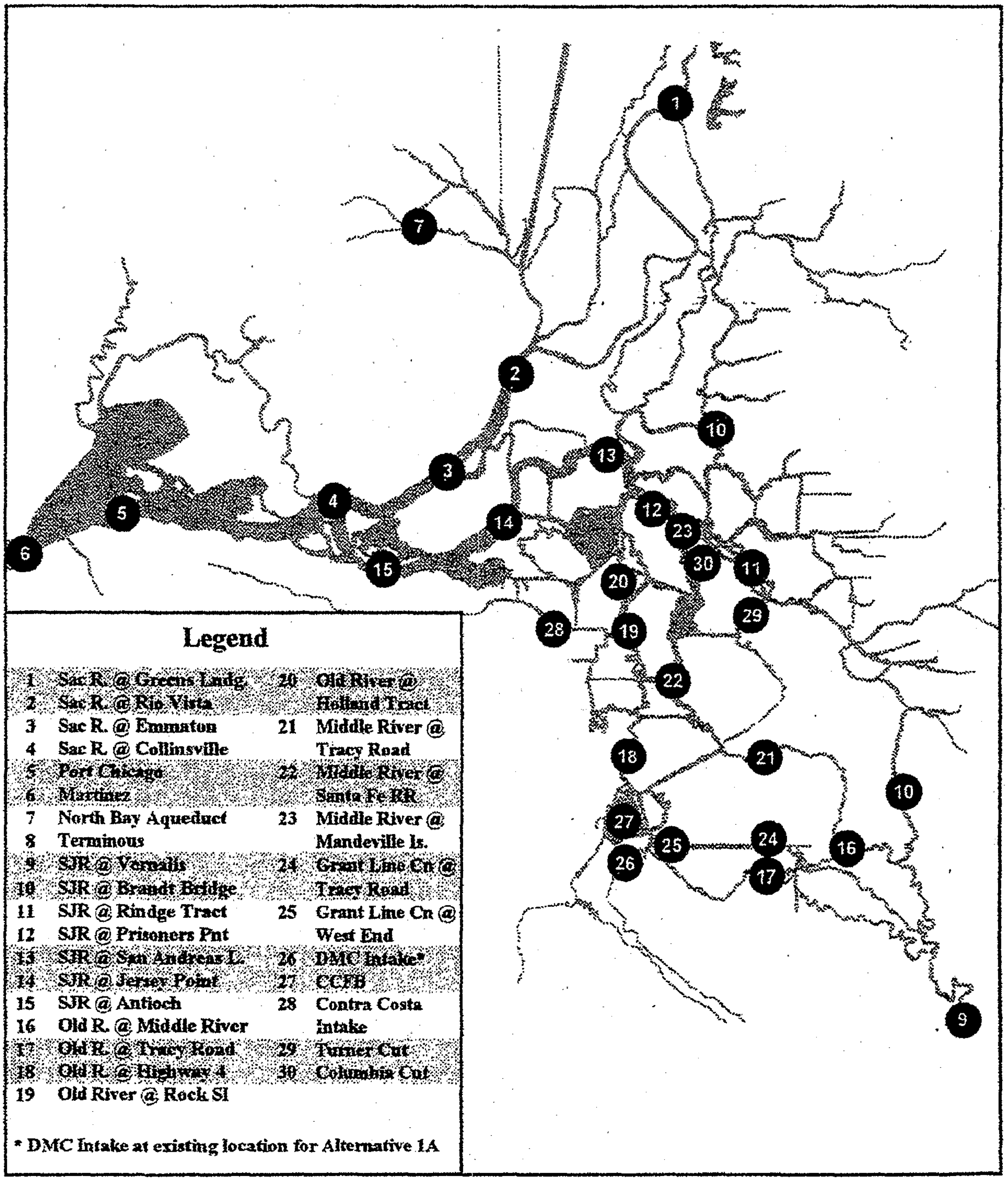
The Delta Simulation Model provides estimates of salinity at many locations throughout the Delta (see following page for locations). Changes in salinity for the alternatives are shown on the following charts as changes in electrical conductivity (EC). Areas with improved water quality (reduced salinity) are shown with a "+" symbol and areas with reduced water quality (increased salinity) are shown with "-" symbol. These EC estimates are based on an average of estimates for the years 1975 through 1991. For this evaluation, the upper end of the range of new storage facilities described in Chapter 3 was included in the simulated operations for each Program alternative.

Alternative 1- Changes in Salinity from No Action Alternative



Note: In these figures "+" means better water quality and reduced salinity measured by electrical conductivity (EC); "-" means worse water quality.

Model Output Locations for Monthly Average Electrical Conductivity



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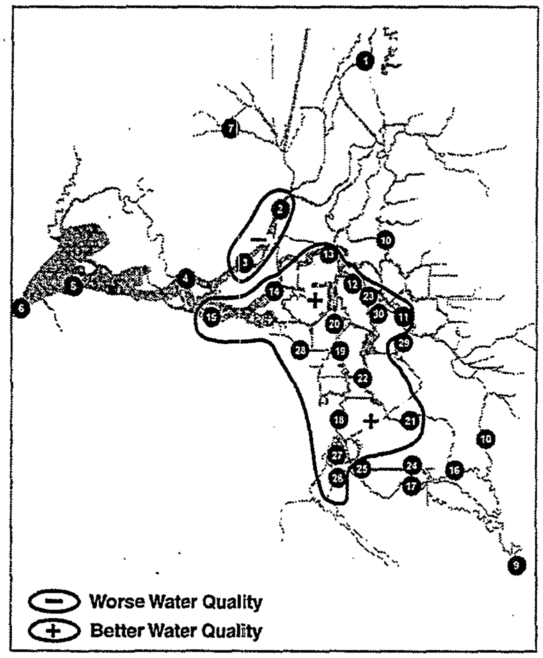
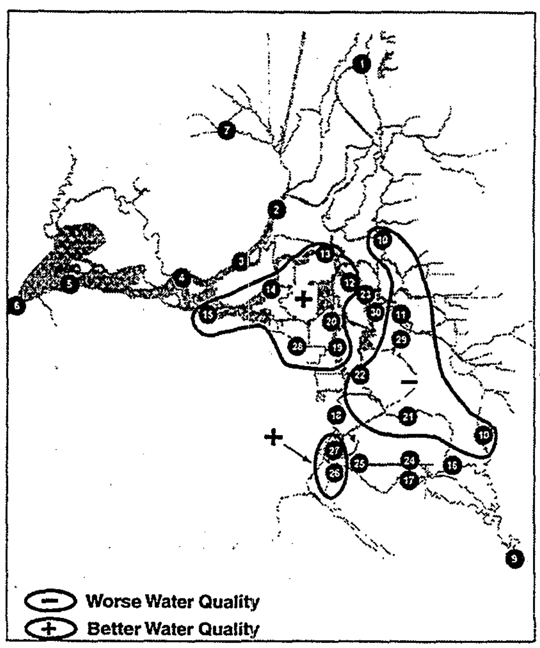
Alternative 2- Changes in Salinity from No Action Alternative



Alternative 3 - Changes in Salinity from No Action Alternative



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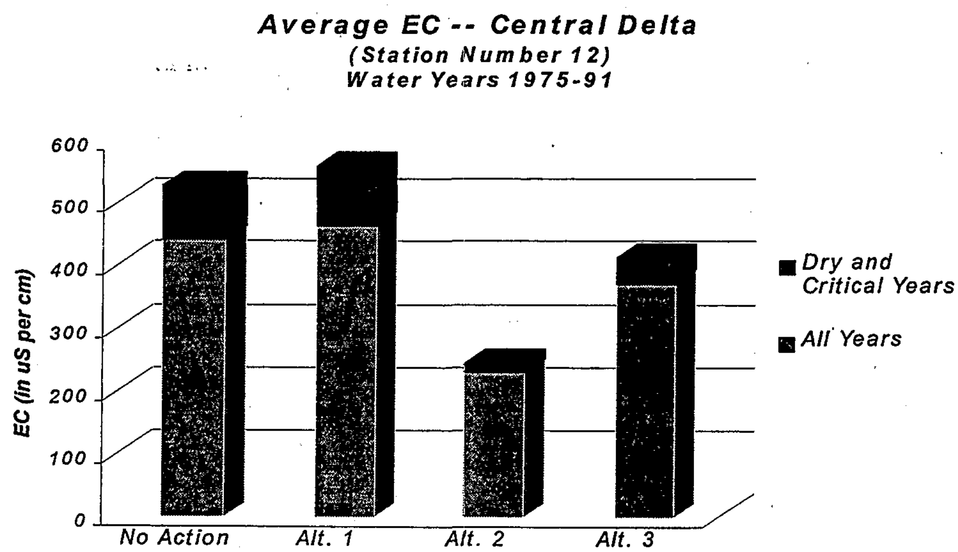
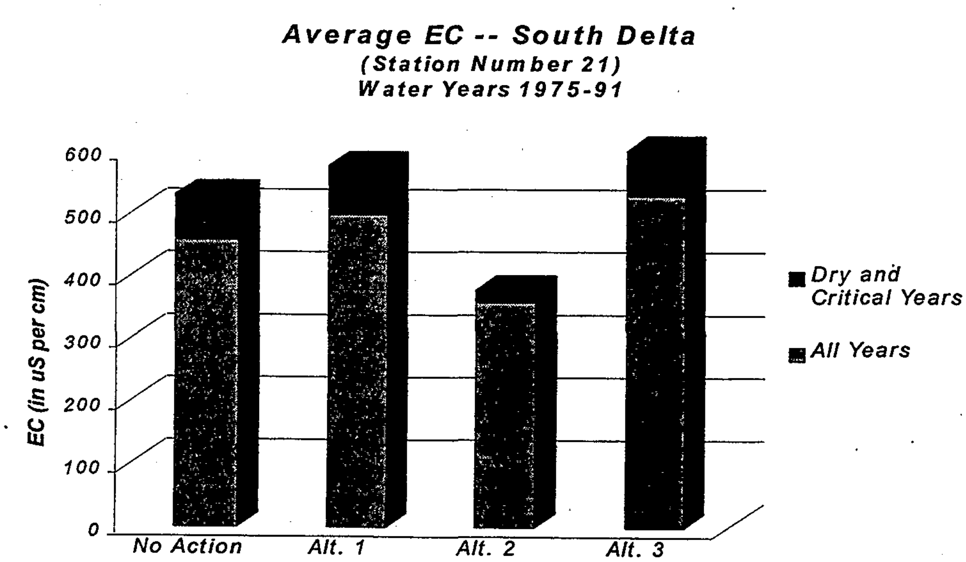
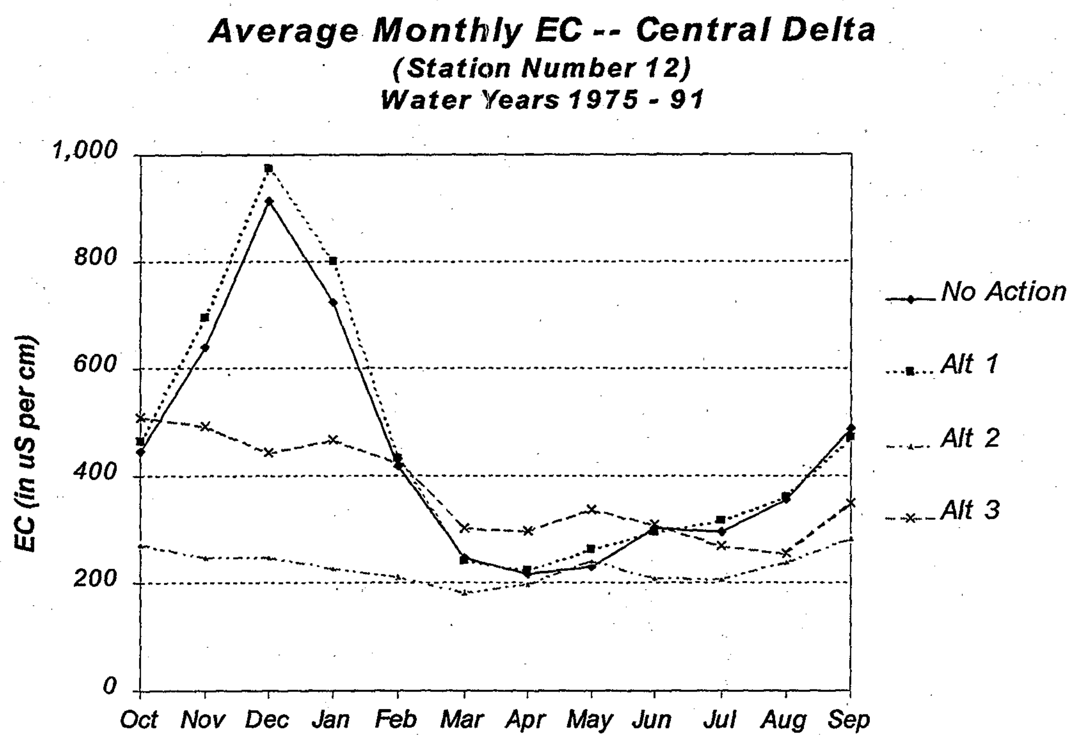
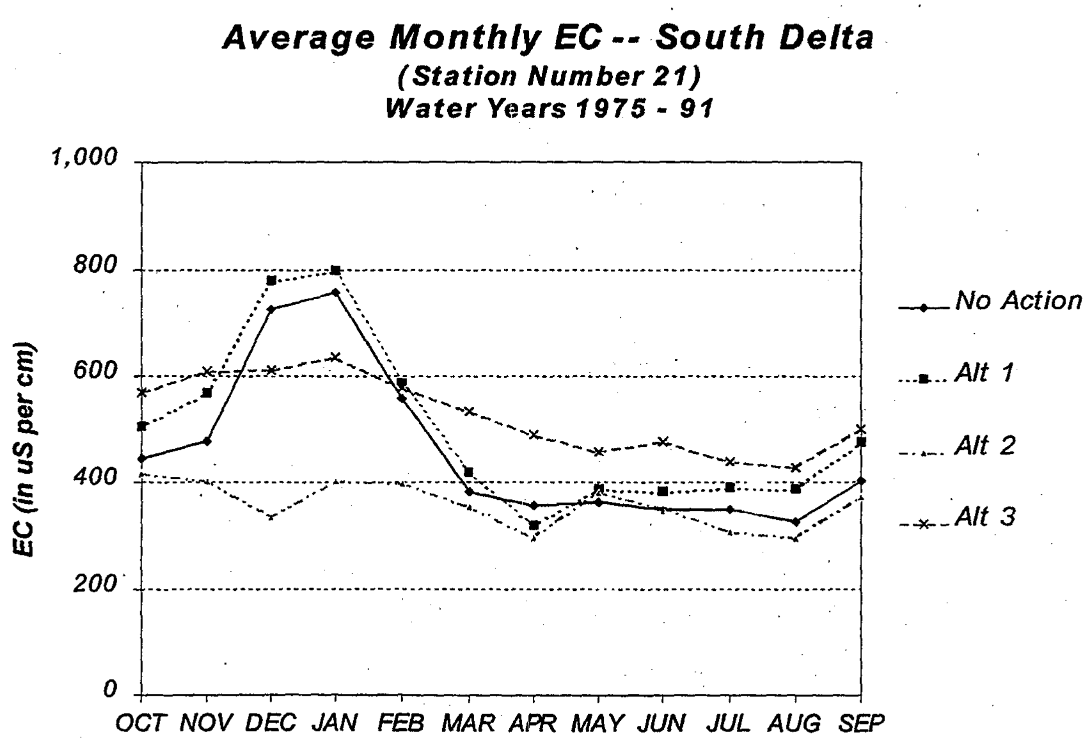
The preceding figures depict the in-Delta salinity consequences of implementing the alternatives, based on model studies. The modeling results indicate implementation of Alternative 1 would have minimal effects on in-Delta salinity. Alternative 2 would improve (reduce) salinity by up to about 45% at some locations in the north and central Delta, while Alternative 3 would result in better conditions in the central Delta, but would reduce quality (increase salinity) by up to 80% percent in the eastern Delta.

The following bar graphs show average EC at two Delta locations. Monthly variations of EC are shown in the graphs located below the average bar graphs. Alternative 2 generally provides better in-Delta water quality.









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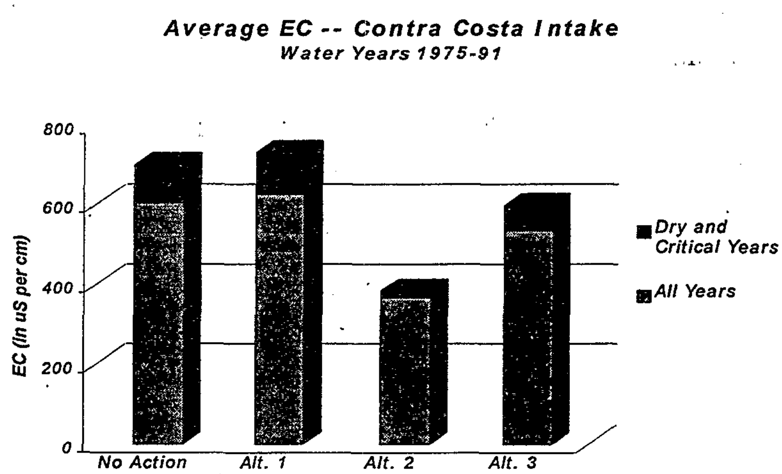
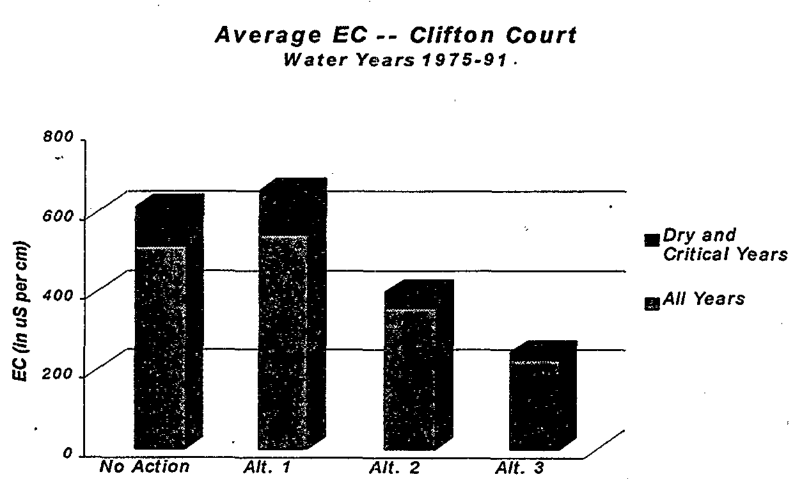
Export Water Quality

Salinity of waters diverted from the Delta would not significantly change if Alternative 1 were implemented. Alternative 2 would reduce salinity (electrical conductivity) by about 40 percent for Contra Costa Water District, while reducing salinity of State Water Project and Central Valley Project exports by about 30 and 35 percent, respectively. Alternative 3 would reduce salinity at the Contra Costa intake by about 10 percent, and would reduce salinity of SWP and CVP exports by about 55 and 60 percent, respectively.





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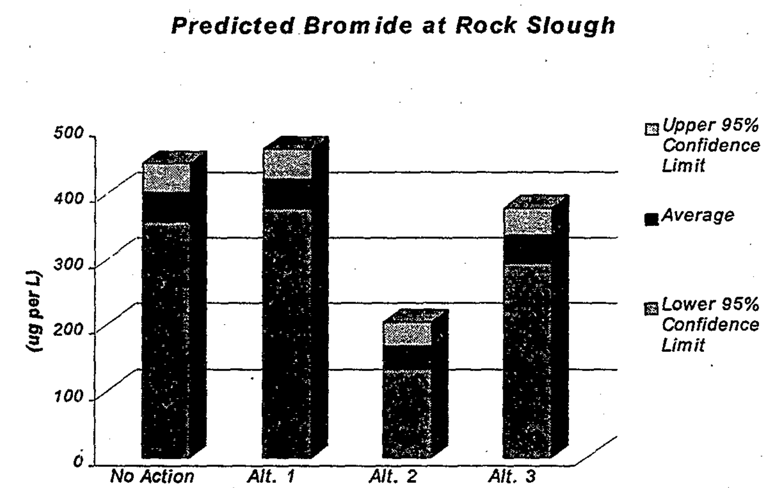
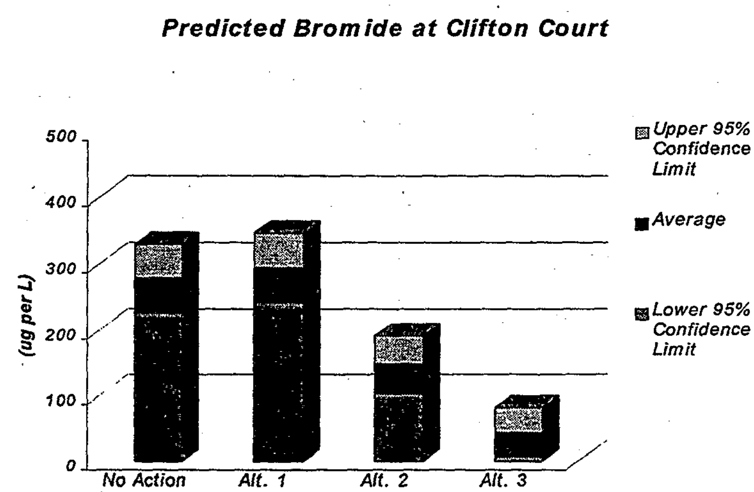
Two important characteristics of drinking water supplies taken from the Delta are organic carbon and bromide. Organic carbon in the system comes primarily from decomposition of plant materials, a major source of which is discharge from organically rich peat soils on Delta islands. Bromide in Delta waters comes primarily from the ocean due to salinity intrusion. Organic carbon and bromide form unwanted and potentially harmful chemicals when water is disinfected with chlorine during drinking water treatment.

No reliable quantitative estimates have been made of the effect of the alternatives on organic carbon concentrations in export waters, although modeling efforts are underway. For programmatic planning purposes, it may be appropriate to assume organic carbon concentrations will be proportional to salinity concentrations in exports, reflecting varying influence of Sacramento River water which is lower both in salinity and organic carbon than are waters of the Delta and of the San Joaquin River.





Bromide concentrations at the Contra Costa intake with Alternative 1 would not change significantly as compared to the No Action Alternative. Alternatives 2 and 3 would reduce average bromide concentrations at that location by about 60 percent and 15 percent, respectively. Bromide concentrations at the combined south Delta point of intake to the SWP and CVP facilities would not change significantly for Alternative 1. Alternatives 2 and 3 would decrease bromide by an average of about 45 percent and 85 percent, respectively. There are substantial technical uncertainties about the implications of organic carbon and bromide for drinking water supplies taken from the Delta. These are addressed in more detail in Chapter 5.

Diversion Effects on Fisheries

Currently, diversions at the CVP and SWP export pumps in the south Delta capture and destroy many fish. Also, adverse flow patterns induced by the diversions have the capacity to disrupt fish movement and affect reproductive success of Delta fishes. Fish mortality from the current system is high due in large measure to predation and to a lesser extent to the need to capture, sort, and transport fish from the fish screens at project pumps to elsewhere in the Delta.

Alternative 1 would continue diversions in the south Delta similar to existing conditions. However, it would tend to increase existing adverse entrainment effects of the SWP and CVP, due to an increase in exports over No Action and existing conditions.

Alternative 2 would improve Delta flow patterns, and new fish screens at Hood on the Sacramento River could reduce the numbers of fish moved into the central Delta. However, Alternative 2 requires diversions to be continued from the south Delta at the same level as Alternative 1, with associated capture and trucking. Net flows in the lower Sacramento River below the diversion would be reduced. In addition net flows west of the Mokelumne River limit the exposure of the young of fishes such as delta smelt and striped bass to the south Delta diversions and from opening the Delta Cross Channel less frequently. Once chinook salmon smolts migrating out of the San Joaquin system reach the Mokelumne, they would receive some benefit from improved net flows. An overriding consideration for them would be that water flowing out of the San Joaquin would continue going to the SWP/CVP export pumps under most circumstances, unless continued or greater export curtailments were implemented to provide some degree of protection. The benefits of Alternative 2 would be offset by the risks associated with the upstream passage of adult fish through the channel from Hood to the Mokelumne River . While CALFED believes measures can be found to provide adequate passage, difficulties have occurred elsewhere in providing adequate upstream passage for multiple species.

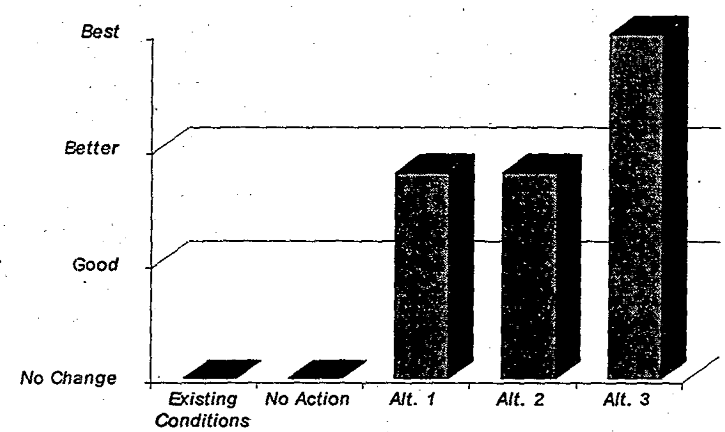
Alternative 3 would improve south and central Delta flow patterns, and new fish screens at Hood on the Sacramento River will reduce the numbers of fish moved into the central Delta. However, effects to northern Delta areas are unknown. Net flows in the lower Sacramento River below the point of diversion would be reduced. Like Alternative 2, bypass flows will exist in the river, so the screened fish will not have to be handled and trucked to another location for release. Fish using the Delta as a spawning and nursery area will not be exposed to the diversion. Like the other alternatives, Alternative 3 would include some negative consequences associated with the increase in exports in relation to No Action conditions and existing conditions, but would include a large benefit associated with the 80% reduction in exports from the south Delta. While the remaining 20% of exports from the south Delta would continue some adverse impacts, major reductions in conflicts between water exports and the protection of fishes would be expected. Major beneficiaries are those fisheries using the San Joaquin Delta as a spawning and nursery area and chinook salmon smolts migrating from the San Joaquin

River. The species residing in the San Joaquin Delta and receiving major benefit include delta smelt, splittail, striped bass and white catfish.

The three CALFED alternatives would affect diversion losses for Sacramento River salmon. Presently, salmon smolts diverted from the Sacramento River into the San Joaquin Delta through either the Delta Cross Channel or Georgiana Slough survive at a rate only 1/3 to 1/2 of those remaining in the Sacramento River. A substantial amount of this negative impact is presently avoided by keeping the Delta Cross Channel closed during salmon migrations, except when negative water quality consequences in the San Joaquin are too great and require opening the Cross Channel. However, the greater exports under Alternative 1 would increase conflicts with San Joaquin water quality and likely result in the Cross Channel being open more frequently.

Many fishery experts agree that Alternative 3 will have more positive effect on fisheries than Alternatives 1 and 2. The judgement of the experts is that there is little overall difference between Alternatives 1 and 2. There is considerable disagreement about the effects of diversions on population abundance. The implication of diversion effects is addressed in more detail in Chapter 5.

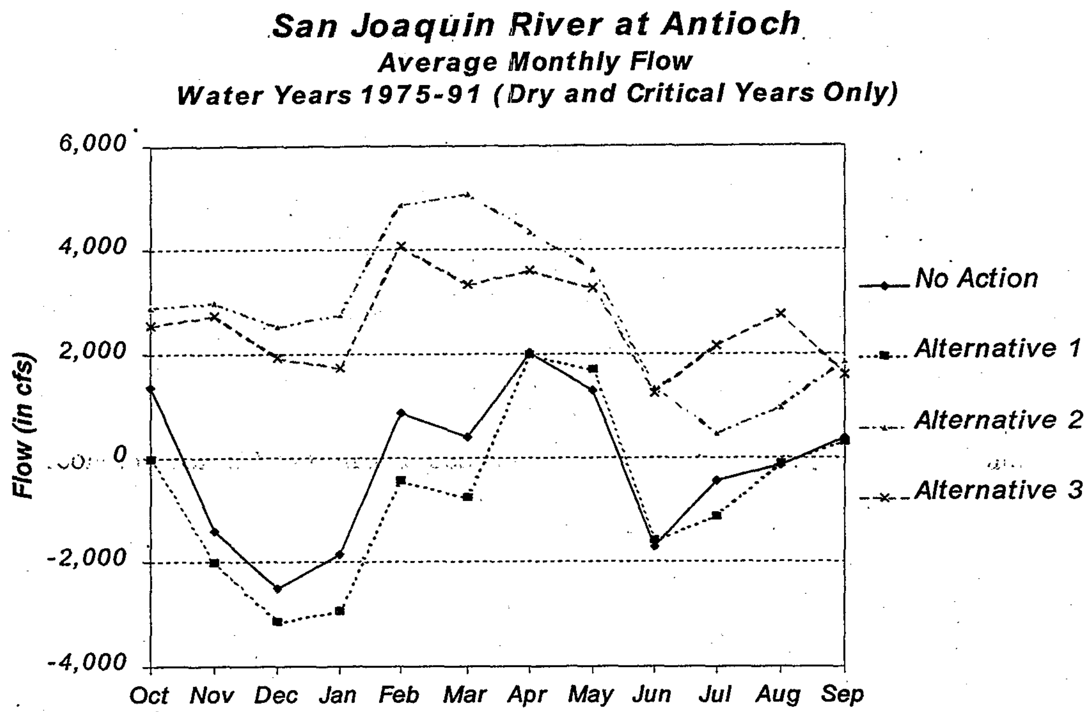
Diversion Effects on Fisheries
(Qualitative Assessment)

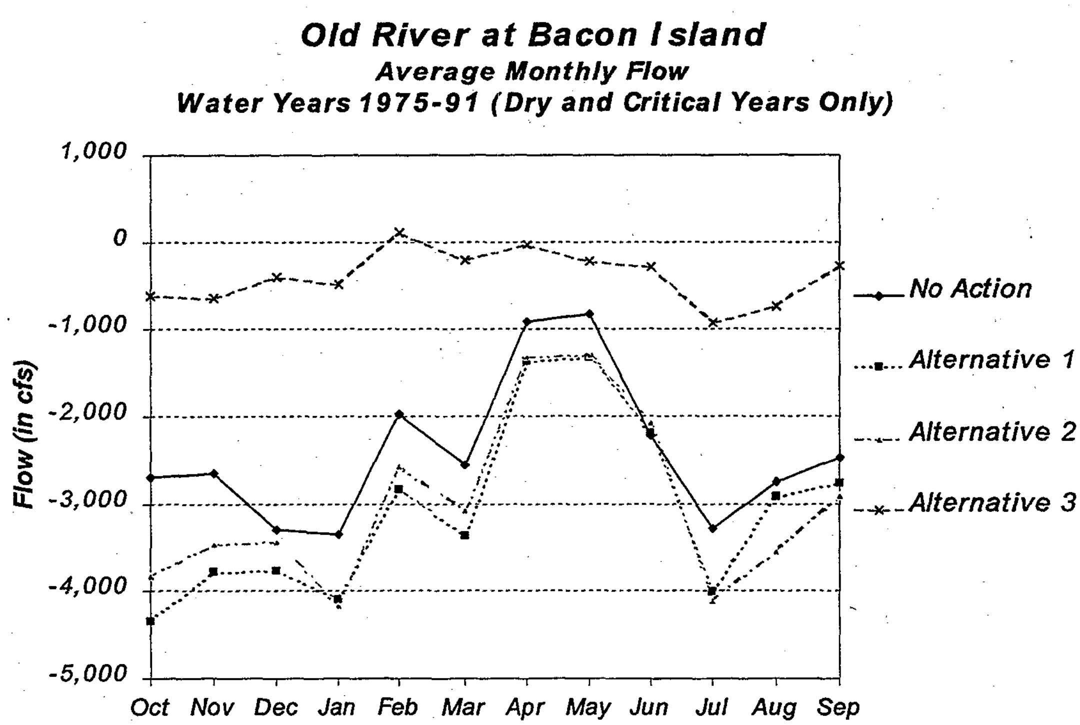


Delta Flow Circulation

In the Delta, the normal ecological flow conditions have been changed primarily by the SWP/CVP pumps being located in the south Delta and the majority of water exported by them coming from the Sacramento River. The result is that the magnitude of flood tides often exceed the magnitude of ebb tides causing a net upstream flow throughout much of the Delta. The result is that many fish and aquatic invertebrates do not have the flow conditions they have evolved to rely on and suffer various adverse consequences.

The following figures compare average monthly flows for the dry and critical years of the period of 1975 through 1991 for each alternative. Flows at two Delta locations are displayed, San Joaquin River at Antioch in the west Delta and Old River at Bacon Island in the southwest Delta. In both locations, the average monthly flows under Alternative 1 are more negative than under no action and Alternatives 2 and 3 for most months. Both Alternatives 2 and 3 have positive average flow conditions throughout the year in the San Joaquin River at Antioch. Only Alternative 3 has near-positive flow conditions in Old River at Bacon Island.


San Joaquin River at Antioch
Average Monthly Flow
Water Years 1975-91 (Dry and Critical Years Only)
Flow (in cfs)
6,000
4,000
2,000
0
-2,000
-4,000
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
No Action
Alternative 1
Alternative 2
Alternative 3

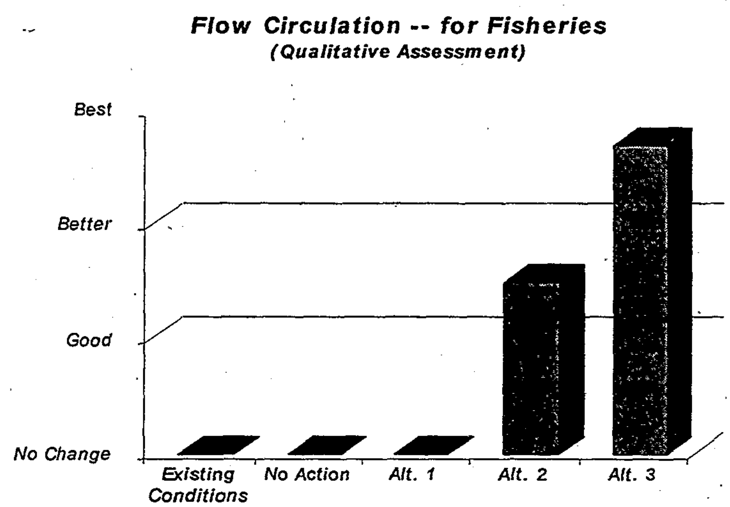

Old River at Bacon Island
Average Monthly Flow
Water Years 1975-91 (Dry and Critical Years Only)
Flow (in cfs)
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
No Action
Alternative 1
Alternative 2
Alternative 3

Under **Alternative 1**, the existing pattern of upstream net flows will continue, accentuated a little by the increase in exports. Some of the species specific consequences will be:

- Young delta smelt and striped bass spawned in the San Joaquin Delta or transported into it through the Delta Cross Channel or Georgiana Slough will have difficulty getting to their primary nursery area in Suisun Bay.
- Young salmon migrating out of the San Joaquin system will have difficulty finding their way through the San Joaquin Delta.
- Adult salmon migrating to the San Joaquin system in the fall will find little or no home stream water to guide them until they reach the reach the eastern Delta.
- Adult salmon migrating to the Sacramento system will more frequently migrate via the San Joaquin Delta.

Under **Alternative 2**, considerably better conditions will exist, as normal net downstream conditions will be restored downstream of the Mokelumne River in the San Joaquin River, although of a magnitude typically less than that which occurred historically. The principal beneficiaries will be delta smelt and striped bass. This benefit will be achieved at some environmental cost, due to reduced flows in the Sacramento River below Hood. Such reduced flows will likely reduce the survival of young chinook salmon and striped bass traveling down the river. Maintenance of minimum flows at Rio Vista should avoid significant adverse consequences. As in Alternative 1, outmigrating San Joaquin salmon smolts will still have difficulty finding their way through the southern Delta, and adult salmon migrating to the San Joaquin system in the fall will find little home stream water to guide them until they reach the eastern Delta.

Under **Alternative 3**, net downstream flows will be restored throughout most of the Delta. The concern over reduced flows in the Sacramento River below Hood will be identical to Alternative 2, as the magnitude of the diversion at Hood will be similar. Continuing exports from the south Delta may cause some reverse flows, but effects should be small in relation to the present situation. Each of the adverse species specific effects enumerated for Alternative 1 should be alleviated.



The overall qualitative assessment of fishery experts is that Alternative 3 performs better than Alternatives 1 and 2. However, there are many unknowns that influence the technical analysis:

- Use of monthly time steps in modeling does not reflect the Delta condition
- There is no way to assess the effects of in-Delta diversions
- There is influence by both tide and fresh water inflows

These issues will be considered in adaptive management strategies.

Water Supply Opportunities

To evaluate water supply opportunities, CALFED used the system operation model, DWRSIM. Using this model, the operation of existing and proposed storage and conveyance facilities is simulated using a hydrologic record from the years 1922 through 1994. DWRSIM may be used to project the effects of adding new facilities or changing operating criteria on Central Valley stream flows and water supplies. For this evaluation of water supply opportunities, CALFED used the model to project water deliveries to south of Delta SWP and CVP water users. Because specific beneficiaries of any potential increased water supply resulting from implementing a CALFED solution will not be identified until later stages of the Program, these SWP and CVP water users were used as a surrogate for all potential water supply beneficiaries.

CALFED estimated south of Delta SWP and CVP water deliveries for existing conditions, No Action, and the three Program alternatives. Each Program alternative was evaluated with and without new surface and groundwater storage components. As discussed in more detail in Chapter 3, none of the Program alternatives includes a set volume or configuration of storage facilities. Instead, CALFED has identified a range of zero to 6 MAF of new storage in each of the three alternatives. Future decisions about the actual amount of storage for any Program alternative will be determined by issues such as cost and site-specific concerns, rather than by a programmatic-level optimization process. More detailed study and significant interaction with stakeholders will be required before specific locations and sizes of new storage are proposed.

To provide an evaluation of this range of storage, CALFED modeled one scenario with no additional storage for each alternative, and a second scenario with approximately 6 MAF of new storage for each alternative. In modeling the upper end (6 MAF), CALFED assumed that additional in-stream flows included in the draft Ecosystem Restoration Program (ERP) would be provided by a portion of the new storage to the extent possible. The remaining new storage, 4.75 to 4.95 MAF depending on the alternative, was assumed to be available for agricultural and urban water supply. Accordingly, the table below, showing the general locations and volumes of new storage considered in this modeling of SWP and CVP operations, indicates an upper limit for storage of 4.75 to 4.95 MAF. These limits are artifacts of the assumptions used in modeling the water supply opportunities of the zero to 6 MAF range of storage, and are not intended as a conclusion about the "optimal" amount of storage.

Storage Components Considered in the Evaluation of Water Supply Opportinities

Storage Component	Range of Storage Capacities Alternative 1	Alternative 2	Alternative 3
Sacramento River Tributary Surface Storage	0 to 2 maf	0 to 2 maf	0 to 2 maf
Sacramento Valley Groundwater Storage	0 to 250 taf	0 to 250 taf	0 to 250 taf
In-Delta Storage	-	-	0 to 200 taf
South of Delta Off-Aqueduct Surface Storage	0 to 2 maf	0 to 2 maf	0 to 2 maf
San Joaquin Valley Groundwater Storage	0 to 500 taf	0 to 500 taf	0 to 500 taf
Total	**0 to 4.75 maf**	**0 to 4.75 maf**	**0 to 4.95 maf**

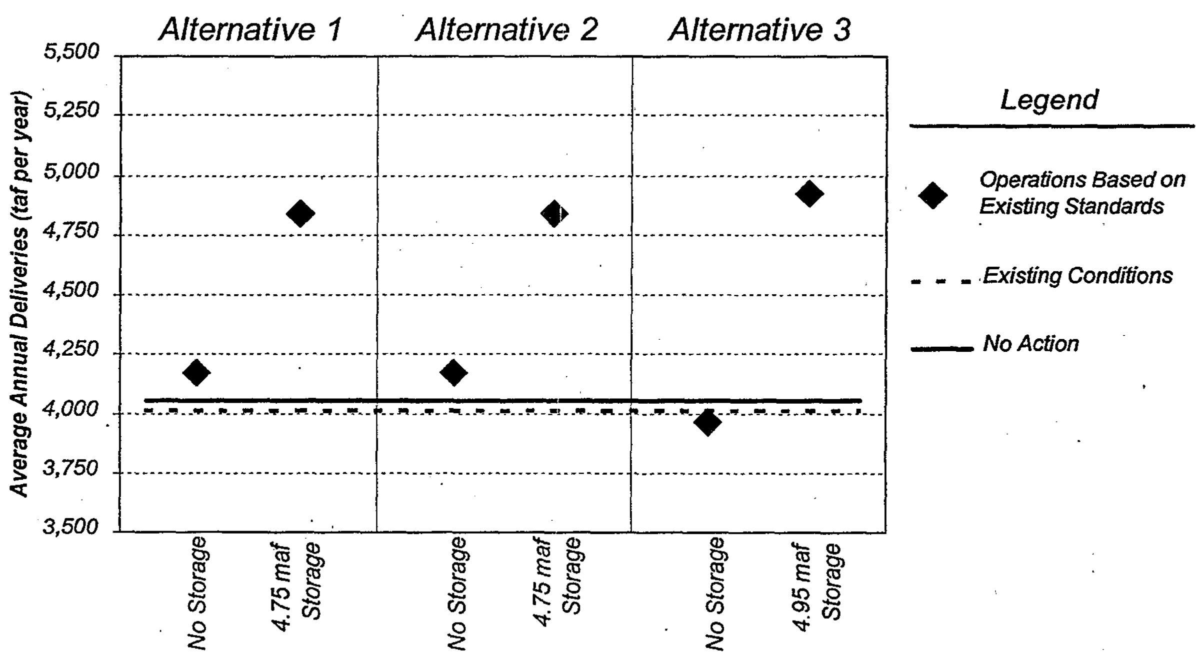
To evaluate water supply opportunities, CALFED developed a set of operating criteria for each Program alternative based on existing Bay-Delta standards. As described in Chapter 3, CALFED made some additional assumptions to address the operation of new storage and conveyance facilities considered in the Program alternatives. It is important to note that these assumptions were made only to aid in the evaluation of the alternatives – no specific changes in Bay-Delta standards are proposed or endorsed by CALFED through this evaluation. As information is developed during the course of implementing the Program, this information will be provided to regulatory agencies for appropriate consideration. Changes in Bay-Delta standards will be made, if at all, by the appropriate agencies in accordance with applicable laws and consistent with any agreements in the CALFED assurances package.

Average annual south of Delta SWP and CVP water deliveries, as simulated using hydrologic records for the May 1928 through October 1934 critically dry period and for the long term period of 1922 through 1994, are displayed in the following figures. Each alternative is represented with and without the quantity of storage shown in the previous table. Projected water deliveries under operating criteria based on existing Bay-Delta standards are represented by diamonds in these figures. For comparative purposes, the figures also include lines representing estimated average annual south of Delta SWP and CVP water deliveries under existing conditions and No Action, respectively.

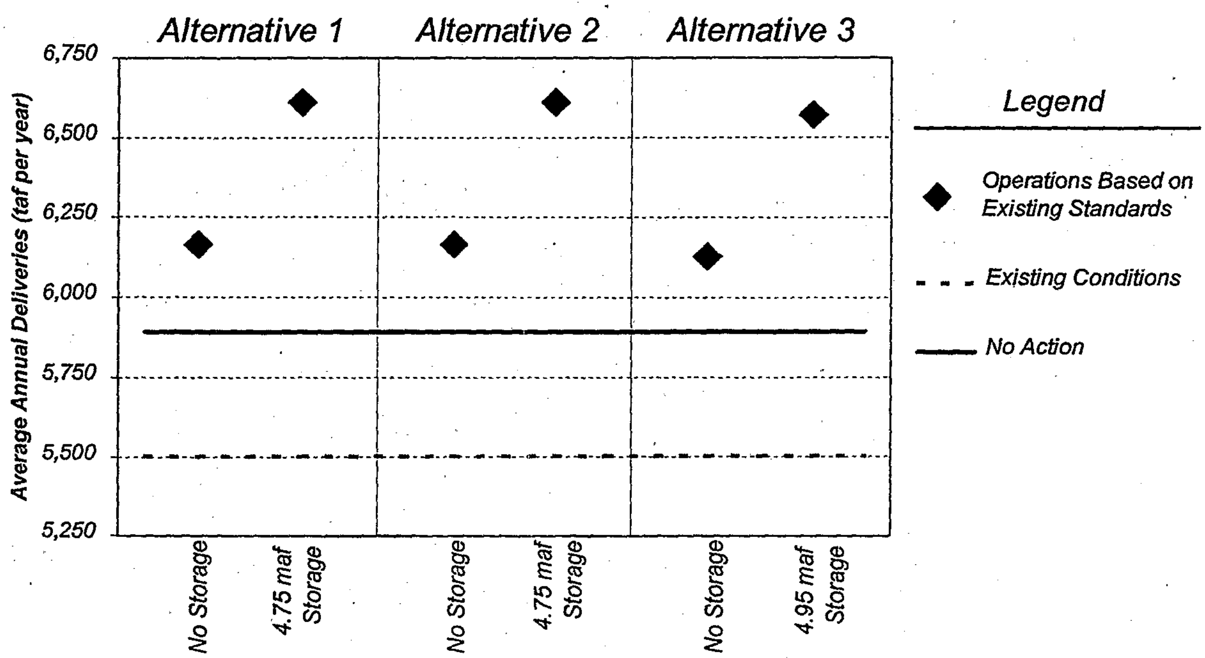
At least two general conclusions are suggested by this evaluation. First, significant increases in water supply opportunities are only provided if new storage is included under all Program alternatives. Compared to No Action, from 750 to 900 TAF of average annual critical period supply could be developed with the previously described new storage included in the Program alternatives, under the operating criteria assumed by CALFED. Without new storage, average annual critical period supply ranges from an increase of about 100 TAF under Alternatives 1 and 2 to a decrease of about 100 TAF under Alternative 3, all compared to No Action. It should be noted that the small relative decrease in water supply under Alternative 3 is primarily due to CALFED's assumption that, whenever possible, exports would be diverted through the isolated conveyance facility as opposed to south Delta channels to maximize fishery protection and export water quality benefits. This assumed priority for location of diversions results in a need for additional Delta outflow to maintain adequate flow in the lower Sacramento River, and a small decrease in SWP and CVP water supply.

Second, under the operating criteria for each alternative assumed by CALFED, each of the alternatives would provide roughly similar water supply opportunities. However, under these assumed operating criteria other Program benefits are not equivalent. For example, CALFED expects that diversion effects on fisheries under these operating criteria would be reduced under Alternative 3, compared to Alternatives 1 and 2. A variation of the operating criteria for Alternative 3 could allow a greater portion of exports to be diverted from south Delta channels instead of through the isolated conveyance facility. This type of operating criteria would provide some additional water supply benefits, but reduce fisheries protection to a level more equivalent to Alternatives 1 and 2.

South of Delta SWP and CVP Water Supply
Average Annual Critical Period Deliveries



South of Delta SWP and CVP Water Supply
Average Annual Long Term Deliveries



Water Supply Opportunities: What if Standards Change?

As highlighted in the previous chapter, Bay-Delta standards are not static. Over the many decades of the implementation of the Program, conditions in the Bay-Delta will most likely change dramatically, both as a result of this program and because of other factors influencing the estuary. Although changes in regulatory standards over this long time period are virtually certain, it is difficult now to predict exactly what those changes will be.

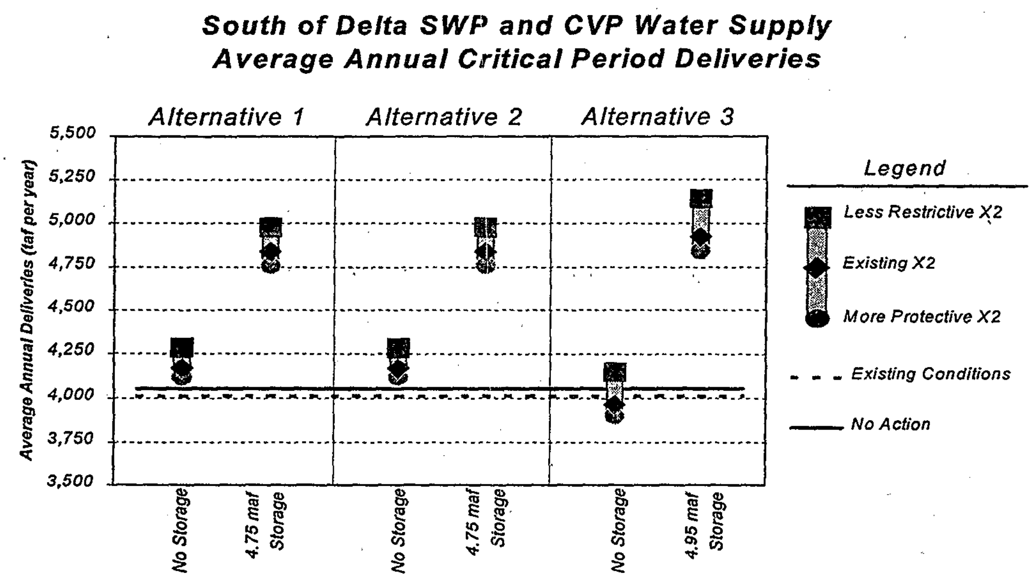
In order to provide decision-makers and the interested public some idea of how the different alternatives might respond to changes in standards, CALFED is including two simplified "sensitivity analyses" of how the water supply opportunities associated with each of the alternatives might respond to changes in the major regulatory standards. The first of these sensitivity analyses looks at the minimum Delta outflow requirements contained in the salinity criteria generally referred to as the "X2" standards. The X2 requirement sets the required position of the salinity gradient in the estuary so that a salt concentration of two parts per thousand is positioned where it may be more beneficial to aquatic life. Freshwater releases from upstream reservoirs or reduction in Delta exports may be required to maintain the salinity gradient at set locations for designated periods of time during the months of February through June.

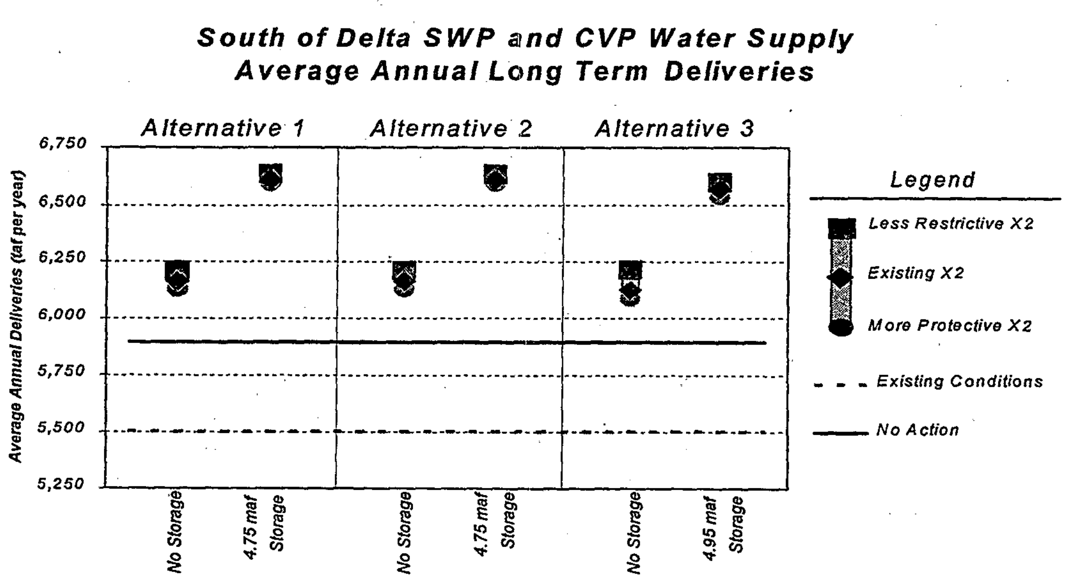
The length of time X2 must be positioned at these set locations in the estuary in each month is determined by a formula that considers the previous month's inflow to the Delta and a "Level of Development" factor, denoted by a particular year. The X2 requirements included in the existing Bay-Delta standards use a Level of Development factor of mid-1971. To get a rough idea of how the water supply opportunities might respond to changes in the X2 requirements, CALFED modeled a more protective X2 Level of Development (1962) and a less restrictive X2 Level of Development (1983).

The charts on the following page show how each of the three alternatives respond to these changes in the X2 standard. These charts portray the average annual south of Delta SWP and CVP water deliveries, as simulated using hydrologic records for the May 1928 through October 1934 critically dry period and also for the long term period of 1922 through 1994. Each alternative is represented with and without additional storage.

These charts suggest the following broad conclusion: Based on the assumptions used in modeling the hypothetical changes in the X2 standard there appears to be only a small effect on water supply opportunities caused by more protective or less restrictive Delta outflow standards within the range examined. Moving to the more protective X2 standard produces virtually no difference in average annual water deliveries as compared to the existing X2 standard, in either the 1928-34 critically dry period or the 1922-94 long term period. Relaxing the X2 standard produces a small improvement of 100 to 200 TAF in average annual deliveries in the critical period, but does not have a significant effect on long term average deliveries. Moreover, the changes caused by a relaxation in the X2 standard are similar in all three alternatives, although slightly higher benefits are produced in Alternative 3.

Sensitivity Analysis of Delta Outflow Requirements Results





Water Supply Opportunities: What if Standards Change? (Con't)

CALFED also considered changes in a second major regulatory criteria -- the "Export-Inflow Ratio" (E-I ratio) requirement. This requirement presently limits Delta exports by the State and federal water projects to a percentage of Delta inflow. During February through June, months most critical to fisheries, the allowable E-I ratio is reduced to help diminish reverse flows and the resulting entrainment of fish caused by south Delta export operations.

In this sensitivity analysis, CALFED compared water supply opportunities under a hypothetical set of more protective E-I ratios during the months of November through June to E-I ratios under existing Bay-Delta standards. A comparison of the monthly ratios used in this evaluation is shown in the following chart.

Sensitivity Analysis of Export-Inflow Ratios

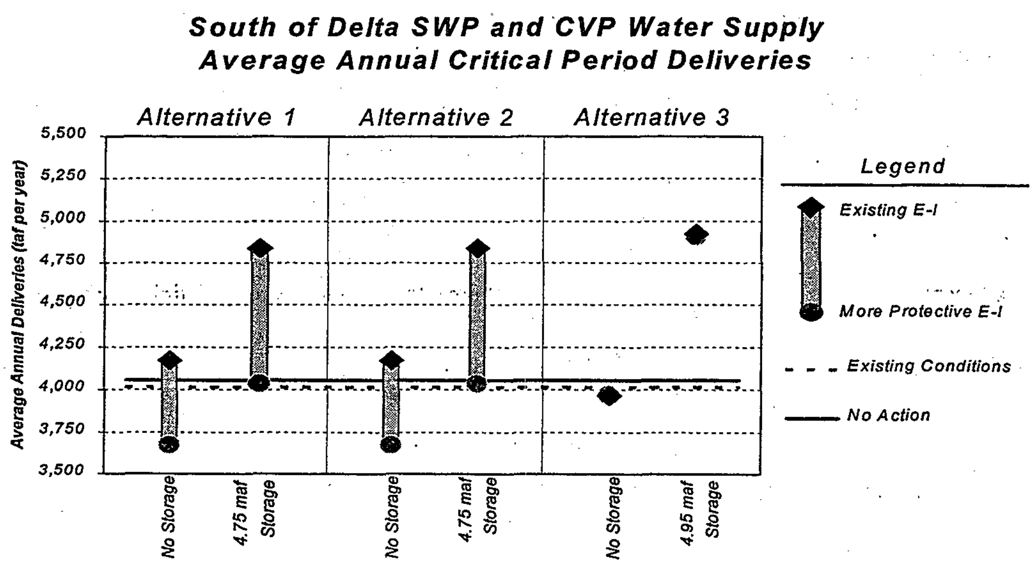
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Existing E-I Ratios												
E/I Ratio	65%	35%-45%	35% of Delta Inflow				65% of Delta Inflow					
More Protective E-I Ratios												
E/I Ratio	50%	25%	25% of Delta Inflow				65% of Delta Inflow				50%	

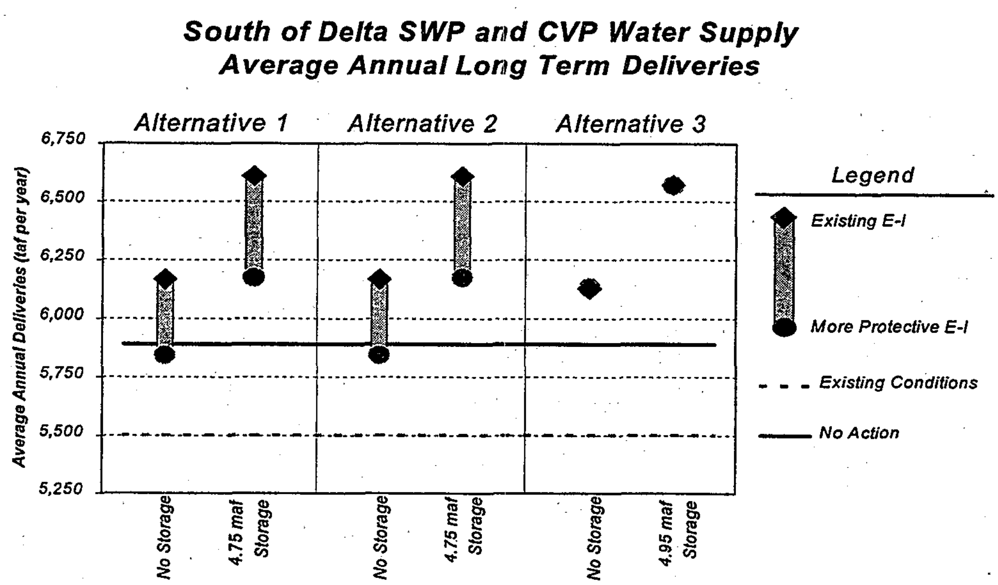
As before, CALFED evaluated the effects of these changes in E-I ratios on water supply opportunities for both the 1928-34 critically dry period and the 1922-94 long term period. The modeled south of Delta CVP and SWP water deliveries under these hypothetical changes in E-I ratios are shown in the charts below.

This evaluation suggests that for Alternative 1 and 2, more protective E-I ratios can have significant water supply impacts in both the critical period and the longer average period. For example, without new storage, average annual critical period supply decreases by about 400 TAF under Alternatives 1 and 2 with the more protective E-I ratios in place compared to No Action. For Alternative 3, however, since CALFED assumed that exports diverted through the isolated conveyance facility are excluded from E-I ratio requirements for this evaluation, the more protective E-I ratio has virtually no impact on water supplies in either the critical or long term average period. CALFED expects that the improvements to Delta flow patterns and the resulting reduction in entrainment of fish that are possible under Alternative 3 would provide at least an equal level of protection for fisheries as compared with Alternatives 1 and 2 with the more protective E-I ratios in place.

Based on this evaluation, the more protective E-I ratios also result in a reduction in the effectiveness of new storage in providing water supply benefits under Alternatives 1 and 2. For example, the net average annual critical period supply benefit of the new storage with the more protective E-I ratios in place is only about 350 TAF, compared to a net benefit of about 650 TAF with existing E-I ratios in place.

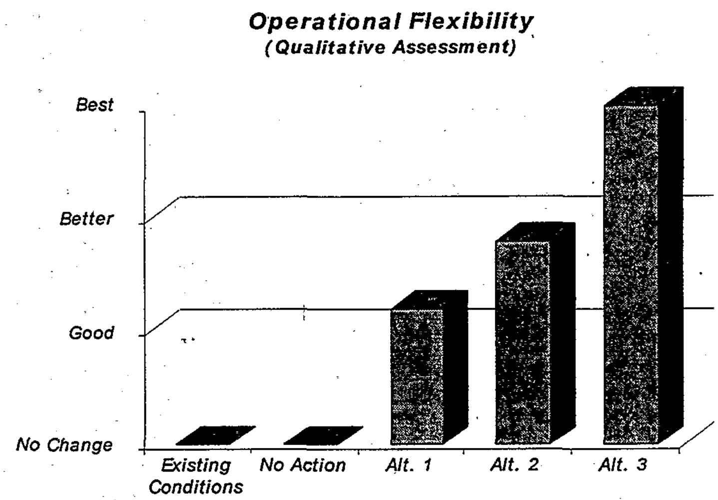
Sensitivity Analysis of Export-Inflow Ratio Requirements Results





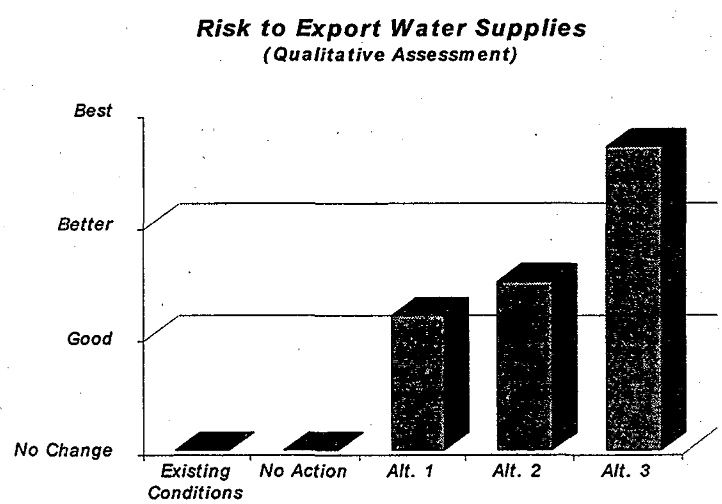
Operational Flexibility

Water storage is the one most significant features that contributes to the operational flexibility of an alternative. Storage allows shifting diversion timing to respond to real time needs of the ecosystem, water quality, and water supply. The potential for adding storage was retained for further analyses for each alternative. In addition, improvements in conveyance also improve operational flexibility. The Alternative 3 conveyance includes two distinct diversion points which provides added flexibility. Therefore, Alternative 2 generally has more flexibility than Alternative 1, and Alternative 3 generally has more flexibility than Alternative 2.



Risk To Export Water Supplies

Alternative 1 would improve the physical integrity of the Delta by strengthening Delta levees. Widening of Delta channels associated with Alternative 2 would provide a degree of additional protection from flooding. Both alternatives would, however, leave the export water supplies relatively vulnerable to seismic failure and sea water intrusion which could accompany catastrophic levee failures. Alternative 3 would provide the best physical security for export water supplies since it provides a new canal around the eastern edge of the Delta where it would not be impacted by major levee failures.



Assurances

Assurances are mechanisms intended to increase participants confidence that an alternative will be implemented and operated as agreed. Although some people believe it impossible to assure appropriate operation of any isolated conveyance channel, others believe that a moderately sized facility can be operated as agreed. Consequently, additional detailed analyses and discussion of assurances must occur before they can be used to distinguish one alternative from the other. Assurances are described in more detail in Chapter 5.

Consistency with Solution Principles

The alternatives are probably not identical in their abilities to meet the solution principles. However, a more thorough analysis and discussion must occur before the solution principles can be used to distinguish one alternative from another.

Comparison of Alternatives

The previous section discussed the major differences between the alternatives on key technical distinguishing characteristics. The discussions reflected information obtained from the technical evaluations of the characteristics performed thus far. Based on the assumptions made in the technical evaluations, Alternative 3 appears to have the potential to provide greater performance on these particular characteristics. The following table provides a general comparison of the alternatives according to these eight distinguishing characteristics. Qualitative rankings of high (H), medium (M), and low (L) were used to summarize the three alternatives. For example, in-Delta water quality ranked best for Alternative 2 and the lowest for Alternative 3. The results of this analysis do not indicate the selection of a preferred program alternative. Indeed, although Alternative 3 has on balance ranked higher than the others on these characteristics, there are significant additional issues that affect selection of a preferred program alternative (including, especially, the issues of assurances and implementability). The evaluation of these issues will continue as CALFED develops a preferred program alternative.

The evaluation depicted graphically here treats each of the key distinguishing characteristics as if they were of equal importance. It is important to understand, however, that it is unlikely that all of the key distinguishing characteristics are of equal importance, and different weighting of these factors could affect the outcome of the analysis. In addition, the above table does not attempt to "standardize" the scales for each characteristic. That is, the relative difference between an "L" and an "M" on one characteristic may be totally different than the difference between an "L" and an "M" on another characteristic. Finally, this ranking is based on the assumptions and technical evaluation methods used in our evaluation, and CALFED is explicitly soliciting public comment on the validity of its evaluation process during the comment peiod. Interested parties, the public, and CALFED agencies must collectively determine the importance of each distinguishing characteristic in the overall evaluation of alternatives leading to selection of the preferred program alternative.

The ranking of the water supply opportunities characteristic in the chart above requires special explanation. Based on the assumptions used in evaluating this issue, the analysis indicates that all three alternatives perform similarly under operating criteria based on existing standards. At the same time, all three alternatives perform significantly better under the "6 MAF of new storage" scenario than under the "no new storage scenario". In addition, again based on the assumptions used (and described in detail in the preceding chapter), the analysis indicates that all three alternatives are roughly equivalent in terms of responsiveness to possible changes in the Delta outflow requirements. This analysis also suggests that Alternative 3 provides a higher level of performance on the "water supply opportunities" characteristic under a scenario of stricter export-inflow (E-I) ratio requirements. As stated above, CALFED is not proposing or endorsing any particular changes to the existing regulatory regime affecting the Bay-Delta. Nevertheless, after consulting with CALFED water project operators and regulatory agencies, CALFED is reflecting this information in the chart above by ranking Alternative 3 somewhat higher than Alternatives 1 and 2 on the "water supply opportunities" characteristic.

Summary Evaluation of Most Significant Technical Distinguishing Characteristics

	In-Delta Water Quality	Export Water Quality (South Delta)	Export Water Quality (Contra Costa)	Minimize Diversion Effects on Fisheries	Delta Flow Circulation	Water Supply Opportunities	Operational Flexibility	Minimize Risk to Export Water Supplies
Alternative 1	M	L	L	L	L	L	L	L
Alternative 2	M+	M	M+	L	M	L	M	M
Alternative 3	L	H	L	M+	M+	M	H	H

Two key distinguishing characteristics seem to be particularly important in making a decision on how well the alternatives perform. Export Water Quality and Diversion Effects on Fisheries, are highly dependent on the alternative selected. Therefore, irrespective of whether these two characteristics are the most important to selection of the preferred program alternative, they are the characteristics most dependent on that decision. The implications of these characteristics are discussed in some detail in Chapter 5 to enable the reader to understand their potential importance to a decision. Plans for further evaluation of these characteristics are described as well.

The following chapter identifies some of the additional issues and concern, and describes how the CALFED process will reach selection of a preferred program alternative.

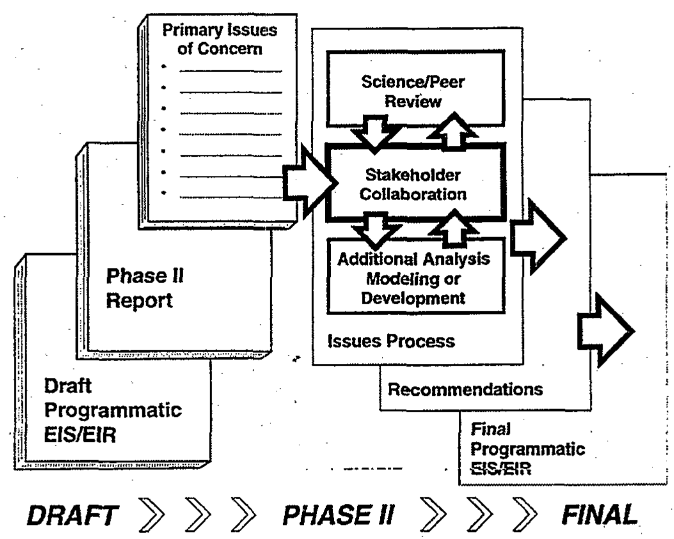
5. ISSUES TO BE RESOLVED PRIOR TO SELECTION OF A PREFERRED PROGRAM ALTERNATIVE

This Phase II Report has identified several significant issues that need to be resolved before the CALFED Program can move forward. Some of the issues are very specific to evaluating the merits of the three alternatives, so that CALFED can identify a preferred program alternative. Other issues, equally important, have been raised as we refine and complete the common program elements. CALFED's task over the next several months will be to set up a process for resolving each of these issues. In this chapter, the major issues are summarized and a process is proposed for agencies and stakeholders to use in moving towards resolution.

The different types of issues to be addressed are:

- Major technical and policy issues
- Refinement and consensus on Program elements
- Assurances package (including financial)
- Other issues relating to ongoing Program refinement (Ongoing work efforts in Chapter 6)

> **Issues to be Addresses**
>
> **Drinking Water Quality**
>
> **Diversion Effects on Fisheries**
>
> **Program Element Refinement**
> - Water Quality Program
> - Ecosystem Restoration Program
> - Levee Protection Plan
> - Water Use Efficiency
> - Watershed Management
> - Water Transfers
> - Storage
> - Conveyance
>
> **Assurances and Financial Plan**
>
> **Additional Concerns**
> - Agricultural Land Impacts
> - Etc.



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CALFED is identifying four sets of issues that need substantial agency and stakeholder review as we move towards identifying a preferred program alternative and developing a final CALFED program.

Two of these issues are considered in detail below: the role of bromide levels in source water as a factor in assuring safe drinking water, and the role of diversion effects as a factor affecting fisheries recovery. Both of these issues are important in reaching a decision about the preferred program alternatives.

Two additional broad issues must be resolved before the CALFED can present a complete program package for adoption and implementation. First, the many issues raised earlier in this Phase II Report about the Program elements must be addressed and those programs must be finalized. Second, CALFED and stakeholders must develop a consensus on an adequate assurances package.

Implications of the Delta Conveyance Decision on Export Water Quality

Most Californians (about two-thirds of the population) get their drinking water supplies from the Sacramento-San Joaquin Delta. The protection of public health by reducing unsafe levels of contaminants in drinking water supplies is therefore an important part of a comprehensive solution. All of the alternatives result in improved drinking water supplies largely through implementation of Water Quality Program element actions such as urban, agricultural, and industrial runoff reduction. However some water quality parameters are less affected by source control strategies. For this reason, the choice of a Delta conveyance alternative may have important implications for drinking water quality.

One of the greatest public health advancements of the past 100 years was the advent of water supply disinfection. Disinfectants, such as chlorine, are added to most drinking water supplies to reduce or eliminate microbial contamination (bacteria, parasites, etc.). The desire to increase the safety of drinking water has resulted in federal and state legislation requiring higher treatment efficiency, including greater disinfection. An unfortunate side effect of disinfection is formation of unwanted chemical byproducts, some of which may have adverse health effects. A challenge, therefore, is to provide greater protection against microbial contamination of drinking water while minimizing unwanted byproducts.

Two features of Delta water quality complicate attainment of the optimum balance of effective disinfection and byproduct suppression. Bromide, a salt of sea water origin, is present in Delta water supplies because of intrusion of sea water into the Delta. The soils of Delta islands are important sources of organic carbon resulting from natural decomposition of plant materials. Bromide and organic carbon react with disinfectant chemicals to produce a broad range and high concentrations of unwanted chemical disinfection byproducts.

Treatment methodologies exist for economically removing organic to some degree. Therefore, in general, organic carbon is considered to be a lesser problem for drinking water than bromide, for which removal from drinking water supplies is not now economically practical. While the level of total organic carbon in Delta supplies used for drinking water is at roughly the national median level for community water systems using surface water, the level of bromide in drinking water supplies diverted from the south Delta is more than six times the national average. As a result, public water systems relying on the Delta as a drinking water supply may face some distinctive challenges in continuing to produce safe drinking water due to the higher bromide levels.

Despite these concerns, Delta water quality is adequate for effective and affordable treatment to meet all current and proposed drinking water standards -- including more stringent standards for disinfection byproducts and microbial contaminants that EPA will promulgate in November 1998. However, the key questions are, will potential requirements from more stringent standards for higher levels of treatment to protect public health result in Delta water bromide levels being a significant and, perhaps, limiting factor? And, are the predicted bromide levels associated with the conveyance alternatives a significant consideration for future drinking water quality?

Although the long-term answers to these questions are fundamentally scientific -- how significant are bromide by-products, how effective and affordable are the treatment technologies, and how significant are the bromide level differences between alternatives -- within the 1998 time frame for the CALFED EIR/EIS, policy judgments must be made within the constraints of continuing scientific uncertainty.

The U.S. Environmental Protection Agency in collaboration with a wide variety of stakeholders has initiated a $200 million effort of research, data collection and analysis on the health effects, occurrence, and potential treatments for a wide range of disinfection byproducts (including bromide byproducts) and microbial contaminants. This massive effort is deemed by all participants to be essential to establish a "good science" basis for any future standards and treatment measures for these contaminants.

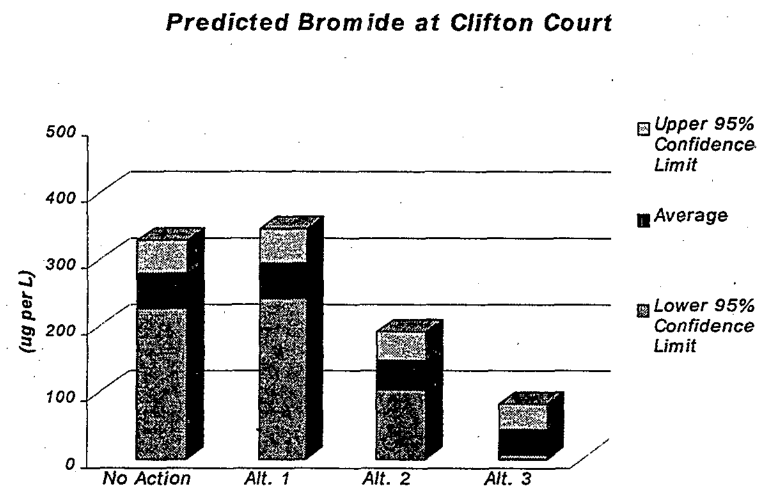
Current health effects research and treatment technology information from this effort simply do not now provide an adequate scientific basis from which to project what the water quality parameters for drinking water standards, or the treatment options to meet those standards, are likely to be over the next five to ten years. As such, the specific importance of bromide levels as a "distinguishing characteristic" for the CALFED alternatives is unclear. In order to properly deal with this uncertainty CALFED will convene an expert review panel to work with CALFED staff and agencies to help frame the proper policy approach to be taken and specifically to:

- Help ensure that CALFED is characterizing the issues and tradeoffs fully;
- Develop observations and questions regarding Delta water quality which may be

useful to the EPA national review process; and

- Ensure that the decision-making process neither overstates the potential for bromides to be a significant decision factor, nor eliminates opportunities to respond effectively to potential for future drinking water standards and protect public health.

In evaluating these issues, CALFED will also consult with stakeholders. Prior to selection of a preferred programmatic alternative this issue and a basic policy approach must be more fully integrated into an overall staged implementation strategy.



Implications of the Delta Decision on Diversion Effects on Fisheries Recovery

Direct and indirect effects of the existing State and federal water projects are thought to be important, perhaps critical, factors in the decline and endangerment of some fish species. Aspects of the current problem include:

- Predation in Clifton Court Forebay; entrainment of fish, eggs, and larvae at the SWP and CVP export pumps (partly due to inadequate fish screen facilities)
- Mortality associated with the need to capture, sort and transport fish to Delta channels away from the screens
- Adverse flow patterns induced by the transport of Sacramento River water across the Delta for diversion, which affects the migration and spawning of fish species.
- Reductions in habitat quality and availability induced by changes in flow conditions in the system caused by project operations and the north-to-south transport of water across the Delta to the export facilities

There is a fair degree of agreement on the relative magnitude of fish losses due to diversion effects that would occur under the various alternatives. However, there is much less agreement on the role of diversion mortality in controlling population abundance when compared to other stressors such as habitat loss. Hence the following analysis makes only limited attempts at such integration.

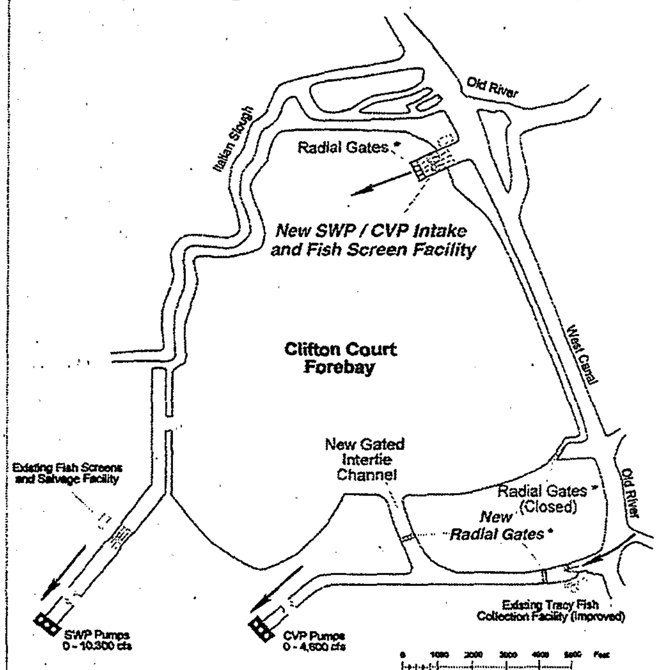
The focus for diversion effects on fisheries is on particular estuarine and migratory fish: chinook salmon, delta smelt, splittail, striped bass, steelhead and white catfish. Observations over the last half century indicate that these species are quite vulnerable to having their behavior disrupted by the transport of water from the Sacramento River to the export pumps in the south Delta. For other fish species, diversion effects do not appear to be a major stressor. Delta resident fish such as tule perch and several members of the sunfish family appear relatively invulnerable to being drawn to the export pumps. Fish such as starry flounder and longfin smelt, and other organisms such as bay shrimp, live primarily downstream of the Delta. Although they are potentially affected by changes in the amount of water flowing from the Delta through San Francisco Bay to the ocean, they appear to have little vulnerability to diversion effects of the export pumps.

Diversion effects on fisheries recovery include direct mortality due to water diversion intakes and associated facilities as well as indirect effects. The indirect effects include: altered flow patterns, disturbed migratory cues, migratory delays and increased predation on migrating fish that can occur when migration is altered or delayed.

Reduction of the direct effects of diversions from the Delta by the SWP and CVP are part of all alternatives being considered by the Program. In each alternative, SWP and CVP intakes are consolidated at the Clifton Court Forebay and are screened with the best feasible technology.

Even with upgraded screens at the South Delta Diversion Facility, some direct mortality would continue. The lack of bypass flows at the screens would require salvage operations: handling and trucking of salvaged fish. Mortalities during salvage operation vary by species, the size or age of the fish and water temperature. Steelhead, which migrate through the Delta at a large size during cool seasons, suffer little mortality. Mortality of chinook salmon smolts during handling is less than ten percent. For delta smelt, experimental data suggest that mortalities during salvage exceed 90 percent, even for adults.

Clifton Court Forebay
(Showing Potential New Facilities)



* *All radial gates have flow control capability*

The proposed improvements will most likely increase the effectiveness of screening smaller or younger fish. Unfortunately, small or young fish suffer the highest mortality during screening salvage operations. The overall reduction in direct mortality may not be sufficient to remove this stress on fisheries recovery. Accordingly, alternatives which include the proposed consolidated, screened facility in the south Delta would continue to impose direct effects on fish mortality as a function of diversion amounts and timing.

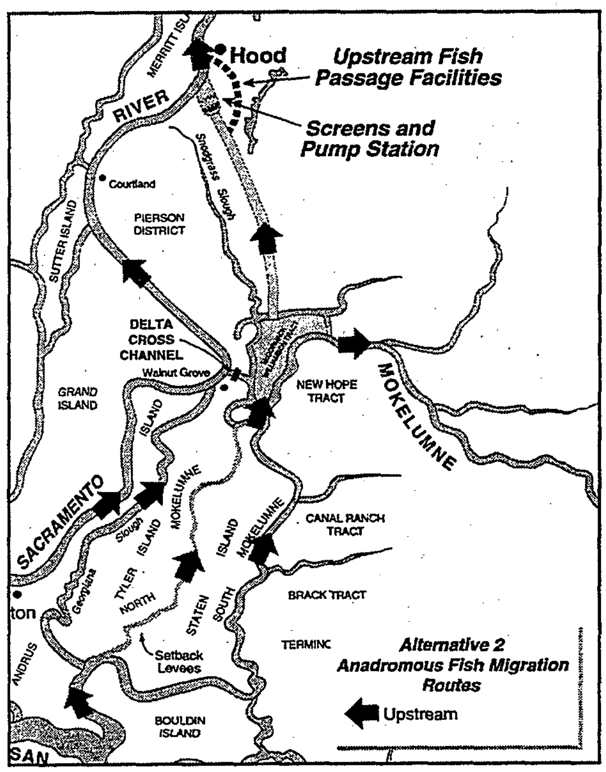
Alternatives 2 and 3 will also have fish screens at Hood on the Sacramento River, and both alternatives envision that the majority of Sacramento River water being exported will pass through these screens. Although screens of this size have never been constructed, a CALFED Fish Facilities Technical Team of agency and consultant experts evaluated the feasibility of installing effective fish screens of the necessary size at this location and concluded that it is feasible. Screens at the Hood location would have a number of features and anticipated effects:

- Bypass flows will exist in the Sacramento River so the screened fish will not need to be handled and trucked to another location for release.

- Fish residing and spawning in the Delta below the Hood diversion will be exposed to lower rates of diversion in the south Delta.

- Some fish migrating through the Sacramento River will be exposed to screening stresses. This is a particular concern for all Sacramento runs of chinook which presently do not encounter any large fish screens and water diversions in the northern Delta.

- The new screens at Hood will still be unable to screen certain (primarily very young) life stages of fish. Therefore, unscreenable life stages of fish that spawn in the Sacramento River will be lost in proportion to the amount of water diverted at Hood. This is a particular concern for striped bass which usually conduct at least 80 percent of their spawning upstream of the proposed Hood diversion. Alternatively, diversions could be curtailed during times of migration, with an associated increase in reliance on south Delta facilities or reductions in exports.



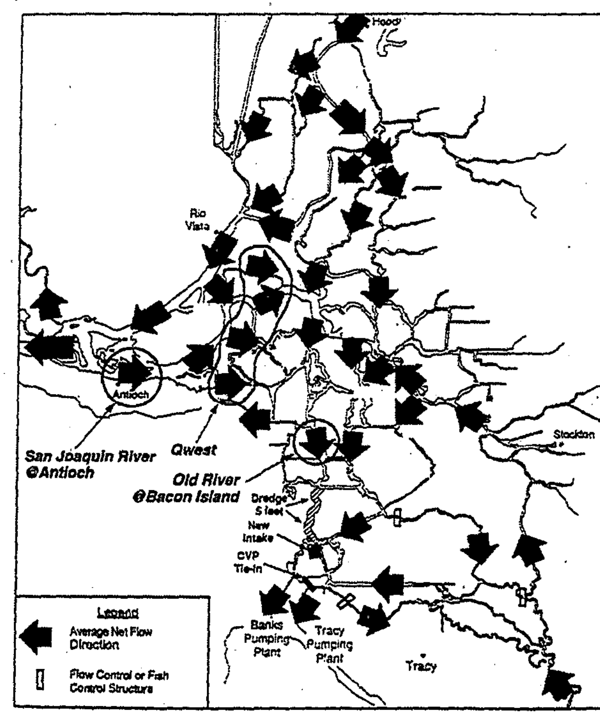
Alternative 2 raises two screening concerns not present with Alternatives 1 or 3:

- That portion of the water screened at Hood which goes to export pumps in the south Delta must be screened again to remove fish entrained as the water passes through the Delta, so the south Delta screens will need to have a capacity of about 15,000 cfs as in Alternative 1.

- Many thousands of adult fish of a variety of species will migrate upstream to the Sacramento River through the new channel into which the water diverted at Hood is discharged. The passage of those fish will be blocked at the pumping plant downstream of the Hood fish screen as shown in the adjacent figure. Substantial fish passage facilities will be needed to bypass the pumping plant and fish screens and get the upstream migrants into the Sacramento River.

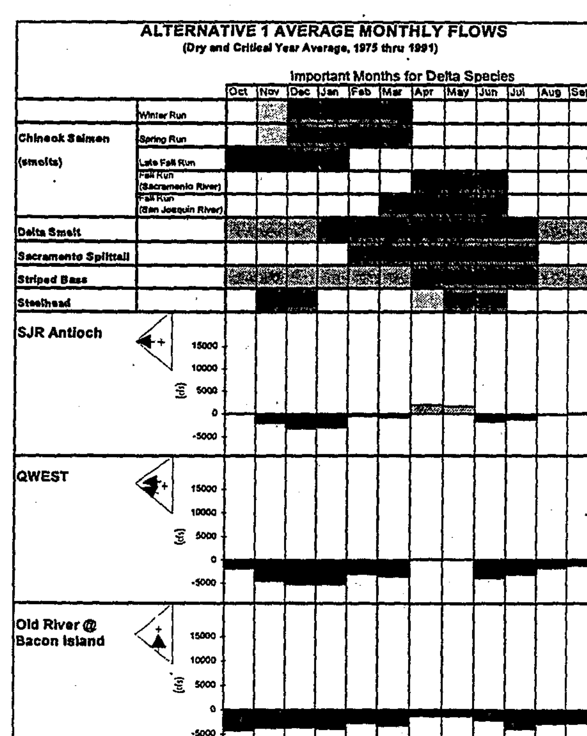
Diversion Effects on Delta Flow Patterns

The CALFED alternatives are characterized by distinctive flow distribution (hydrodynamic) patterns that differ to varying degrees from current Delta conditions. Thus, each alternative will result in some degree of change in the amount of indirect mortality associated with altered Delta flow patterns that result from export diversions.



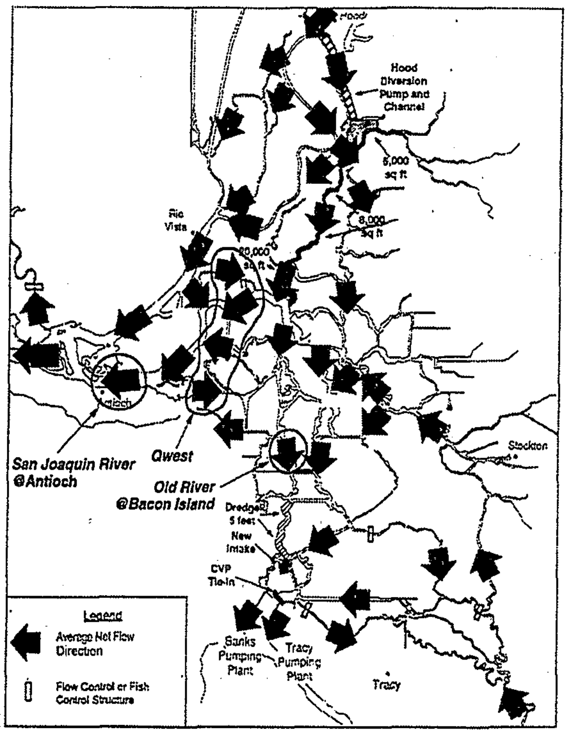
For Alternative 1, the direction of net flows during the critical spring and early summer period is toward the pumping plants from the junction of the Sacramento and San Joaquin Rivers. This flow reversal pattern exposes fish to being drafted toward the export pumps from a larger area of the Delta than either Alternatives 2 or 3. The figures illustrate conditions when these diversion effects are most pronounced, at times of high exports and low Delta inflow. This condition occurs during the spring and summer of dry and critically dry years. Highlighted are three Delta locations where mean flow directions affect indirect mortality associated with export diversions:

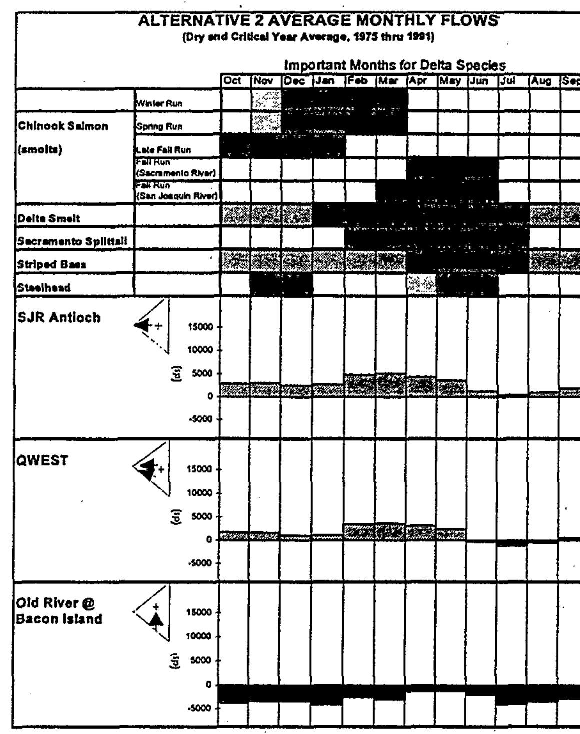
- San Joaquin River at Antioch
- QWEST (the sum of Sevenmile Slough, San Joaquin River at Bradford Island, False River and Dutch Slough)
- Old River at Bacon Island



The bar graph at the right shows Alternative 1 average monthly flows at these locations (for the dry and critical years of the period 1975 to 1991) and the months that are important to Delta species. Note that negative flows occur in most months.

With Alternative 2, sufficient water is diverted at Hood to maintain net downstream flows in the San Joaquin Delta west of the Mokelumne River. The following bar graph also illustrates that the flows at Antioch and QWEST are more positive. Hence fish west of the Mokelumne would no longer be subject to being drafted towards the pumps. Important populations east of that point would still be subject to being drafted towards the pumps.





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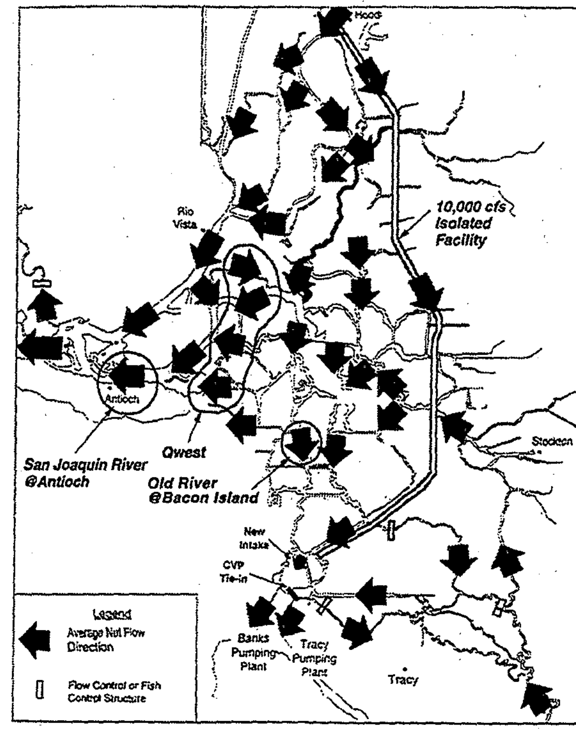
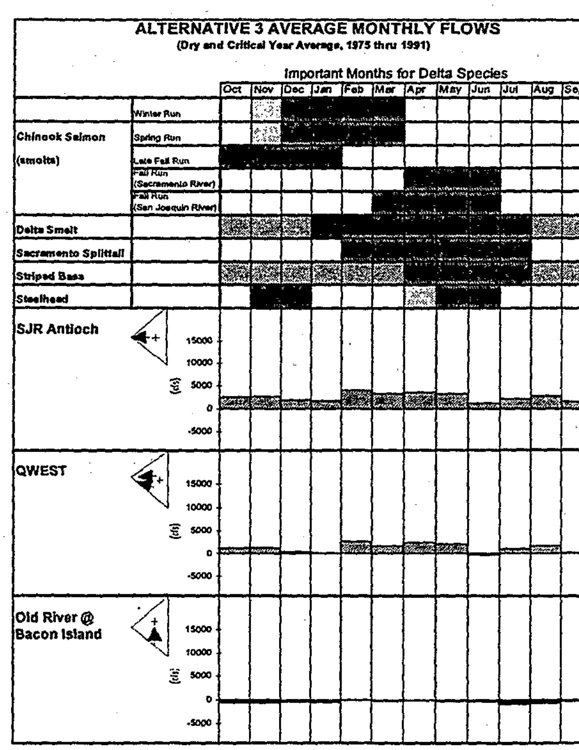
Finally, with Alternative 3 under operating scenarios, about 80% of the water exported from the Delta would pass through the Isolated Facility and 20% would be diverted directly from the south Delta. While net upstream flows would still occur in some areas under worst case circumstances (adjacent figure), approximately an 80% reduction in fish entrainment in the south Delta could be expected in relation to Alternative 1 and a somewhat lesser percentage in relation to Alternative 2. The bar graph below also shows that the flows in all three locations are improved.



Chinook salmon in the Sacramento River system would benefit substantially from habitat improvement features of the common programs both in the river and in the estuary. Under Alternatives 2 and 3, Sacramento River salmon that are diverted into the Central Delta will also benefit from the restoration of net downstream flows throughout the Delta. Existing conflicts with water project operations would continue with Alternative 1 and to a lesser degree with Alternative 2. Under Alternative 3, some conflicts would continue due to the inability to screen egg and larval stages of striped bass, and reduced Sacramento River flows below Hood.



Chinook salmon in the San Joaquin system would also benefit from habitat improvement features of the common program elements and the use of an operable barrier or its equivalent at the head of Old River. These fish would be affected very differently by conveyance aspects of the three alternatives. Under Alternatives 1 and 2 existing diversion effects would be perpetuated, offset somewhat by improved fish screens. Improved flow conditions in the western Delta under Alternative 2 would also offer some benefit to San Joaquin chinook salmon, although these salmon would still have to pass through extensive areas of adverse flow conditions before reaching this part of the Delta. Alternative 3 would be expected to reduce direct diversion effects by at least 80 percent, and flow conditions would be improved for San Joaquin chinook throughout the Delta.

Other fishes, such as delta smelt, splittail, striped bass and white catfish, would benefit to varying degrees from habitat improvement features of the common programs. They would also be affected very differently by the three conveyances of the alternatives. Under Alternative 1, existing diversion and flow distribution effects would be perpetuated. These would be offset some by the improved fish screens, but to a lesser degree than for salmon, since these species generally suffer more losses from handling and transport than salmon. These other fishes would be expected to receive some benefit from Alternative 2, due largely to improved flow distribution in the western Delta, but substantially greater benefit under Alternative 3. The latter would result from approximately an 80 % reduction in diversion losses in the South Delta and improved flow distribution throughout the Delta. Some risk would continue from exposure to diversions at Hood and reduced flows below Hood.

An important question is whether, even with screen relocation and improvement, the effects of continued diversions from the south Delta (including entrainment effects and changes in Delta flow patterns) will outweigh the benefits afforded by the other elements of the CALFED Program. If this were true the implication would be that, even with extensive ecosystem restoration and water quality actions to enhance the estuarine environment, recovery of threatened and endangered species would be unlikely. Such a finding would, in turn, have major implications for a Delta decision. This question has been sufficiently discussed by the experts to reveal that there is not a clear-cut answer. It is, however, possible for the decision makers, interested parties, and the public to develop a more complete understanding of the considerations involved.

To provide an independent perspective on the issues, a science review panel will be convened between release of the draft programmatic EIS/EIR and certification of a final EIS/EIR. The panel will be composed of recognized experts having a range of expertise applicable to the problem. Some of the specific issues that the panel may address are:

- How would fish populations be expected to respond if effects of diversions are reduced, thereby reducing direct and indirect mortality?
- Can diversion effects be offset by habitat improvements?
- Which species, populations, and life stages are most sensitive to diversion effects? When and where are they most affected?
- What uncertainty exists regarding diversion effects on fish species?
- What Sacramento River flow is required below a Hood diversion to protect salmon, striped bass, and delta smelt?

- What survival rate can be expected for striped bass eggs and larvae and delta smelt passing through a Sacramento River screen and pumps in Alternative 2?

- What is the expected effect of potential operational plans under each alternative? Which species would benefit? Which would be harmed? Can operational plans be flexible to fish needs?

- Have alternatives been tested through a large enough range of operational policies to fully evaluate potential beneficial and adverse impacts?

- How would fish populations be expected to respond to the direct and indirect effects of each alternative?

- Do we have sufficient information to predict the probability of fish species recovery under each alternative?

- What increment of protection or improvement for fish species will be provided by other programs such as the Central Valley Project Improvement Act, biological opinions, etc.?

Refining and Developing Consensus on Program Elements

As noted at the beginning of this Phase II Report, CALFED understands that there are substantial concerns among stakeholders and members of the public about particular Program elements. In Chapter 3, we attempted to summarize some of the major concerns that have already been brought to our attention. We anticipate that the public hearing process and written comments submitted during the Draft EIS/EIR comment period will also raise additional significant technical and policy concerns about all of the Program elements.

It is critical to the ultimate success of this Program that CALFED understand and address the substantive concerns raised by the public about all aspects of the Program. Throughout this Phase II Report, we have highlighted specific issues on particular Program elements, and asked for specific comments from the public. In addition, we believe that the entire technical analysis presented in this Phase II Report and in the rest of the Draft EIS/EIR should receive substantial review, and welcome your comments on how best to facilitate that review.

Each issue raised will need to be resolved, and the resolution process may differ depending on the issue. CALFED already anticipates that several issue resolution processes should be established for particular issues. Most of these are discussed in the detail program descriptions and alternatives evaluations in previous chapters of this Phase II Report. In general, these proposed processes fall into the following distinct categories:

Additional Review

Many of the issues raised by stakeholders and the public will require additional technical analyses. For example, CALFED already anticipates that questions raised about hyrological and water supply analyses in the Draft EIS/EIR and Phase II Report may lead to additional refinements in assumptions or, in some cases, perhaps completely different analytical approaches. In addition, we envision substantial additional modeling to review alternative configurations that are developed in response to public comments.

Other issues will also require additional technical review. For example, many have expressed concerns about the potential loss of prime agricultural land as a result of possible Program actions for habitat restoration, levee improvements, facilities construction, etc. A first step in the resolution of this issue is a comprehensive technical evaluation and inventory of the resources at risk. The Program needs to refine its understanding of the actual scope of this problem, and can then consider alternatives.

Similarly, we anticipate that additional economic analyses may be useful in resolving some of the outstanding issues associated with the Water Use Efficiency Program and the Water Transfer Policy Framework. This economic analyses should include an evaluation of alternative methods of achieving water supply reliability objectives, and should be accessible enough so that decision-makers at all levels can understand the many trade-offs in water supply investments. We are also proposing a workshop approach for discussing the role of bromide in maintaining safe drinking water.

CALFED will work with the public during and after the Draft EIS/EIR comment period to identify the most essential additional technical analyses and to prioritize CALFED resources accordingly.

CALFED will also be using the tool of additional scientific review as a process for resolving stakeholder issues. In some cases, this review may be similar to the formal "peer" review process used in evaluating the Ecosystem Restoration Program last fall. This kind of formal process is vital to maintaining the scientific objectivity and defensibility of the CALFED effort. As noted above, CALFED is already proposing a similar science review panel effort to explore the interplay between fisheries recovery and the choice of conveyance alternatives.

By convening these kinds of expert panels, CALFED hopes to move both CALFED agencies and members of the interested public to a common understanding of the issues and possible resolution of these types of issues.

Implementation Planning

CALFED is developing an integrated implementation strategy that describes the overall structure and process by which the CALFED Program will be implemented. This strategy will identify the roles, responsibilities, and reporting relationships of the CALFED agencies, other agencies, environmental, agricultural, urban, and recreational interest groups, and the public who will be involved in the implementation of the Program. The strategy will also describe the process for moving the Program from the programmatic level of detail to ultimate decisions on investments and the adaptive management process. The Implementation Strategy will be completed by the time of certification of the Programmatic EIS/EIR latter this year.

Some of this work for the Implementation Strategy has already begun. For example, CALFED has already begun working with interested stakeholders to develop a process for strategic planning for the ERP. This joint stakeholder-agency effort has prepared a draft outline and has begun identifying a team of scientists to assist in preparing a *Strategic Plan* for the ERP. CALFED will host several strategic planning workshops in the near future to fully develop issues and concerns associated with the structure and content of the *Strategic Plan*.

Similar efforts will be initiated for the water quality program, water use efficiency program, levees program and watershed coordination program.

Additional stakeholder efforts

As CALFED begins to address the issues and concerns raised by the stakeholders and members of the public about various Program elements, it will maintain the existing outreach efforts as a primary forum for conflict resolution. Accordingly, the substantial dialog developed through the Bay Delta Advisory Committee and its many subcommittees should continue.

In addition, CALFED believes that particular issues may require particular stakeholder outreach efforts. For example, the issue of agricultural land conversion noted above requires a more focused outreach effort. Only by engaging with the local landowner communities can CALFED identify and take advantage of the most creative and "multiple benefit" approaches to this issue. Similarly, CALFED intends to initiate a more comprehensive outreach effort to identify and coordinate with local watershed groups in both the upper and lower watershed for the Bay-Delta. These groups frequently have years of specific experience in dealing with many of the problem areas targeted by the CALFED effort.

CALFED is eager to work with stakeholders and the interested public over the next several months to identify other appropriate processes for resolving the many issues facing this Program, and encourages comments on this issue during the public comment period..

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Developing a Consensus Assurances Package

The technical evaluations described in the previous chapter did not make any attempt to consider the question of "assurances". In theory, an assurances package could be constructed that would assure implementation of any of the alternatives. As the debate over the Peripheral Canal in 1982 showed, however, the assurance issues associated with an isolated facility are substantial.

Included below is a summary of the substantial work done by CALFED and the Bay-Delta Advisory Council Workgroup on Assurances to define the assurances issues and develop a range of tools and approaches for resolving these issues.

Before CALFED can move forward with any preferred program alternative, the CALFED agencies and the many stakeholder communities must develop a consensus on an assurances package. As noted below, CALFED recognizes that the assurances process may affect both the timing (staging) and the substance of the implementation of a preferred program alternative. CALFED will continue developing a consensus package by relying on the BDAC Assurances Workgroup effort, although we anticipate additional processes will be necessary to successfully resolve this issue before the Programmatic EIS/EIR is finalized in late 1998.

Assurances

An assurances package is a set of actions and mechanisms to assure that the program will be implemented and operated as agreed. The assurances package will include mechanisms to be adopted immediately as well as a contingency process to address situations where a key element of the plan cannot be implemented or operated as agreed.

CALFED has been working with the Bay-Delta Advisory Council's Assurances Workgroup and stakeholders to identify the building blocks that will make up an assurances package. Thus far, CALFED has identified assurance needs and issues for each of the program elements; identified the assurance concerns of stakeholders; compiled a list of assurance tools; and developed guidelines for evaluating a package of assurances. Each of these elements is described in greater detail in the *Implementation Strategy* appendix to the Draft Programmatic EIS/EIR.

In addition, regardless of which program alternative is selected, CALFED must design an implementation strategy that will operate for the life of the Program actions. Because any alternative will likely require a number of funding, legislative, regulatory, contractual and institutional changes, implementation will be a complex, long-term process. Additionally, the nature and complexity of each program element make it impossible to implement the entire program simultaneously. The Program, therefore, will be implemented in stages.

The challenge in implementing a program in stages is to allow actions that are ready to be taken immediately to go forward, while assuring that each interest group has a stake in the successful implementation of the entire program over the implementation period. CALFED has identified the following three characteristics for a successful staging strategy:

- Each stage should be completed before the next one can begin
- Each interest group should have strong inducements to support the completion of each and every stage
- Program elements which are outside the control of the CALFED agencies should be implemented as early as possible to reduce the risk that outside actors may affect implementation

There is a significant amount of work to occur between the present and certification of the final EIS/EIR if the long-term solution is to be successfully implemented. To that end, the Program is developing individual implementation plans for each program element. Those plans will include:

- A description of the program element
- A summary of the goals, objectives and targets the element is seeking to achieve
- A detailed description of the actions to be taken and the tools and strategies to be used. This section will include a description of the order in which actions should be taken and their relative priorities
- A discussion of how and when success is to be measured
- Any other information necessary to assure timely and effective implementation

These individual implementation plans will be integrated into a program-wide implementation strategy and will also include financing and assurances. As part of this process, Program elements will be refined to improve overall performance.

In addition to the general information described above, CALFED has identified a number of significant assurance concerns relevant to the alternatives being analyzed in this EIS/EIR. A brief summary of some of these concerns follows.

Institutional Arrangements Including a New Entity for Ecosystem Restoration Program - Many stakeholders are concerned that the existing diffused approach to ecosystem management and restoration with responsibilities resting in state, federal, local and private entities is inadequate to assure implementation of the ERPP as envisioned. CALFED, therefore, is examining a variety of implementing approaches including the potential creation of joint powers authorities or new entities.

Any implementing entity would have the powers and resources necessary to implement the ERPP. In addition, the decision of how and by whom new actions in the remainder of the program will be implemented is also pending. Program-wide coordination throughout the implementation phase is essential to successfully implementing the entire program. A decision on an ecosystem entity cannot be made without considering the remainder of the program.

Ongoing Stakeholder Involvement - Many stakeholders are also concerned with the nature and scope of their involvement in the implementation phase of the Program. The almost unanimous opinion expressed at BDAC Assurance Workgroup meetings is that stakeholders would like to advise agencies in a meaningful and timely manner throughout implementation. For some stakeholders, this concept is expressed in stakeholder representation on the governing board of whatever entity implements the ERPP.

Endangered Species Assurances - Many stakeholders are concerned with the nature and extent of assurances given to the recovery of endangered species and the assurances given to water users for protection from future regulatory interference with their activities. The overall concept of "no surprises" is an important assurance for both the ecosystem and the water users. CALFED and stakeholders are examining California and federal endangered species laws to craft mutually acceptable assurances for the Bay-Delta ecosystem, as well as the water users.

Assuring Appropriate Operations of Conveyance Facilities - Many stakeholders are concerned that construction and operation of an isolated conveyance facility will unacceptably alter the "common pool" conditions which currently provide export water users with an incentive to protect the delta levees and channels and maintain specified water quality standards throughout the delta. These stakeholders fear that if water could be exported without first passing through the delta that the delta itself could be harmed and that the incentives to continue to protect the delta will be smaller for those now receiving water from a conveyance facility isolated from the delta.

Although some stakeholders believe a small isolated conveyance facility presents overwhelming problems for assurances, most believe that these difficulties increase with the size of the facility. These stakeholders worry that no assurance mechanisms can adequately prevent the future misuse of a large isolated facility.

Each of these descriptions is but a snapshot of a much larger and complex discussion that is continuing in the BDAC Assurances Workgroup and elsewhere. Although it would be easier developing assurances after a preferred program alternative has been selected, the above discussion should provide some insight into the importance of discussing assurance concerns while alternatives are being evaluated.

The list of potential "tools" available for addressing these and other stakeholder concerns about assuring the implementation of the Program is long and varied, ranging from fairly simple contractual agreements to more complex long term financial agreements and multipurpose legislation. These tools are discussed in more detail in the draft Implementation Strategy attached as an appendix to the Programmatic EIS/EIR. Given the complexity of the assurances issues and the need to coordinate both state and federal authorities applicable to the Bay-Delta problem, CALFED is assuming that any significant assurances proposals (such as changes in agency missions, or substantial long term funding commitments) will require state and federal authorizing legislation.

The assurances effort will continue in public BDAC Assurances Workgroup meetings, briefings to BDAC and other discussions with agencies and stakeholders. An implementation plan will be presented in the final EIS/EIR to be released in late 1998.

Financial Package

The second component of a long-term CALFED implementation plan is the financing package. During Phase II of the Program, a work group appointed by the Bay Delta Advisory Council ("BDAC") identified and discussed a number of issues relating to development of the Financial Implementation Strategy. The work group identified what it considered to be the most important issues relating funding the Solution. A summary of major funding sources is provided below followed by a brief discussion of financial principles and remaining issues to be addressed.

Funding Sources - The implementation strategy for finance is to fund the preferred program alternative through a combination Federal, State and user funds. The majority of the funding to date has been for ecosystem actions. Congress authorized Federal funding in the amount of $143 million per year for three years in 1996 for ecosystem-related actions. Proposition 204 provides for over $500 million of State General Obligation (G.O.) bond funding for CALFED actions, the majority of which is for ecosystem-related activities. User funding is currently being provided through a number of ongoing programs for a variety of activities that are consistent with CALFED objectives, in addition to the over $30 million of user funds for the Category III program.

> **Federal Funding**: Additional Federal funding for ecosystem actions as well as other Program elements will be required in future years. As was the case in 1997 when Congress allocated $85 million to the Bureau of Reclamation for CALFED ecosystem restoration, Federal funding is expected to be appropriated in the form of a consolidated line item for the CALFED Solution, in order to maximize efficiency and effectiveness of the implementation of the Solution.
>
> **State Funding**: Additional State funding will also be required for ecosystem and other Program actions. Governor Wilson has proposed $1.3 billion in additional State G.O.

bonds for a mix of CALFED actions, which would need to be approved by the Legislature and State voters during 1998.

User Funding: Additional user funding is also required. Actions that benefit users directly are expected to be paid for with user funding. In addition, some portion of the common Program elements that create widespread user benefits may be funded with user money. To accomplish this, some type of new broad-based user charge will likely be necessary in order to reach the necessary spectrum of users benefiting from a CALFED solution. The amount and potential application of such a charge has not been determined, and implementation of this approach will likely require state and federal legislation.

Financial Principles - Several principles guide development of the financial package:

Benefits-Based Approach: Sharing the costs of the Solution based on the benefits being created is the cornerstone principle of the CALFED Financial Strategy. The fundamental philosophy is that costs will be paid by those who enjoy the benefits of the actions, as opposed to seeking payment from those who, over time, were responsible for causing the problems being experienced in the Bay Delta system.

Many of the benefits are difficult to quantify. Benefits associated with restoring ecosystem health, for example, are not measurable in the same way as the benefits of water supply improvements. This implies that while the benefits-based approach is useful as a guide, benefits cannot be used in a strictly quantitative way to arrive at an answer regarding sharing of costs.

Also, even though they agree in principle with the benefits-based approach for future costs, some stakeholders and CALFED agencies feel that direct beneficiaries of water development, including water users, should pay something for past damage to the ecosystem prior to using the benefits approach for future costs. The essence of this concept is that a benefits-based approach for the future is only fair if all parties start out from an equal position. Some feel that reaching this "level playing field" would take an initial adjustment in favor of the ecosystem. Assessing water users for this type of adjustment is difficult because there is not general agreement over what role any particular water diversion, or water diversions in general, may have played in degrading the ecosystem to date. In addition, water users argue that they have already paid sufficient amounts over time to offset any past actions.

The remaining questions that must be resolved relating to the benefits-based approach revolve around what to do when benefits that cannot be quantified, and whether or not any adjustment for past impacts is appropriate prior to using the benefits approach going forward.

Public/User Split: Both public money and user money will be used to fund the CALFED solution. The public and user concepts have also been extended to describe the benefits. In principle, public money will be used to do things that create public benefits, and user money will be used to do things that create user benefits. *User money* refers to money, which is collected in exchange for provision of a good or service. Fees paid for water service are a clear example of user money. Although many of the water providers are public agencies, funds collected by these agencies in exchange for their services are not defined as public money for purposes of funding the CALFED solution.

Benefits can be generally classified as either "public" or "user" based on the practicality of excluding individuals from access. If individuals can be effectively excluded from receiving a benefit, then they can probably be charged for access to it.

> *Public benefits* are generally those that are shared by a wide cross-section of the community and from which individuals cannot be realistically excluded. Inability to exclude individuals means that imposing charges for access to the benefit is difficult. If "free riders" can access the benefits without paying, there is no economic incentive for users to spend their money for these benefits. This means that if these benefits are to be created, public funding must be used.
>
> *User benefits* are generally those that accrue to an identifiable subset of the community, and from which individuals can be excluded. The ability to restrict benefits to those that pay enables these benefits to be funded with user money. In some cases, such as metered water use, individuals can be charged based on volume of use. In other cases charges are based on simple access to the benefit.

There are additional questions in defining public versus user benefits that arise in conjunction with benefits that are not clearly one or the other. Some user benefits are so widespread that the group sharing them is substantially the same as the general public. The keys to resolving this issue may lie in whether or not access to the benefit can reasonably be excluded to those who do not pay for that access, and in whether future behavior can be beneficially affected depending on the choice of funding mechanism.

Ability to Pay: This issue relates to whether or not specific users will be obligated to pay the full cost allocation for their benefits, or whether some obligations should be reduced based on the limited ability of certain users to pay the full cost of their benefits. Such reduced obligations would have to be subsidized either by other users or with public funds. A third option that must be considered is the possibility for reducing or eliminating benefits for those who are unable to pay for them. A third option that must be considered is the possibility for reducing or eliminating benefits for those who are unable to pay for them.

In principle, users should pay their full share, with any exceptions to be considered on a case by case basis after a full cost allocation has been made assuming no ability to pay constraints. The concept is that any reductions in cost obligations based on inability to pay the full cost share should be explicitly identified and justified.

Crediting: This policy relates to reducing Solution-related cost obligations to reflect payments made by obliges toward other parallel efforts to address Bay-Delta issues. An interim policy granting credit for cash contributed to the Category III Program has been approved by CALFED, but no additional provisions for long-term crediting have been approved.

In principle, all expenditures directed at the Bay-Delta system are part of the overall effort to improve that system. Consolidating all of the parallel efforts to address Bay-Delta ecosystem issues has been advocated as an important step in ensuring effective and efficient use of the available funding for such efforts. Consolidating these efforts is seen as a way to coordinate the timing and implementation of many diverse and complex projects, as well as to enable flexible use of available funding.

As part of the long-term crediting policy many additional details must be agreed upon, including the start date for crediting, types of payments to be credited, consideration of the timing of payments, and others.

Cost Allocation Methodology: This relates to selection of particular cost allocation techniques for making detailed cost allocations within the sphere of a benefits-based cost allocation approach. No policy decision has been articulated here, although individual CALFED agencies have historical policies relating to cost allocation techniques. Within the stakeholder community, there is general consensus that while traditional methodologies may be applicable for conventional facilities, they may not be appropriate for use with the Common Programs due to the difficulty in including non-market benefits created by the Common Programs in the allocation process.

There are many possible cost allocation methods, each with its own strengths and weaknesses. The BDAC Finance Work Group developed a set of conceptual criteria to guide the selection of methods for dividing the costs of the CALFED solution. Selection of a specific method for each Program element may be in order, and this selection will probably involve tradeoffs among these criteria. There is no single best method that addresses all of the criteria in an optimal way.

While the fundamental policy direction for each of the Financial Principles discussed above has been identified, much work remains to be completed. Most of the remaining work is in the detailed application of these policies to a preferred program alternative. Resolution of these issues will require the involvement of policy level representatives of Federal and State agencies and stakeholder interests. The process for moving these issues through the public and stakeholder process that has defined the Program to date must be implemented during 1998 to enable resolution of these issues prior to finalization of the Implementation Strategy for the Preferred program alternative.

6. OTHER CONTINUING/FUTURE WORK EFFORTS

Restoration Coordination

In December 15, 1994, the Bay-Delta Accord included a commitment by the agency and stakeholder signatories to develop and fund non-flow related ecosystem restoration actions to improve the health of the Bay-Delta ecosystem. This commitment is commonly referred to as *Category III*. Some of the specific non-flow factors identified to be addressed as part of the Category III commitment include unscreened water diversions, waste discharges and water pollution prevention, fishery impacts due to harvest and poaching, land derived salts, exotic species, fish barriers, channel alternations, loss of riparian wetlands, and other causes of estuarine habitat degradation.

While the details of the preferred program alternative are not finalized, Category III actions can be beneficial to the long term program regardless of which alternative is selected. The Category III actions must be consistent with each of the three alternatives and provide early implementation benefits. This implementation will also provide valuable information for use in adaptively managing the system in later years of the program. Category III projects must have appropriate environmental documentation, have no significant adverse cumulative impacts, and must not limit the choice of a reasonable range of alternatives.

Funding sources for near-term restoration activities include $60 million from state Proposition 204 funds (Bay-Delta Agreement Program) and stakeholder contributions of $30 million. In addition, Congress authorized $430 million for fiscal years 1998, 1999, and 2000 to fund the Federal share of Category III and initial implementation of the ERP. In Federal fiscal year 1998, $85 million was appropriated for Bay-Delta ecosystem restoration, a portion of which is considered Category III funding. Proposition 204 also include $390 million for implementation of the ERP, however, this funding will not be available until after the EIS/EIR is final.

In June 1997, CALFED issued a request for proposal (RFP) soliciting applications for ecosystem restoration activities. The RFP focused on targeted species, including anadromous fish, Delta native fish and migratory birds. CALFED received 332 proposals which were evaluated by technical panels comprised of agencies and stakeholders. In addition, public input was obtained via the Bay Delta Advisory Council and its subcommittee, the Ecosystem Roundtable.

On December 17, 1997, the CALFED Bay-Delta Program announced more than $100 million in funding for 50 ecosystem restoration projects selected from the proposals submitted pursuant to the RFP. This included approximately $60 million of CALFED awards using Proposition 204, federal and stakeholder funds, with more than $40 million in cost sharing from project proponents. About three-fourths of the money was devoted to projects that restore rivers, riparian forests, wetlands, and marshes. The remainder went to projects such as installing fish screens to keep endangered fish from being pumped out of rivers; preventing introduction of exotic species that are accidentally released into the wild; water quality monitoring and research, educating farmers on how to improve farming practices to lessen reliance on pesticides, as well as research on endangered species such as delta smelt. Currently, $21.6 million in additional proposals are being considered. Approximately $48.5 million in remaining funds will be awarded in 1998.

For 1999 funding, CALFED is revising and updating the priorities to ensure that they are consistent with the ERPP and to build on restoration actions funded to date. These revised priorities will guide development of restoration actions.

Feasibility Studies

CALFED will also continue work on feasibility studies for the storage and conveyance, water quality, and ecosystem restoration elements. These studies will provide more detailed information than that obtained from the impact analyses for the programmatic EIR/EIS and will move program elements closer to implementation. The following paragraphs show some advantages of continuing with feasibility studies:

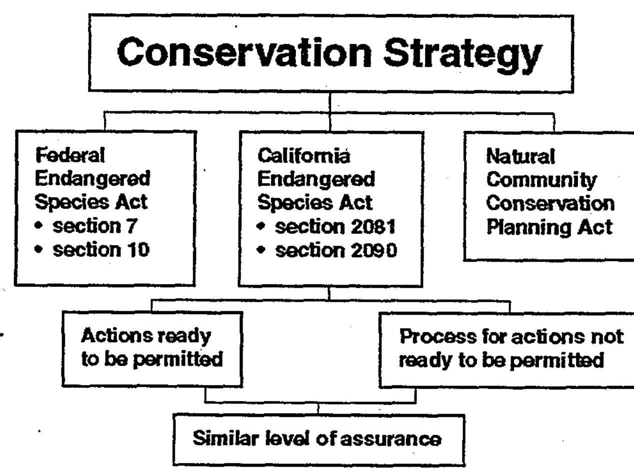
> **Provide Support for Implementation Plans** - The prefeasibility studies provide support for implementation plans by developing specific information on costs, water supply, flows, water quality, site impacts, and other factors for representative combinations of Program elements. For example, the feasibility of implementing offstream storage to enhance water supply opportunities depends on the specific locations available for development such as topography, geology, environmental concern, proximity to a water supply source, and existing conveyance facilities.
>
> **Refine Layouts, Sizes, and Other Details** - While the impact analyses evaluated a broad range of facility sizes, the feasibility studies provide information for additional sizes within that range. The feasibility analyses will provide additional detail that will lead to narrowing the range of sizes for the preferred program alternative and ultimately lead to the selected sizes for implementation.
>
> **Provide Detailed Costs** - The programmatic EIR/EIS will primarily display benefits and adverse impacts of the alternatives and will include only program level costs for the ends of the range being studied. The feasibility studies will provide more detailed cost information to assist the stakeholders and decision makers in their deliberations on the "preferred program alternative".

Shorten Time to Implementation - The feasibility studies provide early direction for the process of planning, site specific environmental documentation, design, and construction required for project implementation in Phase III. While the studies will not progress so far, before the selection of the preferred program alternative, so as to produce unnecessary analysis, continuing the feasibility studies will allow the Program to move more efficiently into project implementation.

State and Federal Endangered Species Act Compliance

CALFED has begun developing a process to comply with the California Endangered Species Act (CESA) and the Federal Endangered Species Act of 1973, as amended (ESA), and will continue to develop that process during Phase II of the Program. As a foundation for implementing the California and Federal ESA compliance process, CALFED is developing a comprehensive Conservation Strategy for the CALFED Program. The Conservation Strategy is intended to integrate CALFED Program enhancement and mitigation actions to provide for improved species and habitat protection, increase assurances of overall Program implementation, and streamline California and Federal ESA take authorization for approved actions.

The regulatory mechanisms that will be used to authorize incidental take under the Federal ESA include formal consultation pursuant to Section 7, permit issuance pursuant to Section 10(a)(1)(B), which includes the development of one or more Habitat Conservation Plans (HCP), and/or a special rule for threatened species under Section 4(d). The regulatory mechanisms that will be used to authorize take under CESA include Section 2835 of the California Fish and Game Code (the Natural Community Conservation Planning Act), which includes the development of a Natural Community Conservation Plan (NCCP), Section 2081 of the California Fish and Game Code, and/or Section 2090 or successor sections of the California Fish and Game Code. The Conservation Strategy will provide the basis for any and all of the above regulatory mechanisms and will remain constant regardless of which mechanism is used to authorize take (i.e., the Strategy will specify the same measures whether take is authorized through Section 7, 10, or 4(d) of the ESA and Section 2835, 2081, or 2090 or successor sections of the CESA).



The Conservation Strategy will address all federally and state listed, proposed, and candidate species that may be affected by the CALFED Program; other species identified by CALFED that may be affected by the Program and for which adequate information is available also will be addressed in the Strategy. The term "covered species" is used to refer to all of the species that will be addressed by the Conservation Strategy. CALFED is currently developing the list of covered species. The Strategy will address the effects of CALFED Program actions (beneficial, adverse, and neutral) on the covered species, and the minimization and mitigation measures needed to offset the anticipated adverse impacts and allow for species recovery. The Conservation Strategy also will address the conservation and protection of habitats affected by the CALFED Program. In addition, the Conservation Strategy will include a monitoring and reporting program, specify a process for adaptive management, and address funding for implementation of the Strategy and to address unforeseen circumstances. The Conservation Strategy, in the context of the CALFED comprehensive long-term plan, will allow for the recovery of listed species and the conservation of currently unlisted species.

Take authorization would be granted, to the appropriate implementing entity or individual, when adequate information is available to assess project effects on listed or other covered species and a determination is made that the appropriate findings or requirements under the California and/or Federal ESA have been made or met. The Conservation Strategy will outline the criteria and process for determining the appropriate regulatory mechanism for implementing the Strategy and authorizing incidental take associated with specific Program actions. As noted above, Federal authorization of incidental take associated with an action may be through formal consultation (Section 7), an incidental take permit and HCP (Section 10), or a special rule for threatened species (Section 4(d)); State authorization of incidental take may occur through an NCCP (Section 2835), an incidental take permit (Section 2081), or formal consultation (Section 2090).

The CALFED Bay-Delta Program is being conducted in a three-phase planning effort. Phase I, completed in September 1996, identified solution alternatives to be further analyzed in the second Phase. During Phase II, the Program is conducting a comprehensive programmatic environmental review by adding a greater level of detail to each of the program components. Phase II will conclude with the selection of a preferred program alternative, the development of an Implementation Strategy and Conservation Strategy, and the completion of a final programmatic environmental impact statement and report. Commitment to implementing the Conservation Strategy will be embodied in an appropriate mechanism, such as an Implementing Agreement.

While implementation of some of the Program actions may begin during Phase II, implementation of many of the Program actions will take place during Phase III of the Program. This period will include any additional site-specific environmental review and necessary permitting. Implementation is anticipated to occur over a period of years primarily because of the size and complexity of the alternatives in solving the problems. Much of the challenge will be to develop an effective Implementation Strategy that acknowledges this long implementation period and finds a way to keep participants committed to the successful completion of all phases of implementation and all components of the Program.

Based on what CALFED expects to complete during Phase II, actions that are likely to have completed California and Federal ESA regulatory compliance and be permitted or conditionally permitted by the end of Phase II include: some ERPP actions, some levee integrity actions, some water quality actions, some conveyance actions within the Delta, and "interim" operating procedures (i.e., covering the transition from existing conditions through completion of the CALFED Program) for water storage and conveyance, including the State Water Project and Central Valley Project.

Compliance with Clean Water Act Section 404(b)(1) Guidelines

Section 404 of the Clean Water Act requires that a project proponent obtain a permit from the Corps for activities that involve the discharge of dredged or fill material into waters of the United States (33 USC 1344). Section 404 requires that the issuance of a permit by the Corps comply with EPA's Section 404(b)(1) Guidelines (Guidelines). These guidelines provide direction and guidance for implementation of Section 404.

EPA's Guidelines (40 CFR 230 et seq.), the Corps' regulatory guidelines (33 CFR 320 et seq.), and the National Environmental Policy Act (NEPA) and NEPA Guidelines (40 FR 1500 et seq) provide part of the substantive environmental criteria and procedural framework used to evaluate applications for Corps permits for the discharge of dredged or fill material into waters of the United States, including wetlands and other designated special aquatic sites. Under the Corps evaluation, an analysis of practicable alternatives is a screening mechanism used to determine the appropriateness of permitting a discharge. The Corps evaluation also includes analysis of compliance with other requirements of the 404(b)(1) Guidelines, a public interest review and evaluation of potential impacts on the environment in compliance with NEPA.

According to the 404(b)(1) Guidelines, an alternative is considered practicable if it is available and can be implemented given considerations of cost, existing technology, and logistics in light of overall project purposes. Practicable alternatives may include siting a project in areas not owned by an applicant, but that could be reasonably obtained by the project applicant, to achieve the basic project purpose (40 CFR 230.10[a][2]).

Many features of CALFED have the potential to require the discharge of dredged or fill material into waters of the United States, including designated special aquatic sites. The ERP contains many such actions, including the restoration of wetlands, restoration of channel islands, construction of fish barriers, construction of fish screens, and restoration of riparian habitat. The Levee System Integrity Program contains actions, such as the creation of setback levees, improvements to levee maintenance, and the flooding of islands, that could require a Corps permit. The water supply reliability components consider actions, such as the creation of additional water storage capacity and the construction of conveyance facilities in the Delta, and the Water Quality Program contains actions, such as the construction of water quality barriers, that would require a Corps permit. Section 404 Permits will be required during Phase III.

A 404 Permit is not required for Phase II of the CALFED process because selection of the preferred program alternative will not authorize implementation of the projects composing the preferred alternative and therefore will not involve the discharge of materials into the waters of the United States. Nevertheless, the alternatives under consideration in the CALFED process are being analyzed in the light of the requirements of the 404(b)(1) Guidelines so that when the Corps is required to determine whether particular Phase III projects comply with the 404(b)(1) Guidelines, it will have the benefit of an analysis as to the consistency of the CALFED preferred program alternative with the 404(b)(1) Guidelines at a programmatic level.

During Phase I of this process, the problems of the Bay-Delta were identified, objectives defined, a comprehensive list of actions for achieving the objectives were compiled, and preliminary alternatives assembled. The remainder of Phase I consisted of an iterative process of analyzing and screening alternatives, leading to the selection of a preferred program alternative. The initial screening of alternatives, beginning with 100 and selecting 10, was principally an effort to combine alternatives so that each, in keeping with the CALFED solution principles, provided balanced benefits to each to the problem areas. In screening from 10 to three alternatives, some were removed from further consideration; others were not eliminated, but became variations of the three main conveyance concepts: existing system conveyance, modified through-Delta conveyance, and dual-Delta conveyance (a combination of through-Delta and isolated conveyance). These three alternatives, and 12 variations associated with them, were carried forward for further refinement in Phase II. In Phase II, the three alternatives are being subjected to further analysis, resulting in further refinements, and will result in the eventual selection of the preferred program alternative.

This process is consistent with the Section 404(b)(1) Guidelines in that the screening of alternatives is intended to lead to the selection of the least environmentally damaging practicable alternative. Implementation of Phase III actions involving the discharge of dredged or fill material into waters of the United States may require site-specific documentation that specific proposals comply with EPA's Section 404(b)(1) Guidelines.

Phase III Site-Specific Environmental Documentation

During Phase III of the CALFED Program, second-tier site-specific environmental documents will be prepared for the individual actions or site-specific projects chosen for implementation during the current Phase II process. Second-tier documents, will be prepared after certification of the Programmatic EIS/EIR to concentrate on issues specific to the individual parts of the program elements being implemented or the site chosen for the action. The second-tier document will summarize and incorporate by reference the issues discussed in the broader program-oriented EIS/EIR and focus on the issues specific to the part of the overall program being implemented. Information presented in the second-tier EIS/EIR will be specific to a smaller area within the CALFED Bay-Delta study area and will focus on impacts within the smaller area and individual action-level mitigation performance criteria.

7. GLOSSARY OF TERMS

AF Abbreviation for acre feet; the volume of water that would cover one acre to a depth of one foot, or 325,851 gallons of water. On average, could supply 1-2 households with water for a year. A flow of 1 cubic foot per second for a day is approximately 2 AF.

Alternative A collection of actions or action categories assembled to provide a comprehensive solution to problems in the Bay-Delta system.

Action A structure, operating criteria, program, regulation, policy, or restoration activity that is intended to address a problem or resolve a conflict in the Bay-Delta system.

Action Category A set of similar actions. For example, all new or expanded off-stream storage might be placed into a single action category.

Anadromous Fish Fish that spend a part of their life cycle in the sea and return to freshwater streams to spawn.

Best Management Practices (BMP) An urban water conservation measure that the California Urban Water Conservation Council agrees to implement among member agencies. The term is also used in reference to water quality standards.

Carriage Water Additional flows released during export periods to ensure maintenance of water quality standards and assist with maintaining natural outflow patterns in Delta channels. For instance, a portion of transfer water released from upstream of the Delta intended for export from south Delta would be used for Delta outflow.

Central Valley Project (CVP) Federally operated water management and conveyance system that provides water to agricultural, urban, and industrial users in California.

Central Valley Project Improvement Act **(CVPIA)** This federal legislation, signed into law on October 30, 1992, mandates major changes in the management of the federal Central Valley Project. The CVPIA puts fish and wildlife on an equal footing with agricultural, municipal, industrial, and hydropower users.

CFS An abbreviation for cubic feet per second.

Channel Islands Natural, unleveed land masses within Delta channels. Typically good sources of habitat.

Common Delta Pool This concept suggests the Delta provides a common resource, including fresh water supply for all Delta water users, and all those whose actions have an impact on the Delta environment share in the obligation to restore, maintain and protect Delta resources, including water supplies, water quality, and natural habitat.

Common Program Six programs for Water Use Efficiency, Water Quality, Levee System Integrity, Ecosystem Restoration, Water Transfers, and Watershed Management Coordiantion that are essentially the same for each of the three Phase II alternatives.

Component A group of related action categories; the largest building blocks of an alternative. The components for the Phase II Alternatives include a component for Delta conveyance, a component for storage, and the four common programs.

Conjunctive Use The operation of a groundwater basin in combination with a surface water storage and conveyance system. Water is stored in the ground water basin for later use in place of or to supplement surface supplies. Water is stored by intentionally recharging the basin during years of above-average water supply.

Conveyance A pipeline, canal, natural channel or other similar facility that transports water from one location to another.

Core Actions Actions that would be included in all CALFED Bay-Delta Program alternatives. Core actions are no longer viewed as a single set of actions. Rather, these actions are now distributed between the six common programs included in each of the three Phase II Alternatives.

Delta Inflow The combined water flow entering the Delta at a given time from the Sacramento River, San Joaquin River, and other tributaries.

Delta Islands Islands in the Sacramento-San Joaquin Delta protected by levees. Delta Islands provide space for numerous functions including agriculture, communities, and important infrastructure such as power plants, transmission lines, pipelines, and roadways.

Delta Outflow The net amount of water (not including tidal flows) at a given time flowing out of the Delta towards the San Francisco Bay. The Delta outflow equals Delta inflow minus the water used within the Delta and the exports from the Delta.

Demand Management Programs that seek to reduce demand for water through conservation, rate incentives, drought rationing, and other activities.

Diversions The action of taking water out of a river system or changing the flow of water in a system for use in another location.

Drought Conditions A time when rainfall and runoff are much less than average. One method to categorize annual rainfall is as follows, with the last two categories being drought conditions:

wet, above normal, below normal, dry critical.

Dual Conveyance A means of improving conveyance across the Bay-Delta by both improving through Delta conveyance and isolating a portion of conveyance from Delta channels.

Ecosystem A recognizable, relatively homogeneous unit that includes organisms, their environment, and all the interactions among them.

Entrainment The process of drawing fish into diversions along with water, resulting in the loss of such fish.

ESA (Endangered Species Act) Federal and State legislation that provides protection for species that are in danger of extinction.

Export Water diversion from the Delta used for purposes outside the Delta.

Fish Migration Barriers Physical structures or behavioral barriers that keep fish within their migration route and prevent them from entering waters that are not desirable for them or their migration pattern.

Fish Screens Physical structures placed at water diversion facilities to keep fish from getting pulled into the facility and dying there.

Groundwater Banking Storing water in the ground for use to meet demand during dry years. In-lieu Groundwater Banking Replaces groundwater used by irrigators with surface water to build up and save underground water supply for use during drought conditions.

HMP (Hazard Mitigation Plan) One of two standards referred to in the alternatives for levee flood protection. Following the flood disasters of the 1980s, HMP standards were established at 1 foot of freeboard above the 100-year flood event level.

Hydrograph A chart or graph showing the change in flow over time for a particular stream or river.

In-Delta Storage Water storage within the Delta by converting an existing island to a reservoir.

In-lieu Groundwater Banking Replaces groundwater used by irrigators with surface water to build up and save underground water supply for use during drought conditions.

Inverted Siphon A pipeline that allows water to pass beneath an obstacle in the flow path. For example, an inverted siphon could be used to allow water in a canal to pass under a Delta channel.

Isolated Conveyance Facility A canal or pipeline that transports water between two different locations while keeping it separate from Delta water.

Land Fallowing/Retirement Allowing previously irrigated agricultural land to temporarily lie idle (fallowing) or purchasing such land and allowing it to remain out of production for a variety of purposes (retirement).

MAF An abbreviation for million acre feet, as in 2 MAF or 2,000,000 AF. For scale, consider that 10,000 cfs flowing for a year is about 7 MAF.

Mining Drainage Remediation Controlling or treating polluted drainage from abandoned mines.

Meander Belt Protecting and preserving land in the vicinity of a river channel in order to allow the river to meander. Meander belts are a way to allow the development of natural habitat around a river.

Non-native Species Also called introduced species or exotic species; refers to plants and animals that originate elsewhere and are brought into a new area, where they may dominate the local species or in some way negatively impact the environment for native species.

Real-Time Monitoring Continuous observation in multiple locations of biological conditions on site in order to adjust water management operations to protect fish species and allow optimal operation of the water supply system.

Riparian The strip of land adjacent to a natural water course such as a river or stream. Often supports vegetation that provides the best fish habitat values when growing large enough to overhang the bank.

Riverine Habitat within or alongside a river or channel.

Setback Levee A constructed embankment to prevent flooding that is positioned some distance from the edge of the river or channel. Setback levees allow wildlife habitat to develop between the levee and the river or stream.

Shallow Water Water with little enough depth to allow for sunlight penetration, plant growth, and the development of small organisms that function as fish food. Serves as spawning areas for delta smelt.

Smolt A young salmon that has assumed the silvery color of the adult and is ready to migrate to the sea.

Solution Principle Fundamental principles that guide the development and evaluation of Program alternatives. They provide an overall measure of acceptability of the alternatives.

South of Delta Storage Water storage supplied with water exported south from the Delta.

State Water Project (SWP) A California state water conveyance system that pumps water from the Delta for agricultural, urban domestic, and industrial purposes.

TAF An abbreviation for thousand acre feet, as in 125 TAF or 125,000 AF.

Take Limit The numbers of fish allowed to be lost or entrained at a water management facility before it must limit or cease operations. The numbers are set for different species by regulations.

Terrestrial Types of species of animal and plant wildlife that live on or grow from the land.

Through Delta Conveyance A means of improving conveyance across the Bay-Delta by a variety of modifications to Delta channels.

Upstream Storage Any water storage upstream of the Delta supplied by the Sacramento or San Joaquin Rivers or their tributaries.

Water Conservation Those practices that encourage consumers to reduce the use of water. The extent to which these practices actually create a savings in water depends on the total or basin-wide use of water.

Water Reclamation Practices that capture, treat and reuse water. The waste water is treated to meet health and safety standards depending on its intended use.

Water Transfers Voluntary water transactions conducted under state law and in keeping with federal regulations. The agency most involved is the State Water Resources Control Board (SWRCB).

Watershed An area that drains ultimately to a particular channel or river, usually bounded peripherally by a natural divide of some kind such as a hill, ridge, or mountain.