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Program Goals and Objectives. Programmatic EIS/EIR Technical Appendix

CalFed Bay-Delta Program

CALFED
BAY-DELTA
PROGRAM

Program Goals and Objectives

Programmatic EIS/EIR
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DRAFT

PROBLEM / OBJECTIVE DEFINITION

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PROGRAM

DRAFT PROBLEM/OBJECTIVE DEFINITION

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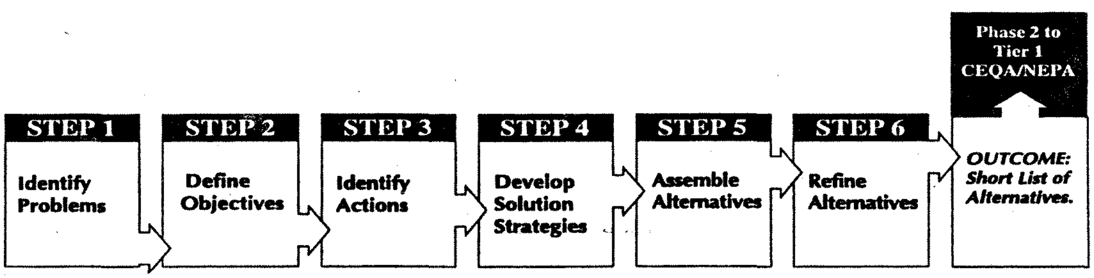
Section 1
Introduction

The CALFED Bay-Delta Program has established an ambitious schedule to develop a long-term solution to the problems affecting the Bay-Delta system. Building on the spirit of cooperation reflected in the December 1994 Bay-Delta Accord, the Program intends to make significant progress toward developing and implementing a Bay-Delta solution in the next three years.

To accomplish this goal, the Program has identified a three phase planning process. Phase 1 efforts focus on developing a short list of promising alternatives by Spring 1996. During Phase 2, the Program will conduct an environmental review of the short list of alternatives. Phase 3 will include site-specific environmental review and permitting of projects and actions.

Phase 1 includes six steps to develop a short list of alternatives:

1. Define the Problem
2. Develop Mission, Goals, and Objectives
3. Identify Potential Actions
4. Develop Solution Strategies
5. Identify Preliminary Alternatives
6. Evaluate and Refine Alternatives to Short List



Step 1—Define the Problem is a critical part of developing effective solutions. Before actions and alternatives can be developed, the Program and affected interests must have a clear and complete understanding of the problems to be addressed by the long-term solution. A clear, concise problem definition focuses the planning efforts of Phase 1 on the potential actions and alternatives that will provide realistic, effective solutions to the problems of the Bay-Delta system. The effort to define the problems also provides the first opportunity for affected interests to discuss issues and concerns and develop a common understanding.

The problem definition includes three important elements:

- Detailed definition of the problems to be addressed
- Description of the geographic scope of the problems
- Clarification of the level of detail for Phase 1 analyses

This report describes each of these three elements. This problem definition was developed through a review of existing programs and problems and an extensive process to include interested groups and individuals. The process to develop this problem statement is described briefly in Section 5. Each of the problems defined in this report forms the basis for developing the Program objectives and potential actions leading toward a short list of promising alternatives.

Step 2—Develop Mission, Goals, and Objectives addresses as the Program's focus for solving the problems identified in Step 1.

The CALFED Bay-Delta Program Mission Statement was developed through an open and public process, with discussion and input from participants at workshops and from members of the Bay-Delta Advisory Council. The Mission Statement is shown below:

MISSION STATEMENT

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

Additional detail for carrying out the mission is described in the Program's solution principles and objectives. The solution principles offer broad policy guidance, while the objectives are more technical in nature. The solution principles guide the Program to develop solutions that meet these criteria:

- Affordable
- Equitable
- Implementable
- Durable
- Reduce conflicts in the System
- No significant redirected impacts

The solution principles will continue to be refined.

Section 2
Summary of Problems and Objectives

When state and federal agencies signed a framework agreement in the summer of 1994, pledging cooperation in solving problems of the Bay-Delta system, four critical resources areas were identified.

Therefore, the CALFED Bay-Delta Program developed problem and objective statements for each of the four areas - ecosystem quality, water supply reliability, water quality, and system vulnerability. While these four areas represent interrelated components of the Bay-Delta system, grouping problems and objectives in these categories begins to establish the increasing level of detail for understanding the problems and objectives.

The appendix to this document contains detailed problem and objective statements for each of the four resource areas presented in outline form. The narrative summaries presented below were developed in response to comments that the detailed problem statements and objective statements for each of the four areas were too long and "sterile" to provide a casual reader with a feel for the problem. Furthermore, these narratives were developed to introduce the aspect of linkages between the four resource areas.

Ecosystem Quality

Problem

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. Much of the public focus on ecosystem problems has centered on fisheries, especially those populations which have been designated as threatened or endangered under Federal and State laws. Declining fish populations and endangered species designations have generated major conflicts among beneficial uses of water in the Bay-Delta system. The underlying problems, however, are much broader and more far-reaching than a decline in fish. 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 effect of hydraulic mining was twofold. First, habitat degradation occurred in Central Valley streams as channel beds and shallow areas filled with sediment. Then 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 inundated 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 muted 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 unnatural 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 exacerbate the impacts from overall 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 selenium 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.

Objective

The primary Program objective for ecosystem quality is to improve and increase aquatic and terrestrial habitats and improve ecological functions in the Bay-Delta system to support sustainable populations of diverse and valuable plant and animal species. Important habitat types include shallow water, shaded riverine aquatic, tidal slough, brackish and freshwater marsh, and riparian woodland. These habitats provide essential areas for activities that include breeding, foraging, resting, avoiding predators, and overwintering.

Linkages

The decline of species dependent on the Bay-Delta system for all or part of their life cycle now results in considerable conflict among beneficial uses of the Delta and highlights the urgent need for resolution and restoration. Key issues which affect ecosystem quality are water export, outflow, levee and channel maintenance, and other nonflow related issues. Ecosystem quality can be restored or improved through changes in export timing and the method(s) of export. Enhanced flexibility in diversion and export activities can contribute significantly to restoration of beneficial flow patterns. If additional water supplies are developed in an environmentally sensitive manner or water needs are reduced, more functional Delta outflow can be provided. Improvement in levee maintenance and stabilization can be achieved by incorporating habitat restoration on or in levees and channels into future actions. If the conflicts over levee maintenance versus habitat could be addressed, levees could be rebuilt or improved using sound levee stabilization techniques which incorporate waterside berms that provide habitat elements such as shaded riverine aquatic and riparian. Additional habitat restoration could also be accomplished during efforts to address Delta island subsidence.

Water Supply Reliability

Problem

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 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 which could vary in length from days to several months.

Objective

The primary objective for water supply reliability is to reduce the mismatch between Bay-

Delta water supplies and current and projected beneficial uses dependent on the Bay-Delta system. This can be accomplished by reducing the conflict among beneficial water uses, improving the ability to transport water through the Bay-Delta system, and reducing the uncertainty of supplies from the Bay-Delta system. The mismatch between supplies and projected beneficial uses needs to be addressed for both the short and long-term planning horizons. The mismatch can be addressed from both the supply and demand sides. Flexibility in the transport of water across the Delta needs to be enhanced so that all of the water management tools, including demand management, water transfer, and supply augmentation, are available to the water service agencies to match quantity and timing of supply with beneficial use patterns. Steps also need to be taken to more effectively manage the risk associated with catastrophic failure of the Delta water transport system.

Linkages

A critical issue which affects water supply reliability is the impact of water supply diversions on the ecosystem, especially endangered species. Therefore, water supply reliability can be improved by actions which recover and protect endangered species. By reducing the conflict between the ecosystem and water diversions, the opportunities to transport water through the Delta can be increased. This reduction in conflict will create flexibility to more effectively use water supplies through water management programs such as water transfers (e.g. drought year transfers) and augmentation of water supply. Supply augmentation actions may consist of conjunctive use, coordinated operation of existing reservoirs, developing surface and groundwater storage programs, developing storage capabilities within the Delta, development of groundwater resources, and water reclamation.

Water management programs that alter the timing of Delta inflow can produce synergistic benefits, providing Delta inflow when it is beneficial to Delta aquatic habitat and improving water quality in Delta channels . Similarly, water management programs that provide opportunities to alter timing of Delta outflow can benefit Suisun Bay and San Francisco Bay while at the same time providing opportunities for additional water supply transport across the Delta. This can reduce conflict among beneficial uses and provide benefits for the ecosystem and for water supply reliability. In order to effectively reduce the conflict between ecosystem water needs and other beneficial uses of water dependent on the Bay-Delta system, water management programs may need to include elements to reduce or manage demand, improve Delta water transport capabilities, and reduce the risk to the transport system from catastrophic failure.

Water Quality

Problem

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.

Pollutants 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 a variety of sources and pose both human health and treatment-related concerns.

Objective

The primary objective for water quality in the Bay-Delta system is to provide good quality water for all beneficial uses. In this context, the term "beneficial uses" covers a wide range of water uses and includes fish and wildlife use, municipal and industrial use, agricultural use, recreational use, and other uses. In most cases, the specific water quality objectives for the various beneficial uses relate to reducing constituent levels. In other cases, the specific objective is to better manage water quality through a variety of measures including minimizing the cost of treating the source waters.

Linkages

The quantity and timing of the water flowing into and out of the Delta directly affects water quality in the Bay-Delta system. Quantity and timing are functions of the natural runoff patterns, changes in land and water use, operations of upstream water projects, diversions (upstream and in-Delta), and exports from the Delta. Thus, any modification to system operations to improve ecosystem quality or to reduce the conflict between ecosystem and water supply, will directly affect water quality for specific beneficial uses, either positively or negatively. Similarly, modifications to system operations to improve water quality will directly affect water supply reliability. This linkage is especially apparent in some reaches of the San Joaquin River within the Delta. While managing and improving water quality is a primary objective of the CALFED Bay-Delta Program, the achievement of the key specific water quality objectives is closely linked to objectives for ecosystem quality and water supply reliability.

System Vulnerability

Problem

Levees were first constructed in the Sacramento-San Joaquin Delta during the late 1800s, when settlers began to turn tidal marshes into agricultural land. Over time, both natural settling of the levees and shallow subsidence of Delta island soils (oxidation which lowers the level of the land over time) resulted in a need to increase levee heights to maintain protection. There is a growing concern that this increased height, coupled with poor levee construction and inadequate maintenance, makes Delta levees vulnerable to failure, especially during earthquakes or floods. Failure of Delta levees can result in flooding of Delta island farmland and wildlife habitat. If a flooded island is not repaired and drained, the resulting large body of open water can expose adjacent islands to increased wave action and possible levee erosion. Levee failure on specific islands can have impacts on water supply distribution systems such as the Mokelumne Aqueduct. Similarly, levee failure on key Delta islands can draw salty water up into the Delta, as water from downstream rushed to fill the breached island. This would be of particular concern in a low water year when less freshwater would be available to repel the incoming salt water. Such a failure could result in a long interruption of water supply for in-Delta and export use by both urban and agricultural users, until the salt water could be flushed from the Delta. Long-term flooding of key Delta islands can also have an effect on water quality by changing the rate and area of the mixing zone.

Local reclamation districts are concerned with the cost of maintaining and improving the levee and channel system. The complex array of agencies with planning, regulatory, and/or permitting authorities over levees makes rehabilitation and maintenance efforts difficult. Regulatory measures which protect endangered species or critical habitat sometimes conflict with and prolong levee rehabilitation and maintenance work, which can further increase the vulnerability of the system.

Objective

The primary program objective for addressing Bay-Delta system vulnerability is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees. The vulnerability of the levee system to both general failure and sudden catastrophic failure can be reduced by implementing an integrated and comprehensive program for Delta levees and channels. This plan would need to streamline and consolidate the planning, regulatory, and permitting processes which affect the system, and provide a reliable funding source for system maintenance and rehabilitation.

Linkages

An important aspect of reducing risk and making the system less vulnerable to failure will be to reduce the conflict between protection of wildlife habitat that occurs on levees, and maintenance of these levees to prevent failure. Riparian woodland, shaded riverine aquatic, and shallow water habitats are very important for fish and wildlife in the Delta, including threatened and endangered species. In many cases, objectives of reducing risk of catastrophic failure and protection of ecosystem quality can be achieved by incorporating habitat restoration and protection elements in levee system stabilization actions. Conversely, projects to restore or enhance habitat can achieve multiple objectives if they are planned with levee vulnerability in mind. A second critical linkage can occur between efforts to reduce or reverse subsidence and efforts to restore habitat. Both the Delta ecosystem (including the aquatic habitat and the terrestrial habitat found on the levees and inside the islands) and system stability can benefit from reducing land surface subsidence adjacent to the levees. This achievement of multiple objectives can occur where levee stabilization is proposed and where habitat enhancement (riverine and riparian) is proposed. For example, one method to reduce subsidence, the creation of shallow wetlands adjacent to the land side toe of the levee, also serves to enhance habitat.

Section 3
Geographic Scope

The appropriate scope of analysis and action for the CALFED Bay-Delta Program (**Program**) is a crucial program element that required the early attention of the Program Team and the Bay-Delta Advisory Council (BDAC). A conceptual version of the more comprehensive "geographic scope" presented in the following sections was first introduced at the BDAC meeting held on June 29, 1995. The following form has evolved through the discussions and modifications provided at three public workshops and an equal number of BDAC meetings. This level of public review was solicited because the Program Team believes that an appropriate geographic and issue scope is essential to the success of the Program. A scope that is too narrow, while expedient, may result in issues not being addressed in a comprehensive fashion. A scope that is too large may result in an overly complex planning process causing difficulty in developing implementable solutions.

The approach which has evolved through both technical and public forum discussions is a tiered geographic scope focusing on the Bay-Delta system for purposes of problem definition, while allowing solution generation from a much broader area. The specifics of the geographic scope which has been adopted by the CALFED Bay-Delta Program are presented in the following narrative.

Geographic and Issue Scope for Problems

The geographic scope for the CALFED Bay-Delta Program will consist of the legally defined Delta, Suisun Bay (extending to the Carquinez Strait) and Suisun Marsh. For purposes of this discussion paper this geographic area will be called the "Bay-Delta System" or the "Bay-Delta."

The Program proposes to address problems which are manifest in or closely linked to the Suisun Bay/Suisun Marsh and Delta area. However, the scope of possible solutions to these problems may encompass any action which can be implemented by the CALFED agencies or can be influenced by them to address the identified problems, regardless of whether its implementation takes place within the Delta/Suisun Bay/Suisun Marsh area (see figure 1).

Any problem currently associated with (1) the management and control of water or (2) the beneficial use of water within the Bay-Delta[1] (including both environmental and economic uses) is within the purview of the CALFED Bay-Delta Program provided that at least part of the problem is manifested within the Bay-Delta or is directly associated with conditions within the Bay- Delta. This general definition can be further illustrated by two general (and overlapping) perspectives: (1)

[1] The California Code of Regulations, Title 23, Sections 660 - 674, lists a number of beneficial uses of water in California. Beneficial uses which are relevant to the identification of Delta problems are: Domestic Uses; Irrigation Uses; Municipal Use; Industrial Use; Fish and Wildlife Preservation and Enhancement Use; Aquaculture Use; Recreational Use; Water Quality Use; and Heat Control Use.

the Bay-Delta as a region in its own right; and (2) the Bay-Delta as one piece of a complex and interconnected water/biological system. Examining each perspective in turn:

> The Bay-Delta as a region in its own right. Viewed without reference to the outside world, the Bay-Delta has numerous characteristics, and many of the problems associated with these characteristics fall under the aegis of the Program. For example, the problems associated with fish and wildlife habitat, providing flood protection for land use/farming, providing for continuing recreation, protecting resident fish, plant and wildlife species, protecting In-Delta municipal and industrial water uses, and protecting Delta infrastructure are all manifested within the Bay-Delta and therefore are part of the problem scope.

> The Bay-Delta as one piece of an interconnected water/biological system. Many things, from water and water quality constituents on to fish and birds, move across the boundaries of the Bay-Delta, whether into the Bay-Delta, out of the Bay-Delta, or across the Bay-Delta. Problems which are identified with these various "inputs" and "outputs" fall under the aegis of the Program, provided that at least part of each problem is manifested in the Bay-Delta or is directly associated with conditions within the Bay-Delta.

During the BDAC and Public review period this approach to problem scope raised some issues relating to the specific treatment of problems associated with San Francisco Bay. These issues revolve around whether the Program will address (1) interactions between the Delta and San Francisco Bay such as flow or sediment and (2) export and diversion service area water management (e.g., water conservation). As explained earlier, the Program will address such problems with respect to San Francisco Bay, by examining the "inputs" and "outputs," from the Bay-Delta problem area. Thus, under the adopted approach "outputs" such as flow or sediments needed to protect the rest of the Bay are within the scope of the Program. However, problems which originate outside the problem area such as toxic discharges into the South Bay are not. With respect to water management, the output of water from the problem area through diversions has been identified as a problem. Consequently, part of the solution to that problem may be changes in the way water is managed (i.e. demand management, alternative supply development, etc.).

Further examples of Bay-Delta inputs and outputs which are either manifested in, or directly associated with the Bay-Delta and which may trigger the identification of a problem within the purview of the Program include:

INPUTS

- Inflow patterns
- Toxic inflows
- Salinity inflows
- Nutrient inflows
- In-migrating fish
- In-migrating birds
- Temperature inflows

OUTPUTS

- Delta outflow patterns
- Toxic outflows
- Salinity outflows
- Nutrient outflows
- Out-migrating fish
- Out-migrating birds
- Temperature outflows
- Water diversion patterns
- Water quality constituents in diversions
- Entrainment of biota in diversions

The following examples of problems-which would be outside the purview of the CALFED Bay-Delta Program because they fail to qualify as either manifest in, or directly associated with the Bay-Delta -may help further clarify the adopted definition:

- Problems caused by discharges from wastewater treatment plants in the South Bay.
- Land subsidence in the Central Valley.
- Populations of fish in reservoirs outside the Bay-Delta.

Geographic and Issue Scope for Solutions

In contrast to the PROBLEM SCOPE, which excludes problems not manifested within or directly associated with the Bay-Delta, the SOLUTION SCOPE is quite broad, potentially including any action which could help solve identified problems. Thus, the geographical scope for solutions may expand to include at least the Central Valley watershed, the Southern California water system service area, and the portions of the Pacific Ocean out to the Farallone Islands.

An expanded solution scope is necessary because many problems related to the Bay-Delta are caused by factors outside the Bay-Delta. Moreover, an expanded solution scope is desirable from a planning point of view because more benefits may be generated at lower cost if solutions are not limited to the geographic Bay-Delta. For example, the problem of salmon populations is linked to the Bay-Delta because of high salmon mortality during salmon migrations. However, the broader problem of salmon populations goes far beyond the Bay-Delta. One solution action might be to reduce salmon mortality during salmon migration through the Bay-Delta. However, it might be less expensive or ecologically preferable to combine that action with an effort to promote greater salmon production upstream.

Similarly, if water-borne organic carbon generated within the Bay-Delta is deemed to be a problem because it may form carcinogens during water treatment processes, one solution action might be to reduce the production of organic carbon within the Bay-Delta or to shift the diversion point. Alternatively, water exporters may be able to improve water quality in a more cost-effective or ecologically preferable manner through new treatment technologies or a combination of those two actions.

Solution Priorities

The Program cannot fully solve every problem within its purview. Therefore, the Program will assign priorities to various problems and give highest priority to problems (as defined above) which are acute, of broad concern, closely related to the Delta as a region or as an element in an interconnected water/biological system, and which have solutions which are implementable by the CALFED agencies. Other problems will receive lower priority.

For example, the Bay-Delta is an ecological zone of major importance and a major element in an interconnected biological system (e.g., it is a migration corridor). Therefore, the problem of the Bay-Delta's environmental health, including inputs to and outputs from the Bay-Delta, will receive high priority. Similarly, the Bay-Delta is a key element in the water supply system and consequently, problems with unsatisfactory water diversion patterns (volume and quality) will also receive high priority.

Dealing with the Impacts of Possible Solutions

The Program is charged with developing solutions to a number of identified Bay-Delta problems. Each possible solution to Bay-Delta problems, in turn, may have additional impacts, both within and outside the Bay-Delta (whether positive or negative). The Program will analyze carefully the possible negative impacts of various Bay-Delta solutions as part of the environmental review process and will take those impacts into consideration in the development of viable alternatives. Where impacts remain, the Program will develop mitigation measures as required by the environmental review process. A key solution principle which will be followed is that solution alternatives cannot create significant negative redirected impacts. That is, when the benefits and impacts of the solution alternatives are examined in their entirety the balance must be positive for all of the interests depending upon the Bay-Delta system resources.

Integration with Other Processes

The CALFED Bay-Delta Program is not operating in isolation. Numerous other programs already exist to address some of the problems and solutions within the purview of the Program, particularly in the upstream areas. The Program will assess the degree to which existing processes are successfully dealing with problems from the perspective of the Program. Where existing processes are adequate, the Program may establish a linkage between the existing process and the proposed solution alternatives. Where existing processes are inadequate because of lack of funding or other institutional constraints, the Program may need to include recommendations to improve existing processes, include new actions in its various alternatives, or mobilize the CALFED agencies to advance the existing processes. In this way, the CALFED Bay-Delta Program will provide a framework that facilitates the coordination of new and existing programs so as to achieve a comprehensive and lasting solution.

Section 4
Level of Detail

The level of detail is an important determination of the problem definition step. The level of detail determines the depth and complexity for analyzing problems and evaluating solutions. Too much focus on highly detailed problems and solutions will result in costly analyses and delay progress towards solutions. Too little detail in the analysis will result in insufficient distinctions between potential actions, limiting the ability to select effective solutions.

Accordingly, the level of detail of analysis must match the level of detail of the current planning phase. During Phase 1 (developing a short list of promising alternatives), analyses will focus on the primary and secondary level problems and corresponding objectives. Therefore, potential actions will be defined in broad, conceptual detail. The following example shows the planned level of detail for Phase 1:

- One potential action to address a problem may be to increase the amount of high quality shaded riverine habitat. This potential solution would be described to show the general location and approximate range of habitat acreages to be added. For example, provide 5,000 to 10,000 acres of new shaded riverine habitat on central and eastern Delta islands. Details on specific islands and quantity would not be provided in this level of detail.

- Another potential action to address a different problem may be to provide additional water storage in the system. This potential solution would be described to show the general location and approximate range of size for the storage. For example, provide 100,000 to 200,000 acre-feet of additional off-channel storage north of he Delta. Details on specific projects would not be provided in this level of detail.

As the Program proceeds through Phases 1, 2, & 3, increasing detail will be developed to define the specifics of potential solutions. During Phase 1, the focus will be on the broad problems described in each resource area and conceptual (or program level) actions to address these problems.

Section 5
Process to Develop Problem Definitions

The CALFED Bay-Delta Program has conducted an extensive, collaborative process to develop the problem definition. This section describes the activities to date.

Review work Products of Bay-Delta Oversight Council. The Program staff reviewed briefing papers prepared by the Bay-Delta Oversight Council (BDOC) and initial reports prepared by the five BDOC technical advisory committees. The bibliography contains a listing of these briefing papers and initial reports.

Review Existing Problem Statements and Objectives. The Program staff collected and reviewed problem statements from previous planning efforts related to the Bay-Delta system. Staff also reviewed problem statements as identified by major California interest groups concerned about the Bay-Delta. These problem and objective statements were considered and incorporated into the problems and objectives for the CALFED Bay-Delta Program. For the most part, all of the significant problems and concerns identified in previous efforts can be found in the problem definition for this Program.

The programs and materials reviewed (CALFED, August 31, 1995) include the following activities and organizations:

- Association of California Water Agencies
- Bay-Delta Oversight Council
- California Farm Bureau
- California State Association of Counties
- California Water 2000
- Central Valley Habitat Joint Venture
- Committee for Water Policy Consensus
- Delta Protection Commission
- League of California Cities
- League of Women Voters
- Metropolitan Water District of Southern California
- Northern California Water Association
- Restoring the Bay
- San Francisco Estuary Project
- Sierra Club
- Southern California Water Committee
- Stakeholders Group Matrix Group
- State Water Contractors
- Three Way Process

Public Workshops. Two public workshops relating to problems and objectives were conducted in Sacramento (August 3 and September 14, 1995). The first workshop was a brainstorming effort to identify problems of concern to interested parties (about 100 participants). The information packet (CALFED, July 20, 1995) for the first workshop described the overall approach to developing a short list of promising alternatives and the role of the problem definition step. The pre-workshop packet was distributed to approximately 300 people interested in attending the workshop. Following the workshop, a summary (CALFED, August 9, 1995) of the problems and issues was prepared. Many of the problems raised by participants were more accurately categorized as causes of problems in the Delta. These causes were recorded in the workshop summary for review during identification of potential actions.

Prior to the second workshop, the workshop summary and draft problem and objectives statements (CALFED, September 1, 1995) were distributed to the Program mailing list (approximately 400 people). The second workshop (90 participants) focused on reviewing and refining the problem statements prepared by staff from the literature review and first workshop. Following the second workshop, a workshop summary (CALFED, September 29, 1995) was prepared to document the comments and suggestions from the participants. The information packet (CALFED, October 2, 1995) for the third public workshop contained revised problem and objective statements. These incorporated workshop and written comments. The information packet (CALFED, November 20, 1995) for the fourth public workshop contained narrative summary statements of problems and objectives.

Agency Review. Draft problem statements were circulated for review by staff of the CALFED agencies on two occasions. Preliminary drafts were circulated following the first workshop, before public distribution. Revised drafts were circulated after incorporating comments from the second workshop. Additional comments from CALFED agency staff were incorporated after the third workshop.

BDAC Meetings. Members of the Bay-Delta Advisory Council have received all drafts of the problem definitions and workshop materials. BDAC members reviewed problem definitions and approved the Program's mission statement and primary objectives.

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APPENDIX
PROBLEM STATEMENTS

PROBLEM AND OBJECTIVE STATEMENTS

The CALFED Bay-Delta Program will develop a long-term comprehensive plan to solve problems in the Bay-Delta system related to four resource areas: ecosystem quality, water supply reliability, water quality, and vulnerability of Bay-Delta system functions. Problems and Program objectives related to each of these resource areas are listed below.

Ecosystem Quality

Introduction

Problems of the Bay-Delta System related to ecosystem quality are expressed primarily in terms of the inadequacy of aquatic and wetland habitats. This emphasis on habitat reflects an ecosystem approach to problem-solving. An ecosystem approach entails addressing the underlying causes of ecosystem degradation through protecting, enhancing, and restoring important habitats.

Limitations in Delta habitat affect species in various ways. Some species reside in San Francisco Bay as adults and use Delta habitats for spawning and juvenile rearing (e.g. longfin smelt). Other species (e.g. salmonids) spawn upstream of the Delta and reside as adults in the Pacific Ocean but must travel through the Delta and Bay during juvenile outmigration and adult inmigration. The size and health species populations and species communities residing in the Bay-Delta system will be used as indicators to judge the success of the CALFED Bay-Delta Program in resolving habitat problems. If habitat problems are correctly identified and Program objectives are met, the result should be an increase in the size and health of species populations. For example, recovery of populations of resident species such as delta smelt and anadromous species such as chinook salmon that use the Delta would indicate that improvements to Delta habitats had been successful.

Problem Statements

Many of the plant and animal species that use the Bay-Delta have experienced moderate to severe declines. The Bay-Delta ecosystem does not now contain the amount or quality of habitat needed to support a diverse assemblage of valuable plant and animal species. The major problems for the Bay-Delta's fish and wildlife and the aquatic and wetland habitats that support them are outlined below. Important species of fish, animals, plants, and other life-forms are identified in the problem statements as examples of the organisms adversely affected by the named habitat problems.

A. **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. The problems for specific aquatic habitats include:

1. **Lack of Shallow Riverine Habitat** limits spawning success and early survival of many estuarine and anadromous fish in the estuary. Examples of affected species include Sacramento splittail, chinook salmon, striped bass, delta smelt, and American shad.

    a. **Lack of Riverine Edge Habitats** limits spawning success and survival of juveniles of many fish species that use such habitats for spawning and rearing (e.g. Sacramento splittail, delta smelt, largemouth bass, and chinook salmon).

    b. **Lack of Shallow Shoal Habitat** within the main channels of the Delta and upper Bay limits shallow foraging habitat and protective cover for juveniles of many estuarine fish (e.g. Sacramento splittail, striped bass, delta smelt, longfin smelt, starry flounder, and white sturgeon).

2. **Lack of Shaded Riverine Habitat** limits growth and survival of estuarine resident and anadromous fish in the estuary (e.g. Sacramento splittail, chinook salmon, and tule perch).

    a. **Lack of Riparian Woodland** limits cover and terrestrial food production for Delta fish.

    b. **Lack of Large, Woody Debris** along Delta levees limits feeding and refuge habitat for juvenile and adult fish in the Delta.

    c. **Lack of Shaded Habitat** results in elevated water temperatures.

3. **Reduced Quality of Tidal Slough Habitat** limits the aquatic resource production capacity of the Delta (e.g. delta smelt, chinook salmon, striped bass, Sacramento splittail, tule perch, and copepods).

    a. **Degradation of Dead-End Slough Habitat** reduces areas available for spawning and rearing of some native resident fish species.

b. **Abundant Water Hyacinth** may limit productivity of tidal slough habitats.

c. **Primary Biological Production** during tidal cycling is limited by lack of tidal slough habitat.

4. **Springtime Upstream Relocation of Estuary Entrapment/Null Zone Habitat** by low Delta outflow limits the availability of suitable rearing habitat in the estuary (e.g. delta smelt, longfin smelt, and striped bass).

a. **Saltwater Intrusion into Suisun Bay** reduces the bay's value as a low-salinity nursery area.

b. **Low Salinity (less than 10 ppt) Habitat** is confined to deeper channels in the Western Delta where it is of limited value as compared to Suisun Bay.

c. **Brackish Water (1 to 25 ppt) Habitat** occurs less frequently in San Pablo Bay with reductions in Delta outflow during the winter and spring which may limit production of bay species such as bay shrimp, starry flounder, Pacific herring, and dungeness crab.

5. **Reduced and Altered Transport Flows** hinder successful movement of larval and juvenile fish from spawning habitats to nursery habitats in the Delta and Bay (e.g. longfin smelt, striped bass, chinook salmon, and Sacramento splittail).

a. **Reduced Transport of Young Fish from the Delta to Suisun Bay** nursery areas because of low Delta outflow reduces growth, survival, and abundance of important estuarine fish (e.g. striped bass and delta smelt).

b. **Reduced Transport of Young Fish through the Delta** to the ocean limits survival and abundance of estuarine and anadromous fish (e.g. chinook salmon, steelhead, and American shad).

c. **Increased Transport of Young Fish from North to South across the Delta** and direct entrainment of fish because of high export-to-inflow ratios reduces survival and abundance of estuarine and anadromous fish (e.g. chinook salmon, delta smelt, striped bass, steelhead, and American shad).

d. **Local Structures** block and alter transport flows and increase predation rates (e.g. chinook salmon).

6. **Altered Migratory Cues** disrupt upstream and downstream movement of anadromous and estuarine fish (e.g. chinook salmon, steelhead, and white sturgeon).

    a. **Upstream Migration of Adult Salmonids through the Delta is Disrupted** by lack of olfactory cues caused by export of spawning-river water in and above the Delta.

    b. **Outmigration of Juvenile Fish through the Delta is Hindered** by net downstream flow cues toward South Delta export pumps (e.g. delta smelt, striped bass, American shad, and Sacramento splittail).

    c. **Upstream Migration of Adult Estuarine Fish into Delta and River Spawning Areas is Hindered** by altered net flow of water across the Delta.

7. **Reduced Food Web Productivity** in aquatic habitats limits forage availability for fish species (e.g. delta smelt, longfin smelt, Sacramento splittail, chinook salmon, striped bass, starry flounder, bay shrimp, and neomysis).

    a. **Entrainment of Food Productivity** by diversions limits habitat suitability for desirable fish species.

    b. **High Concentrations of Toxicants** in the water column and in sediments reduces production and survival of aquatic plants and invertebrates.

    c. **Introduced Species** compete for food and habitat space with desirable species.

    d. **Reduced Residence Time of Water** in Delta channels limits plankton blooms.

    e. **Reduction in Nutrient Inputs** from wetland and riparian habitats limits aquatic productivity.

    f. **High Salinity Levels** in Delta aquatic habitats limit seasonal productivity patterns of estuarine food-chain organisms.

g. **Reduction and Seasonal Shift of Freshwater Inflow to the Delta** directly limits primary and secondary productivity of the estuary during critical periods.

8. **Excessive Concentrations of Toxic Constituents and their Bioaccumulation** directly limits survival and growth of desirable fish, wildlife, and other species (e.g. delta smelt, longfin smelt, Sacramento splittail, chinook salmon, striped bass, starry flounder, rails, avocets, grebes).

a. **Excessive Pesticide Residues** directly affect some fish and wildlife species.

b. **Excessive Hydrocarbons, Heavy Metals, and other Pollutants** directly harm some fish and wildlife species.

B. **Important Wetland Habitats** are inadequate to support production and survival of wildlife species in the Bay-Delta system. The problems for the specific wetland habitats include:

1. **Lack of Brackish Tidal Marsh Habitats** of high quality limits supportable populations of wildlife species that inhabit them (e.g. Suisun Slough thistle, Suisun song sparrow, and snowy egret).

a. **Altered Vegetation Composition** in brackish marshes caused by changes in salinity levels limits habitat suitability for some species.

b. **Reduced Areal Extent and Patchiness** of brackish marsh limits wildlife populations and genetic exchange.

c. **Disconnection of Supporting Habitats** such as aquatic habitats and riparian woodlands and adjacent uplands limits productivity in brackish marshes.

2. **Lack of Freshwater Habitats** of high quality limits supportable populations of native plant and wildlife species (e.g. giant garter snake, tri-colored blackbird, and Mason's lilaeopsis).

a. **Inappropriate Increased Salinity Levels** do not support desirable vegetation composition and thereby limit habitat suitability for some species.

b. **Reduced Areal Extent** of high quality freshwater marsh habitats does not support sustainable populations sizes of some wildlife species.

c. **Lack of connection between** freshwater marsh habitats does not provide corridors for population movement and genetic exchange.

d. **Vulnerability of Delta Islands to Levee Failure** threatens sustainability of existing freshwater marshes.

3. **Limited Riparian Woodland Habitats** of high quality in the Delta reduce diversity and sizes of supportable native wildlife populations (e.g. Swainson's hawk, riparian brush rabbit, western yellow-billed cuckoo, neotropical migrant songbirds, and northern California black walnut).

a. **Lack of Riparian Habitat Structure** near foraging areas limits nesting opportunities for some native bird species.

b. **Fragmentation** of riparian habitat does not provide corridors for population movement and genetic exchange.

c. **Limited Areal Extent** of riparian habitats prevents use by some native bird species.

d. **Disconnection of Supporting Habitats** such as aquatic habitats and brackish marshes limits productivity in riparian woodlands.

4. **Reduced Breeding Waterfowl Habitats** limit production of desired populations of dabbling ducks (e.g. mallard, cinnamon teal, and wood duck).

a. **Lack of Brood Habitat** of high quality near nesting habitat limits dabbling duck production.

b. **Lack of Nesting Habitat** of high quality near brood habitat limits dabbling duck production.

5. **Reduction in Wintering Wildlife Habitats** for foraging and resting limits desired populations of wintering waterfowl (e.g. Aleutian Canada goose, mallard, tundra swan, white-fronted goose and shore birds).

a. **Decreasing Waste Grain** on agricultural lands limits availability of wildlife forage.

b. **Lack of Resting Areas** near foraging areas limits wintering wildlife populations that can be supported in the Delta.

c. **Reduction in Historical Foraging Habitats** (e.g. freshwater marsh and brackish water marsh) limits availability of high quality foraging areas for wintering wildlife.

d. **Vulnerability of Delta Islands to levee Failure** threatens sustainability of some wintering wildlife habitats.

6. **Lack of Managed Permanent Pasture Habitat** limits wintering crane populations (e.g. lesser sandhill crane, greater sandhill crane).

a. **Lack of Foraging Habitats** of high quality for cranes in proximity to roosting habitats limits supportable wintering populations.

b. **Lack of Roosting Habitats** of high quality for cranes in proximity to foraging habitats limits supportable wintering populations.

7. **Restricted Flood Plains and Associated Riparian Habitat** of sufficient size and high quality in the Delta reduce the diversity and sizes of fish and wildlife populations.

a. **Lack of Suitable Flood Plains** reduces the availability of temporarily flooded spawning habitat for fish such as the Sacramento splittail.

b. **Narrow Restricted Channels** increase the risk of levee failure and subsequent catastrophic losses of wildlife habitat protected by these levees.

C. **Populations of some species of plants and animals** dependent on the Delta have declined.

1. **Many species in the Bay-Delta system** have declined to the point that they are threatened, endangered, or species of special concern.

2. **Many species of economic importance** that are dependent on the Bay-Delta system have declined.

3. **Some prey or food species** dependent on the Bay-Delta system have declined to the point that they no longer adequately support populations of predator species.

Ecosystem Quality Objectives

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. **Improve and Increase Aquatic Habitats** so that they can support the sustainable production and survival of native and other desirable estuarine and anadromous fish in the estuary.

1. **Increase Amount of High Quality Shallow Riverine Habitat** to allow sustainable fish spawning and early rearing.

    a. **Increase Amount of Quality Riverine Edge Habitat** to allow spawning and rearing by sustainable populations of native fish species.

    b. **Increase Amount of Quality Shallow Shoal Habitat** within the main channels of the Delta and upper Bay to allow shallow foraging by sustainable populations of juvenile estuarine fish.

2. **Increase Amount of High Quality Shaded Riverine Habitat** to allow the growth and survival of sustainable populations of estuarine resident and anadromous fish in the estuary.

    a. **Increase Amount of Quality Riparian Woodland Habitat** to allow production of terrestrial food sufficient to support sustainable populations of resident and anadromous fish.

    b. **Increase Amount of Large, Woody Debris** along Delta levees to allow juvenile and adult feeding and refuge for sustainable populations of fish.

    c. **Increase Amount of Shaded Riverine Habitat** to provide for localized temperature reduction.

3. **Increase Amount of Quality Tidal Slough Habitat** containing emergent and submerged vegetation to support the fish production capacity of the Delta.

    a. **Increase Amount of Dead-End Slough Habitat** to allow spawning and rearing of sustainable populations of some resident species.

    b. **Reduce Water Hyacinth** populations in tidal slough habitats to improve habitat quality for sustainable populations of Delta fish.

c. **Increase Amount of High Quality Tidal Slough Habitat** to allow increased primary biological production.

4. **Increase Amount of High Quality Estuary Entrapment/Null Zone Habitat** to support sustainable fish populations in the Bay-Delta system.

   a. **Reduce Saltwater Intrusion** into Suisun Bay to increase the nursery area for sustainable populations of plants and animals.

   b. **Expand** the geographic extent of **Low Salinity Habitat** in Suisun Bay.

   c. **Increase** the occurrence of **Brackish Water Habitat** in San Pablo Bay during the winter and spring to support sustainable populations of Bay species.

5. **Provide Sufficient Transport Flows** at the proper times to move eggs, larvae, and juvenile fish from spawning habitats to nursery habitats in the Delta and Bay.

   a. **Increase the Transport of Young Fish from the Delta to Suisun Bay** nursery areas to support sustainable populations of important estuarine species.

   b. **Increase the Transport of Young Fish Through the Delta** to the ocean to support sustainable populations of estuarine and anadromous fish species.

   c. **Reduce the Transport of Young Fish from North to South across the Delta** and the entrainment of fish in the Delta to increase the survival and abundance of estuarine and anadromous species.

   d. **Reduce the Blockage of and Alterations to Transport Flows** by local structures.

6. **Reestablish Appropriate upstream and downstream movement** of anadromous and estuarine fish.

   a. **Enhance Upstream Migration of Adult Salmonids** through the Delta.

   b. **Increase Successful Outmigration of Juvenile Fish** through the Delta.

c. **Enhance Upstream Migration of Adult Estuarine Fish** into the Delta and river spawning areas.

7. **Improve the Productivity of the Bay-Delta Aquatic Habitat Food Web** to support sustainable populations of desirable fish (and other) species.

   a. **Reduce Entrainment** of biological productivity throughout the aquatic food web.

   b. **Reduce Concentrations of Toxicants** in the water column and in sediments.

   c. **Reduce the Effects of Introduced Species** on ecosystem productivity and in competing with desirable species for habitat.

   d. **Increase the Residence Time of Water in Delta Channels** to increase plankton productivity and reduce undesirable algal-mat growth in the Delta.

   e. **Increase the Input of Nutrients** from wetland and riparian habitats to aquatic habitats.

   f. **Reduce Salinity Levels** in Delta aquatic habitats.

   g. **Increase Flows of Freshwater** into the estuary.

8. **Reduce Concentrations of Toxic Constituents and Their Bioaccumulation** to eliminate their adverse effects on populations of fish and wildlife species.

   a. **Reduce the Concentrations of Pesticide Residues** in Bay-Delta system water and sediments.

   b. **Reduce the Concentrations of Hydrocarbons, Heavy Metals, and other Pollutants** in Bay-Delta system water and sediments.

B. **Improve and Increase Important Wetland Habitats** so that they can support the sustainable production and survival of wildlife species.

1. **Increase the Amount of High Quality Brackish Tidal Marsh Habitat** in the Bay-Delta system to better support sustainable populations of native wildlife species.

   a. **Modify salinity levels in Brackish Tidal Marshes** to improve their vegetation composition.

   b. **Increase the Areal Extent** of brackish tidal marsh habitats.

   c. **Improve the Connectivity** between brackish tidal marsh habitats and their supporting habitats such as aquatic habitats and riparian woodlands and adjacent uplands.

2. **Increase the Amount of High Quality Freshwater Marsh Habitat** to better support sustainable populations of native wildlife species in the Delta.

   a. **Restore Appropriate Salinity Levels** in freshwater marsh habitat in the Delta to enhance forage productivity and habitat suitability for some native species.

   b. **Increase the Areal Extent** of freshwater marsh habitats.

   c. **Improve the Connectivity** among freshwater marsh habitats to provide corridors for population movement and genetic exchange for dependent species.

   d. **Reduce the Vulnerability** of existing freshwater marshes to levee failure.

3. **Increase the Amount of High Quality Riparian Woodland Habitat** in the Delta to better support sustainable populations of native wildlife populations.

   a. **Increase Amounts of Riparian Habitat Structure** for nesting near foraging areas for some native bird species.

   b. **Reduce the Fragmentation** of riparian woodland habitat patches to provide corridors for population movement and genetic exchange for dependent species.

   c. **Increase the Areal Extent** of riparian woodland habitats.

d. **Improve the Connectivity** between riparian woodlands and their supporting habitats such as aquatic habitats and brackish marsh habitats.

4. **Increase the Amount of Breeding Waterfowl Habitat** to better support sustainable populations of dabbling ducks.

   a. **Increase the Amount of High Quality Brood Habitat** near nesting habitat for dabbling ducks.

   b. **Increase the Amount of High Quality Nesting Habitat** near brood habitat for dabbling ducks.

5. **Increase the Amount of Wintering Wildlife Habitat** for foraging and resting to better support sustainable populations of wintering waterfowl.

   a. **Increase** supplies of suitable forage such as **Waste Grain** on agricultural lands.

   b. **Increase** the amount of **Resting Areas** near foraging areas for wintering wildlife.

   c. **Increase** the amount of high quality **Foraging Areas** (e.g. freshwater marsh and brackish water marsh) for wintering wildlife.

   d. **Reduce the Vulnerability** of some existing wintering wildlife habitats to levee failures.

6. **Increase the Amount of Managed Permanent Pasture Habitat for** to better support wintering crane populations.

   a. **Increase** the amount of **Foraging Habitat** in proximity to roosting habitat.

   b. **Increase** the amount of **Roosting Habitat** in proximity to foraging habitat.

7. **Increase Flood Plains and Associated Riparian Habitat** to improve diversity and sizes of fish and wildlife populations.

   a. **Increase** suitable flood plains to improve the availability of **Temporary Flooded Spawning Habitat** for fish.

b. Improve narrow restricted channels to **Reduce the Risk of Catastrophic Losses** of wildlife habitat from levee failure.

C. **Increase population health and population size** of Delta species to levels that assure sustained survival.

1. **Contribute to the recovery** of threatened, endangered or species of special concern.

2. **Increase populations** of economically important species.

3. **Increase populations** of prey or food species.

Water Supply Reliability

Introduction

The problems of water supply associated with the Bay-Delta system can be divided into three basic categories: conflict among beneficial uses, economic impact, and Water Quality (Water Quality Problems are described separately). If there were no conflict among competing beneficial uses, only hydrology would constrain exports or out-of-stream uses. The identified problems can be measured in two ways: adequacy of supply and predictability of supply. In turn, shortfalls or uncertainty are manifest in economic impacts.

The adequacy of a supply is the degree to which supply and demand are matched. There is a mismatch between Bay-Delta water supply quantities and current demand patterns. With a growing population as well as a growing recognition of the water needed to sustain the biological resources of the Bay-Delta, it has become clear that water supplies are not adequate to meet existing and projected demands, particularly in times of drought. Mismatches between supply and demand generally cause problems, both for water users and the environment.

The predictability of a supply is the degree to which we can accurately predict supply or supply patterns in the future. Unpredictable supplies cause problems because they increase the likelihood that we will either overinvest in water supply (e.g., build unnecessary storage), under invest in production (e.g., plant too few acres) or suffer unacceptable shortages. Delta water supplies are dependent upon California's highly variable rain and snowmelt runoff, tempered to some extent by groundwater and reservoir storage. The timing, amount, and form (rain or snow) of precipitation from year to year is unpredictable, although historical data and seasonal runoff forecasts provide some guidance for water users.

Problems with adequacy and predictability can be viewed from either planning or operational perspectives. An operational perspective looks at current water conditions and tries to project water supply patterns in the short-term (days, weeks, months, possibly years). A planning perspective does not look at current conditions, but attempts to define the water supply patterns that can be expected in the future over the long-term.

Finally, different end users use water differently. What is a problem for one user may not be a problem for another user. Thus, the various users of water must be considered separately. For example, urban and agricultural water users want supplies which are relatively consistent, year after year. By contrast, the environment requires variations in flows from year to year. Too many high flow or low flow years are undesirable. Each of these beneficial uses require water of adequate quality, which differs for each use. Delta levees, combined with fresh water inflow, repel the brackish water from the Bay. In general, these levees are fragile and vulnerable to failure, thus increasing the vulnerability of water supplies dependent upon the Delta.

To summarize, water supplies in the Bay-Delta system are inadequate and unpredictable, in the short term and over the long term, to meet the existing and future needs of in-Delta uses, export uses, and the environment.

Problem Statements

There is a mismatch between Bay-Delta water supplies and current and projected levels of beneficial use dependent on the Bay-Delta system. As in-stream and out-of-stream water needs have grown, water shortages for all the uses have become larger and more frequent and water supplies have grown less predictable. This water reliability problem is projected to become more acute over time.

A. **Water supplies of the Bay-Delta system do not meet needs**, because of conflict among beneficial uses, and because of system inadequacies.

   1. **Bay-Delta system supplies do not meet** existing and future short-term and long-term **in-Delta beneficial use needs**.

      a. **In-Delta short-term water supplies** in some locations **do not meet needs** during water short periods for the following two users:

         1. Lowered water levels limit access to water for **agricultural water needs** during some periods.

         2. Water supply and timing do not meet short-term **environmental water needs** (see Ecosystem Quality section).

      b. **Bay-Delta system water supplies** in some locations **are inadequate to meet projected long-term in-Delta needs** for the following three users:

         1. Lowered water levels limit access to water for long-term **agricultural water needs**.

         2. Water supply and timing do not meet long-term **municipal and industrial water needs**.

         3. Water supply and timing do not meet long-term **environmental water needs** (see Ecosystem Quality section).

2. **Bay-Delta system export water supply and timing do not meet existing and future short-term and long-term needs,** and the opportunities for transporting additional water across the Delta are limited.

   a. **Short-term export water supplies do not meet needs** for the following three users:

      1. Water supply and timing for export do not meet short-term **agricultural water needs.**

      2. Water supply and timing for export do not meet short-term **municipal and industrial water needs**.

      3. Water supply and timing for export do not meet short-term **environmental water needs** (see Ecosystem Quality section).

   b. **Bay-Delta system water supplies are inadequate to meet projected long-term export water needs** for the following three users:

      1. Water supply and timing for export do not meet long-term **agricultural water needs**.

      2. Water supply and timing for export do not meet long-term **municipal and industrial water needs**.

      3. Water supply and timing for export do not meet long-term **environmental water needs** (see Ecosystem Quality section).

3. **Available water does not meet short-term and long-term expected needs for Delta outflow** (see Ecosystem Quality and Water Quality sections).

B. **Bay-Delta system water supplies are uncertain** with respect to short-term and long-term needs.

1. The water supply in and from the Bay-Delta system is unreliable due to the **vulnerability of the levees** that protect the Delta water transport system. (See Vulnerability of Delta Functions Section).

2. The water supply available from the Bay-Delta system from season to season and from year to year **cannot be predicted** with desired certainty.

a. The water supply available from the Bay-Delta system over the **short-term** cannot be predicted with sufficient certainty for the following three water users:

1. **Agricultural water suppliers** cannot plan and manage for efficient water use due to the unpredictability of the water supply available in the coming season.

2. **Municipal and Industrial water suppliers** must plan and manage for possible interruption of water supplies.

3. **Environmental water** users cannot plan and manage for efficient water use due to the unpredictability of the water supply available in the coming season (see Ecosystem Quality section).

b. The water supply available from the Bay-Delta system over the **long-term** cannot be predicted with sufficient certainty for the following three water users:

1. Long-term regional planning for **agricultural water supply** cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply.

2. Long-term regional planning for **municipal and industrial water supply** cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply.

3. Long-term regional planning for **environmental water** supply cannot be conducted with sufficient certainty due to the unpredictability of available Bay-Delta system water supply (see Ecosystem Quality section).

Water Supply Objectives

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

A. **Reduce the conflict among beneficial water users** and **improve the ability to transport water** through the Bay-Delta system.

1. **Maintain adequate Bay-Delta system supplies to meet the existing and future short- and long-term in-Delta beneficial use needs.**

   a. Maintain or provide adequate **in-Delta short-term water supplies** in water short periods for the following two users:

      1. Improve access to water for short-term expected **agricultural water needs**.

      2. Provide water supply and timing that meet short-term expected **environmental water needs** (see Ecosystem Quality section).

   b. Maintain or improve the adequacy of Bay-Delta system water supplies to meet **long-term** needs of in-Delta beneficial uses for the following three users:

      1. Improve access to water for long-term **agricultural water needs**.

      2. Maintain adequate water supply and timing meet long-term expected **municipal and industrial water demands**.

      3. Provide adequate supply and timing that meet long-term expected **environmental water demands** (see Ecosystem Quality section).

2. **Improve Bay-Delta system export water supply and timing to help meet reasonable existing and future short-term and long-term needs.**

   a. Improve **short-term export water supplies** during water short periods for the following three users:

      1. Water supply and timing for export to help meet short-term **agricultural water needs**.

2. Water supply and timing for export to help meet short-term **municipal and industrial water needs**.

3. Water supply and timing for export to help meet short-term **environmental water needs** (see Ecosystem Quality section).

b. Provide Bay-Delta water supplies that are adequate to help meet **long-term export water projections** of beneficial use need for the following three users:

1. Water supply and timing for export to help meet long-term **agricultural water needs**.

2. Water supply and timing for export to help meet long-term **municipal and industrial water needs**.

3. Water supply and timing for export to help meet long-term **environmental water needs** (see Ecosystem Quality section).

3. Improve the adequacy of Bay-Delta water to meet short-and long-term expected needs for **Delta outflow** (see Ecosystem Quality section).

B. **Reduce the uncertainty of Bay-Delta system water supplies** to help meet short- and long-term needs as shown below:

1. Improve the reliability of the Bay-Delta system by reducing the **vulnerability of the levees** that protect it (see Vulnerability of Delta Functions Section).

2. **Improve the Predictability** of the water supply available from the Bay-Delta system from season to season and from year to year.

a. Improve the predictability of the water supply available from the Bay-Delta system over the **short-term** for the following three water users:

1. Improve predictability for **agricultural water supplies** for planning and management for efficient water use in the coming season.

2. Improve predictability for **municipal and industrial water** supplies for planning and management for efficient water use in the coming season.

3. Improve predictability for **environmental water supplies** for planning and management for efficient water use in the coming season (see Ecosystem Quality section).

b. Improve the predictability of the water supplies available from the Bay-Delta system over the **long-term** for the following three water users:

   1. Improve long-term predictability for **agricultural water supplies.**

   2. Improve long-term predictability for **municipal and industrial water supplies.**

   3. Improve long-term predictability for **environmental water supplies** (see Ecosystem Quality section).

Water Quality

Introduction

The quality of water in the Bay-Delta System is vital to the economy of California. The Delta is a source of drinking water for millions of Californians, and is a critical to the state's business and agricultural sectors. Yet, despite progress water quality issues remain a concern in the estuary. In addition to the pollutants entering the system, the presence of both organic carbon and salts in the waters of the estuary are of concern. These salts, entering the estuary through the Bay and ocean, decrease the utility of Delta waters for most purposes. Agricultural use of water exported to the San Joaquin Valley concentrates salts and returns them to the estuary as agricultural drainage.

Issues of human health exist regarding the waters of the Bay-Delta System. The level of organic carbon in the water (thought mainly to result from the process of plant decay on many of the Delta's peat soil islands) is of concern because of the way organic carbon reacts with treatment chemicals in the process of treating drinking water. Potentially harmful "by-products" are created in this process, which in turn must be treated by water providers in order to achieve safe drinking water. Contaminants are found at high enough levels in some fish and wildlife species (such as mercury in striped bass) that public health warnings have been issued concerning public consumption of certain species.

Problem Statements

Water quality problem statements are developed around five beneficial use categories. These categories represent the primary beneficial uses requiring improved water quality from the Delta: drinking water, agriculture, industry, recreation, and ecosystems. **Drinking water** quality problem statements are tied to health effects, aesthetics, treatment costs and difficulty, and federal and state drinking water regulations. **Agricultural water quality** problem statements relate to economic productivity, crop choice, and operational difficulties. **Industrial water quality** problem statements relate to treatment and production costs and operational difficulties. **Recreational water quality** problem statements relate to health risk and aesthetics. **Ecosystem water quality** problems are addressed under Ecosystem Quality. The major problems can be categorized as follows:

A. Water quality is often inadequate or is perceived as inadequate for **Drinking Water needs.**

   1. Certain water quality parameters present in Delta water have or may have **Adverse Human Health Effects**.

   2. Certain water quality parameters present in Delta water have or may have **Adverse Aesthetic Effects**, in particular concerning taste, odor, and appearance.

3. Levels of certain water quality contaminants may increase the **Cost of Treating** Delta water in order to meet the existing drinking water quality standards.

4. **Fluctuating Raw Water Quality** increases the difficulty of water treatment plant operations.

5. **Stricter Future Regulations** may be difficult to meet with the existing treatment techniques and raw water quality.

B. Delta water quality is often inadequate for **Agricultural** needs.

1. Certain water quality contaminants may reduce **Agricultural Economic Productivity** by reducing crop productivity, the choice of suitable crops, or by increasing costs.

2. Certain water quality contaminants such as sediments may result in **Operational Difficulties**.

C. Delta water quality is often inadequate for some **Industrial** needs.

1. Certain water quality contaminants may increase **Cost of Treatment and Production** for industrial users or even prevent user from discharging effluent.

2. **Fluctuation of Raw Water Quality** increases the difficulty of plant operation for industrial users.

D. Delta water quality is often inadequate for water **Recreational** needs.

1. Certain water quality contaminants may pose an **Increased Health Risk** to recreationists.

   a. **Body Contact Recreational Activities** in the Delta may increase the risk of exposure to contaminants.

   b. **Consuming Fish** caught in the Delta may increase the risk of exposure to contaminants.

2. Certain water quality parameters may adversely impact **Aesthetic Conditions** in the Delta, in particular taste, odor and appearance.

E. Water quality is often inadequate for **Environmental** needs for the Bay-Delta system. (see Ecosystem Quality)

Water Quality Objectives

Provide good water quality for all beneficial uses.

A. Provide good water quality in Delta water exported for **Drinking Water** needs.

1. **Reduce** the level of water quality parameters of **Concern to Human Health** in water supply or treat to reduce concern.

2. **Reduce** the water quality parameters that cause **Aesthetic Effects**, in particular concerning taste, odor and appearance in water supply.

3. **Minimize the Cost of Treating** Delta water and continue to meet the existing drinking water quality standards.

4. **Minimize the Fluctuation of Raw Water Quality** to improve water treatment plant operation.

5. **Improve Raw Water Quality** and/or treatment to comply with stricter future drinking water regulations.

B. Provide good Delta water quality for **Agricultural** use.

1. Improve or manage water quality to **Maintain or Improve Agricultural Economic productivity** by reducing water quality contaminants that reduce crop productivity on lands receiving Delta water, reduce cropping choices, or increase costs.

2. Improve water quality or recommend change in irrigation technology to **Minimize Operational Difficulties**.

C. Provide good Delta water quality for **Industrial** use.

1. **Reduce Industrial Treatment and/or Production Costs**.

2. **Minimize the Fluctuation of Raw Water Quality** to improve industrial plant operations.

D. Provide good Delta water quality for water **Recreational** use within the Delta.

1. **Reduce Health Risk** to recreationists.

a. **Reduce Health Risk Associated with Body Contact** recreational activities.

b. **Reduce Health Risk Associated with Consuming Fish** caught in the Delta.

2. **Improve Aesthetic Conditions** in the Delta, in particular taste, odor and appearance.

E. Provide improved Delta water quality for Environmental needs. (see Ecosystem Quality)

Bay-Delta System Vulnerability

Introduction

The Bay-Delta system is vulnerable to levee failure and the resulting inundation of agricultural lands, infrastructure, and wildlife habitat. Inundation of one or more islands in the Delta would disrupt farming operations and other land uses either permanently or for a significant period of time until repairs could be made. Inundation of roads, electric power lines, telephone lines, gas mains, and other infrastructure would cause lengthy breaks in service. Several State highways and many Delta roads run along levees that are vulnerable to collapse due to erosion, seismic events or structural failure. Major water pipelines also pass through the Delta and are at risk of failure. Even if they survive the initial effects of inundations, long-term inundation would make continued maintenance and repair much more difficult.

Inundation of one or more key islands in the western and central Delta would allow salinity to intrude further into the Delta. In addition, inundation of any Delta island during low flow periods would allow salinity to intrude further into the Delta. This salinity intrusion would degrade water quality and result in a need to halt in-Delta use as well as export pumping, perhaps for extended periods. In order to lower salinity in the Delta to acceptable levels again, flushing flows would need to be released from upstream reservoirs. Stored water supplies in these reservoirs could be seriously depleted.

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.

Problem Statements

Many of the "problems" commonly listed for the vulnerability of Bay-Delta system functions are actually causes of problems. For example, poor levee construction, inadequate maintenance, the lowering of the islands due to subsidence, levee instability, and lack of resistance to earthquake and floods are causes of the problems tied to levee failure. There are four major problems for the vulnerability of Bay-Delta system functions due to potential failure of Delta levees and inundation of islands: loss of land use, infrastructure and associated economies; damage to wildlife habitat; interruption of water supply; and reduction in Delta water quality. The problems can be categorized as follows:

A. **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.

   1. **Reduction of Agricultural Productivity and Damage to Infrastructure** can result from seepage, and overtopping of the levees.

2. **Long-term Loss of Agricultural Productivity and Infrastructure** can result from catastrophic island inundation.

B. **Water Supply Facilities and Operations** in the Delta are at Risk from Increased Salinity Intrusion, which can result from Sudden Catastrophic Inundation of Delta Islands.

1. **In-Delta water supply** can be interrupted as a result from catastrophic island inundation and resultant salinity intrusion. (See Water Supply Problem Statement.)

2. **Export water supply** can be interrupted as a result from catastrophic island inundation and resultant salinity intrusion. (See Water Supply Problem Statement).

C. **Water Quality** in the Delta is at Risk from Increased Salinity Intrusion which can result from Sudden Catastrophic Inundation of Delta Islands.

1. Water quality for some **In-Delta beneficial uses** can be degraded as a result of catastrophic island inundation and resultant salinity intrusion. (See Water Quality Problem Statement).

2. Water quality for **export water supply** can be degraded as a result of catastrophic island inundation and resultant salinity intrusion. (See Water Quality Problem Statement).

D. 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.

1. **Reduction of Ecosystem Productivity** and damage to valuable habitat can result from seepage, erosion, and overtopping of levees.

2. **Long-term loss of valuable Aquatic and Terrestrial habitat** can result from catastrophic island inundation and resultant salinity intrusion.

Bay-Delta System Vulnerability -- Objectives

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

A. **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.

   1. **Manage the risk of reduction of agricultural productivity and damage to infrastructure** from seepage and overtopping of the levees. **Manage subsidence** of the Delta island peat soils and foundations which places additional pressure on surrounding levees and increases the risk of failure.

   2. **Manage the risk of long-term loss of agricultural productivity and infrastructure** which can result from sudden catastrophic inundation.

B. **Manage the risk to water supply facilities and operations** in the Delta from catastrophic inundation of Delta islands.

   1. **Manage the risk of interruption of in-Delta water supply** which can result from sudden catastrophic island inundation and the resultant salinity intrusion. (See Water Supply Objective Statement).

   2. **Manage the risk of interruption of export water supply** which can result from sudden catastrophic island inundation and the resultant salinity intrusion. (See Water Supply Objective Statement).

C. **Manage the risk to water quality** in the Delta from catastrophic inundation of Delta islands.

   1. **Manage the risk of degradation of in-Delta water quality** which can result from sudden catastrophic island inundation and the resultant salinity intrusion. (See Water Quality Objective Statement).

   2. **Manage the risk of degradation of export water supply** which can result from sudden catastrophic island inundation and the resultant salinity intrusion. (See Water Quality Objective Statement).

D. **Manage the risk to existing Delta ecosystem** from gradual deterioration of Delta conveyance and flood control facilities and catastrophic inundation of Delta islands.

1. **Manage the risk of reduction of ecosystem productivity and damage to valuable habitat** which can result from seepage, erosion, and overtopping of levees. **Manage subsidence** of the Delta island peat soils and foundations providing this ecosystem productivity which places additional pressure on surrounding levees and increases the risk of failure.

2. **Manage the risk of long-term loss of valuable aquatic and terrestrial habitat** which can result from sudden catastrophic inundation and the resultant salinity intrusion.