

Long-Term Levee Protection Plan

**Early Review Draft
9/30/98**

**Revised Draft
Programmatic EIS/EIR
September 1998**



**CALFED
BAY-DELTA
PROGRAM**

***Long-Term Levee Protection Plan
Early Review Draft
September 30, 1998***

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



CALFED
BAY-DELTA
PROGRAM

CALFED BAY-DELTA PROGRAM LONG-TERM LEVEE PROTECTION PLAN

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DELTA LEVEE SYSTEM INTEGRITY PROGRAM

Early Review Draft

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Foreword

The Delta Levee System Integrity Program, like all components of the CALFED Bay-Delta Program, is being developed and evaluated at a programmatic level. The complex and comprehensive nature of a Bay-Delta solution requires implementing many different programs and activities over time. Solution alternatives will be evaluated as sets of programs and activities in order to identify broad benefits and impacts. More focused analysis and environmental documentation of specific programs and actions will occur in subsequent refinement efforts.

EXECUTIVE SUMMARY

This Long-Term Levee Protection Plan is an appendix to the Draft Programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the CALFED Bay-Delta Program (CALFED). The document outlines a long-term strategy to reduce the risk to land use and associated economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees. To achieve this and other CALFED objectives, in addition to meeting CALFED solution principles, Delta levees generally must remain in their current configuration.

The benefits of an improved Delta levee system include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and flood control benefits. The wide range of beneficiaries of the Delta Levee System Integrity Program (Levee Program) include Delta local agencies; landowners; farmers; boaters; wildlife; and operators of railroads, state highways, utilities, and water distribution facilities. Delta water users and exporters also benefit from increased protection to water quality. Federal interests benefit from improvements to navigation, commerce, and the environment and from reduced flood drainage.

Recognizing these potential benefits, state and local agencies formed a partnership to reconstruct Delta levees. This effort has resulted in a steady improvement in the Delta levee system. The success of the Delta in the 1997 and 1998 flood events illustrates the value of approximately \$100 million of improvements made with Senate Bill (SB) 34 funds and over \$10 million in emergency Public Law (PL) 84-99 work performed by the U.S. Army Corps of Engineers (Corps). These funds, in addition to local funds, have resulted in over \$160 million in improvements to Delta levees since the SB 34 program's inception in 1988. Staff from the

California Department of Water Resources (DWR), California Department of Fish and Game, and many local agencies have worked together to successfully implement the existing levee program under SB 34 and Assembly Bill (AB) 360. In addition to managing over \$100 million in levee funds, SB 34 and AB 360 program staff have developed and implemented a supply depot in the Delta for quick deployment of emergency materials, developed and began implementation of 32,000 lineal feet of new wildlife habitat, advanced subsidence control including new levee designs and monitoring techniques, coordinated beneficial reuse of dredged material projects, and continued to advance solutions to the numerous complexities related to flood control and habitat creation in the Delta's environmentally sensitive ecosystem. These efforts represent a positive first step in meeting the long-term CALFED objectives.

However, much more remains to be done, including:

- Improving levees to a higher standard,
- Developing adequate and reliable funding,
- Addressing permit issues to enable expanded dredging and beneficial reuse of dredged material,
- Incorporating habitat enhancements into Levee Program actions,
- Further improving existing emergency response capabilities,
- Improving permit coordination,
- Expanding subsidence control, and

- Continuing to quantify seismic risk and implementing appropriate risk management strategies.

CALFED provides a unique opportunity for federal, state, and local agencies to jointly address these needs. Existing Delta levee system problems and solution strategies proposed by CALFED are outlined below.

Many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. The existing levee program was intended to improve Delta levees up to the Federal Emergency Management Act (FEMA) Hazard Mitigation Plan (HMP) standard. For the most part, that goal was achieved. Because the FEMA standard will not assure success of the Levee Program objectives, a stricter standard is needed.

The Levee Program will institute a cost-shared program to reconstruct Delta levees to the Corps PL 84-99 Delta Specific Standard. Requirements of this standard exceed those of the HMP standard and are commensurate with the beneficial uses most levees protect. The Levee Program will provide additional flood protection for key Delta levees that protect public benefits of statewide significance.

Funding for levee work is insufficient, inconsistent, and often delayed. Under the existing State levee programs, local districts have financed projects in anticipation of reimbursements. The Delta Levees Maintenance Subventions Program (Subventions Program) annually administers available funds, distributing funds on an equal basis to all participants in accordance with funding priorities approved by The Reclamation Board. Each fiscal year, districts are notified of the available funding but cannot be sure what their final reimbursement will be until all claims are received and processed. The Delta Levees Special Project Program (Special Projects Program) receives applications and enters into agreements with participants to fund specific projects. Projects eligible for funding must be in accordance with

priorities approved by the California Water Commission. Once projects are deemed eligible, agreements are executed and districts can receive payments as work progresses. The lack of adequate and consistent appropriations in the Subventions and Special Projects Programs poses a challenge for local agencies to complete planned maintenance and rehabilitation projects.

Many districts have experienced difficulty in rebounding from the long-term financial debt that was incurred while they waited for resolution of the 1980-1986 state and federal disaster assistance claims. The more recent 1995, 1997, and 1998 floods also have strained local financial resources. The overall financial health of these districts has significantly affected their ability to maintain their levee systems and limited their ability to upgrade their levees to a long-term levee standard. The Levee Program will secure federal cost-sharing for Levee Program actions. The Corps "Delta Special Study" will be used to establish a federal interest and subsequent federal funding. The Levee Program goal will be to establish consistent adequate funding for the Subventions Program that will enable districts to plan and finance their work with greater certainty of reimbursement.

Dredging to increase channel capacity and to provide material for levee reconstruction and subsidence control has been drastically curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta. Regulatory agencies severely limit dredging in the Delta due to water quality and endangered species concerns. Because insufficient data is available to quantify impacts and establish acceptable dredging criteria, the agencies regulate dredging activities more conservatively. Lack of a General Order for Waste Discharge Requirements (WDRs) complicates the permitting process.

CALFED will work with the Regional Water Quality Control Board (RWQCB) and the Corps to develop a Regional Dredged Material Management Plan and General Order for WDRs.

Existing emergency response capabilities need to be continuously refined and funding increased. The existing emergency response system has been improving over the past several years. DWR continues to work with other emergency response organizations to improve the emergency response system. However, the system is limited by insufficient dedicated funding. Command and control procedures also need to be continuously improved using adaptive management principles.

The continuous refinement of the existing emergency response plan is a cornerstone of the Levee Program. CALFED will work to:

- Establish a \$10 million Emergency Response Revolving Fund,
- Improve existing command and control systems,
- Collect and strategically place flood-fighting materials,
- Develop criteria that trigger asset deployment,
- Establish standardized contracts, and
- Identify post-flood recovery measures.

A natural by-product of the Levee Program is the establishment of resident heavy equipment such as cranes and barges necessary for effective emergency response.

Levee reconstruction and maintenance often conflicts with management of terrestrial and aquatic habitat resources on or around levees. In general, vegetation on levees results in more difficult levee maintenance. Stakeholders have voiced concern that activities to control levee and channel vegetation are often delayed because of potential impacts on endangered species habitat. Because levee districts often maintain unvegetated levee slopes to avoid the need to contend with endangered species requirements, potential opportunities for quality habitat are

lost. Better strategies are needed to allow quality habitat to flourish on or around levees without hampering levee maintenance and construction.

CALFED will establish existing environmental baseline values on or around levees. When reconstructing levees, mitigation and enhancement of existing habitat must be relocated outside the minimum section required for levee integrity (structural cross section) of the levee when possible. CALFED will work to establish a conservation strategy that encourages levee managers to allow critical habitat to grow on levees while enabling levee managers to maintain the levee.

Obtaining permits for levee work can be difficult and time consuming. Historically, obtaining permits for levee work has been difficult. In 1996, the California Department of Fish and Game (DFG) assumed a more active role in assisting levee districts with the regulatory process. This participation is a significant improvement and should continue. However, other regulatory agencies often lack sufficient resources to issue permits without delays. In addition, disagreements exist between regulatory agencies with overlapping jurisdiction. A more efficient permit coordination process is needed.

To ensure successful implementation of all CALFED programs, a coordinated permit process will be established. The process will anticipate the numerous permit requirements for actions approved as part of CALFED. Coordinated permitting will not result in relaxation of permitting requirements but will include information sharing among regulatory agencies to streamline the permitting process. It is expected that the coordinated permit process and framework will include (1) a permit assistance team to aid project proponents in understanding and obtaining required permits, (2) a regulatory permit review team dedicated to CALFED projects, and (3) a regulatory steering review team. The regulatory team (comprised of agencies responsible for permitting) would expedite review of environmental documentation, provide close interagency coordination, and

develop mitigation measures and monitoring requirements. The permit coordination framework also would be designed to address broad issues in order to improve the efficiency of such processes as general and regional permits and mitigation banks.

Subsidence of portions of some Delta islands threatens levee integrity. Subsidence near some levees in the Delta may adversely affect levee integrity. The Subsidence Subteam considers that subsidence can be corrected and levee integrity assured. However, a grant program is recommended to develop new methods that are more effective and less intrusive to current use. Oxidation of deep, highly organic peat soils can be corrected by constructing landside berms or covering peat soil with a thin layer of mineral soil. Dredge material is a good source of mineral soil, with the added benefit of increasing channel capacity. Areas around levees with deep, highly organic peat soils should be monitored even after treatment to identify further treatment needs.

Seismic loading threatens Delta levees. Earthquakes pose a catastrophic threat to Delta levees. Seismic forces can cause multiple levee failures in a short time. Such a catastrophe could overwhelm the current emergency response system.

The Seismic Risk Assessment Subteam quantified the seismic risk to Delta levees and developed several risk management options for inclusion into the CALFED Preferred Alternative. The subteam considers that proper implementation of the available risk management options can address the seismic risk. Seismic risk assessment also will require continued monitoring and analysis. The available risk management options include:

- Improving emergency response capabilities,
- Developing storage south of the Delta,
- Reducing the fragility of the levees,
- Improving through-Delta conveyance,

- Releasing more water stored north of the Delta,
- Curtailing Delta diversions, and
- Constructing an isolated facility.

The final Risk Management Plan will include one or more of these options.

In summary, this report concludes that an effective strategy can be implemented to achieve the Levee Program objective and is indeed necessary to facilitate all CALFED objectives. The Long-Term Levee Protection Plan would be implemented over a 30-year period and cost approximately \$1.5 billion.

TABLE OF CONTENTS

SECTION	PAGE
Executive Summary	ES-1
GLOSSARY	vi
LIST OF ACRONYMS	ix
WHAT'S NEW IN THE LONG-TERM LEVEE PROTECTION PLAN?	xi
CONSOLIDATED RESPONSE TO COMMENTS	xii
Long-Term Levee Protection Plan	1
INTRODUCTION	1
DELTA AND LEVEE BACKGROUND INFORMATION	2
CURRENT DEFICIENCIES	3
Delta Levee System Integrity - Problem Statements	3
VISION	5
MISSION	5
PROGRAM ELEMENTS	6
Delta Levee Base Level Protection Plan	6
Introduction	6
Scope	7
Criteria and Project Approval	8
Agreements	9
Project Priority	9
Maintenance	9
Oversight and Inspections	10
Emergency Response	10
Delta Levee Special Improvement Projects	10
Introduction	10
Scope	11
Delta Levee Subsidence Control Plan	13
Introduction	13
Background	14
Remedial Action and Prevention	15
Current Program	15
Proposed Program	16
Delta Levee Emergency Management and Response Plan	16
Introduction	16
Background	16
Current Program	17
Proposed Program	18

TABLE OF CONTENTS (Continued)

Delta Levee Seismic Risk Assessment	19
Introduction	19
Background	19
Proposed Program	20
ECOSYSTEM RESTORATION PROGRAM/LEVEE PROGRAM	
COORDINATION	21
Current Program	21
Proposed Program	22
PERMIT COORDINATION	23
LINKAGES	25
ADAPTIVE MANAGEMENT	27
MONITORING AND RESEARCH	28
COST ESTIMATE	28
Delta Levee Base Level Protection Plan	28
Delta Levee Special Improvement Projects	29
Delta Levee Emergency Management and Response Plan	30
Delta Levee Seismic Risk Assessment	30
FUNDING	31
Delta Levee Base Level Protection Plan Funding	33
Current Funding Provisions	33
Proposed Funding Provisions	33
Delta Levee Special Improvement Project Funding	35
Current Funding Provisions	35
Proposed Funding Provisions	35
Delta Levee Subsidence Control Plan Funding	35
Current Funding Provisions	35
Proposed Funding Provisions	36
Delta Levee Emergency Management and Response Plan Funding	36
Current Funding Provisions	36
Proposed Funding Provisions	36
Delta Levee Seismic Risk Assessment Funding	36
Current Funding Provisions	36
Proposed Funding Provision	37
STAKEHOLDER/SCIENCE REVIEW	37
IMPLEMENTATION STRATEGY	38
SUISUN MARSH LEVEE SYSTEM	40
Introduction	40
Background Information	41
Cost Estimate	42
Annual Maintenance	43
Funding	43

APPENDICES

APPENDIX	PAGE
A. PL 84-99 Delta Specific Standard and PL 84-99 Overview	A-1
B. Cost Estimate Backup and Report	B-1
C. Water Code Excerpts	C-1
D. Special Projects Information Matrix	D-1
E. Subsidence Evaluation	E-1
F. Emergency Management and Response	F-1
G. Seismic Report	G-1
H. Proposals for Ecosystem Restoration	H-1

LIST OF TABLES

TABLE		PAGE
1	Chronological Summary of Events Important to the Delta	Follows text
2	Implementation Objectives, Targets, and Actions Associated with the Base Level Protection Element	7
3	Delta Levee Inventory	Follows text
4	Implementation Objectives, Targets, and Actions Associated with the Special Improvement Projects Elements	11
5	Special Projects Matrix of Objectives and Attributes	Follows 12
6	Implementation Objectives, Targets, and Actions Associated with the Subsidence Control Element	14
7	Implementation Objectives, Targets, and Actions Associated with the Emergency Management and Response Plan Element	17
8	Implementation Objectives, Targets, and Actions Associated with the Seismic Risk Assessment Element	20
9	Delta Levee Permit Coordination Issues	24
10	Proposed Levee Program 7-Year Cost Sharing	34
11	Levee System Integrity Program Proposed Cost Sharing	34
12	Composition of Levee Implementation Group	37
13	Chronological Summary of Events Important to the Suisun Marsh	41

LIST OF FIGURES

FIGURE		PAGE
1	The Legal Delta	Follows 6
2	Federal Flood Control Project Levees	Follows 7
3	Local Flood Control Non-Project Levees	Follows 7
4	Levee Standards	Follows 8
5	Possible Strategies for Levee and Habitat Improvements	Follows text
6a-6e	Selected Strategies for Levee Habitat Improvements	Follows text

GLOSSARY

The following terms are used in describing the Delta Levee System Integrity Program:

Action. A physical, operational, legal, or institutional change intended to maintain or achieve a desirable condition (target) of the Delta levee system.

Boil. A seepage exit point on the landside of the levee that is characterized by the rapid movement (boiling) of sand particles.

Channel islands. Small, unleveed land masses in Delta channels that typically provide quality wildlife habitat. Some islands are remnants of original Delta marsh lands, and others are the result of channel widening, levee construction, and dredged material disposal.

Cut-off wall. An impermeable barrier constructed through the levee to interrupt (cut off) seepage through the levee or foundation. A slurry cut-off wall is a combination of soil, cement, and bentonite (a clay material) constructed inside a trench down the center of the levee. This trench must be sufficiently deep to cut off or reduce seepage through or under the levee.

Delta. The Sacramento-San Joaquin Delta as described in the California Water Code Section 12220.

Delta islands. Islands in the Sacramento-San Joaquin Delta protected by levees. The surface of the majority of islands are below sea level and provide many benefits, including agriculture, recreation, water quality, and habitat for fish and wildlife.

Drainage blanket. A layer of crushed or rounded gravel and coarse sand, usually encapsulated in a geotextile filter fabric, that is placed on the slope and landside toe of a levee to control seepage and piping. Drainage blankets usually are placed prior to the addition of a stability berm.

Erosion. Loss of levee material due to the effects of channel flows, tidal action, boat wakes, and wind-generated waves.

Ecosystem Restoration Program Plan. A comprehensive plan for restoration and management of the Bay-Delta ecosystem, including upstream tributaries and watersheds.

Hydrostatic pressure. The pressure of water at a given depth resulting from the weight of the water above it.

Implementation objective. A description of what the program will strive to maintain or achieve for the Delta levee system that is not intended to change over the life of the program.

Levee crown. The highest, near-horizontal part of the levee between the water and landside slopes. The levee crest.

GLOSSARY (Continued)

Liquefaction. A condition in which saturated silty sands or sandy silts have no shear strength. Liquefaction occurs often when loose soils are subjected to ground shaking during an earthquake.

Local agency. Any city, county, local agency, or other political subdivision of the state that is authorized to maintain project or non-project levees.

Non-project levee. A local flood control levee in the Delta that is not a project facility under the State Water Resources Law of 1945, as shown on page 38 of DWR's "Sacramento-San Joaquin Delta Atlas," dated 1993. (See Figure 3.)

Oxidation. The conversion of organic matter (such as peat) by bacteria to carbon dioxide. The conversion is directly related to aerobic soil bacteria.

Piping. Erosion of levee or foundation material at seepage exit points. The process carries away levee material, resulting in shorter seepage paths and accelerated internal erosion of the levee.

Primary zone. The Delta land and water area of primary state concern and statewide significance that is situated within the boundaries of the Delta but not within the urban limit line or sphere of influence line of any government's general plan or currently existing studies, as of January 1, 1992 (Delta Protection Act of 1992).

Project levee. A federal flood control levee, as shown on page 40 of DWR's "Sacramento-San Joaquin Delta Atlas," dated 1993, that is a project facility under the State Water Resources Law of 1945—if not less than a majority of the acreage under the jurisdiction of the local agency that maintains the levee is within the Primary zone of the Delta, as defined in the Public Resources Code (and above). (See Figure 2.)

Seepage. The movement of water through a porous material in response to a hydraulic gradient.

Seismicity. The frequency, intensity, and distribution of earthquake activity in an area.

Setback levee. A constructed embankment that is positioned some distance from the edge of the river or channel to prevent flooding and is not in contact with the original levee. Setback levees provide area for wildlife habitat to develop and for floodflow capacity.

Settlement. A downward movement of a surface as a result of underlying soil compression or consolidation caused by an increased load or the loss of underlying soil (foundation) support.

Slope protection. Various types of materials used to protect the levee surface and stream bank adjacent to the levee from erosion.

GLOSSARY (Continued)

Stability berm. Earth fill usually placed against the levee landside slopes to act as a counterweight to prevent rotational slides.

Structural section. The minimum levee cross section required for levee integrity.

Subsidence. A decrease in ground surface elevation. Subsidence in the Delta is the result of a complex interaction of deep or large-scale processes and numerous shallow, near-surface causes.

Suisun Marsh islands. Islands in the Suisun Marsh protected by levees. The surface of the majority of islands are below sea level and provide many benefits, including recreation uses and habitat for fish and wildlife.

Target. A qualitative or quantitative statement of an implementation objective. Targets may vary as new information becomes available and according to Delta conveyance alternatives. Targets are to be set based on realistic expectations; must be balanced against other resource needs; and must be reasonable, affordable, cost effective, and practicably achievable.

Toe ditch. The open trench along the landside toe of the levee typically used to collect seepage water and distribute the water for agricultural purposes.

Toe drain. A trench along the landside toe of the levee designed to reduce saturation of the levee, control seepage, and help prevent boils. A toe drain is constructed by placing crushed rock in a trench at the landside toe of the levee. The rock is encapsulated in filter fabric that prevents levee and foundation soils from migrating into the rock.

LIST OF ACRONYMS

AB	Assembly Bill
Bay	San Francisco Bay
Base Levee Protection	Delta Levee Base Level Protection
BMPs	best management practices
Board	State Reclamation Board
CALFED	CALFED Bay-Delta Program
CMARP	Comprehensive Monitoring, Assessment, and Research Program
Corps	U.S. Army Corps of Engineers
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CVRWQCB	Central Valley Regional Water Quality Control Board
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DWR	California Department of Water Resources
EIS/EIR	Environmental Impact Statement/Environmental Impact Report
Emergency Management Plan	Delta Levee Emergency Management and Response Plan
FEMA	Federal Emergency Management Act
GIS	Geographic Information System
HMP	Hazard Mitigation Plan
LERDS	lands, easements, rights of way, relocations, and disposal areas
Levee Program	Delta Levee System Integrity Program
LIG	Levee Implementation Group
LTMS	Long-Term Management Strategy
MOU	memorandum of understanding
PL	Public Law
RWQCB	Regional Water Quality Control Board
SEMS	Standardized Emergency Management System
Special Projects	Special Delta Flood Protection Projects
SRCD	Suisun Resource Conservation District

LIST OF ACRONYMS (Continued)

Subsidence Control
Subventions Program
SWP

Delta Levee Subsidence Control Plan
Delta Levee Maintenance Subventions Program
State Water Project

WDRs

Waste Discharge Requirements

ZOI

zone of influence

WHAT'S NEW IN THE LONG-TERM LEVEE PROTECTION PLAN?

The Long-Term Levee Protection Plan continues to be improved in response to comments, studies, and research. The plan is being developed with the same Objectives, Mission, and Vision as originally established and presented in the March 1998 draft. However, much is different in this draft. The report has been reorganized. Descriptions of the Levee System Integrity Program (Levee Program) elements have been expanded. Discussions of Ecosystem Restoration Program and Levee Program coordination, linkages with other CALFED programs, and implementation have been expanded. Sections have been added on "Permit Coordination," "Adaptive Management," "Monitoring and Research," "Funding," and "Stakeholder/Science Review." CALFED has added the Suisun Marsh levee system into the Levee Program as an optional strategy to achieve its Objectives. Efforts to clarify linkages of these actions to the Objectives is ongoing. In addition, a detailed base level protection plan cost estimate has been prepared by engineers who are knowledgeable of Delta conditions.

The Base Level Protection and Special Improvement Projects sections of the plan have been revised to bring them into agreement with the existing Subventions and Special Projects Programs described in the California Water Code. The Subsidence Control element has been revised to reflect a shift in emphasis from whole island subsidence to subsidence as it affects levee integrity. The Seismic Risk Assessment element has been revised to reflect the recently completed evaluation of Delta seismicity, levee fragility, and levee system vulnerability.

CONSOLIDATED RESPONSE TO COMMENTS

Public comment on the Draft Programmatic Environmental Impact Statement/Environmental Impact Report (EIS/EIR) resulted in receiving approximately 110 comments concerning the Levee System Integrity Program in 47 different comment letters. Draft responses to all the comments have been prepared, and these comments will be provided in a separate document. The most prevalent comments were sorted, and consolidated responses are provided in the interim. The most comments, 35%, concerned impacts on flood control and hydraulic mitigation. The top six topics, accounting for 80% of the comments, include flood control, levee-ecosystem coordination, levee maintenance, land use impacts, setback levees, and subsidence. The responses are presented below roughly in order, based on topic frequency.

Impacts on Flood Control and Hydraulic Mitigation

CALFED is considering flood control issues in its decisions. Multiple flood control benefits would be generated from CALFED actions such as levee improvements, channel capacity improvements, and improved emergency response capability.

One Levee Program goal is to rehabilitate all Delta levees to the U.S. Army Corps of Engineers' (Corps') Public Law (PL) 84-99 Delta Specific Standard. Hydraulic impacts upstream and downstream of the Delta will be determined.

CALFED concurs that flood control needs must be integrated into the planning process. To this end, CALFED is coordinating with the Corps and the State Reclamation Board (Board) in their efforts on the Sacramento-San Joaquin River Basins Comprehensive Flood Control Study that currently is under way. The study area includes major tributaries into the Delta. The CALFED Program and planning efforts will be compatible with the comprehensive study.

CALFED recognizes the importance of coordinating Ecosystem Restoration Program, Levee Program, and Storage and Conveyance actions to avoid unnecessary adverse impacts. The respective program managers are coordinating their actions. Mitigation for hydraulic impacts caused by specific levee or channel upgrades will be addressed in environmental documents for individual projects.

CALFED Program Coordination

The Base Level Protection element of the Levee Program specifies that all Delta levees will be rehabilitated and maintained to at least the Corps' PL 84-99 Delta Specific Standard. The Levee Program recognizes that the Delta must remain generally in its current configuration if CALFED is to achieve its objectives for water quality, ecosystem restoration, and levee integrity.

CALFED recognizes the importance of coordinating Ecosystem Restoration Program and Levee Program actions to avoid unnecessary adverse impacts. The respective Program Managers are coordinating their actions as needed. The results of this coordination will be included in the Long-Term Levee Protection Plan, Ecosystem Restoration Program, and the Conservation Strategy. Prospective designs for Ecosystem Restoration Program/Levee Program coordination will be presented. Specific locations for their implementation will be addressed in subsequent environmental documents for individual projects.

The Long-Term Levee Protection Plan will be fully coordinated with the Ecosystem Restoration Program. Levee Program staff have made a substantial effort to coordinate with Ecosystem Restoration Program actions. The Levee Program will balance the management of environmental usage with the protection of area landowners. Levee and habitat integration concepts continually are being reviewed and revised to develop designs that will permit the levee flood control system to be operated and maintained without compromising levee integrity or harming the environment.

The Long-Term Levee Protection Plan includes a section on Ecosystem Restoration Program/Levee Program Coordination that explains the importance of Assembly Bill (AB) 360 and other statutes in ensuring that levee maintenance and reconstruction work do not conflict with ecosystem goals. The Levee Program also recognizes that an effective emergency response capability is essential to any levee program.

The revised Programmatic EIR/EIS will include a section specifically addressing Ecosystem Restoration Program/Levee Program coordination efforts.

Levee Standards and Maintenance

CALFED concurs that the rehabilitation of the Delta levee system must be an integral part of the selected preferred alternative. A basic tenant is that the Delta should generally remain in its current configuration if CALFED is to achieve its objectives. Moreover, any attempt to substantially change the current configuration would be viewed as non-implementable and therefore would not meet CALFED's solution principles. The Levee Program is one of the six common programs that would be implemented regardless of the selected preferred alternative.

Levee Program goals include obtaining sufficient reliable funding to rehabilitate and maintain all levees to the Corps' PL 84-99 Delta Specific Standard. The plan is to increase protection for islands by raising and strengthening levees and controlling subsidence, while shifting environmental enhancement responsibilities and coordination to the Ecosystem Restoration Program.

The Levee Program includes a Base Level Protection Element and a Special Improvement Projects Element. The Levee Program will build on existing levee programs identified in the California Water Code, such as the Delta Levee Subventions Program that was modified by AB 360 and the existing Special Projects Programs. The Levee Program will be consistent with

the mandates of AB 360. Under the existing levee programs, local agencies prioritize Base Level Protection projects based on their individual needs, and the California Department of Water Resources (DWR) prioritizes Special Projects based on public benefit. CALFED plans to continue this approach, as will be specified in the CALFED Implementation Strategy.

The Levee Program seeks a mechanism to provide ongoing and reliable funding. Maintenance of the Delta levees benefits the general population of California, not only the individuals who live and work in the Delta. Accordingly, the Levee Program intends to finance levee improvements and maintenance by balancing local funds with state and federal funds. In those areas covered by the Delta Levee Program, local agencies will continue to maintain the levees at their cost. Mitigation for impacts on specific structures from Levee Program actions will be addressed in the environmental documentation for individual projects, and funds for such mitigation will be part of the project costs.

Impacts on Land Use

History is the best evaluation of the sustainability of Delta levees. The current Delta Levee Subventions Program has demonstrated the long-term sustainability of the Delta and that the existing levee system can be stabilized and perform reasonably well. Over the past 10 years (1988-1998) the Delta has, with few exceptions, satisfactorily passed extremely high flood flows coupled with very low barometric pressures and high winds. Compared to the previous 10 years (1978-1988), where nearly two dozen levee breaks were observed, a trend showing significant progress emerges. CALFED's intention is to continuously improve on this successful approach.

Land acquisition needed to improve levee integrity would be minimal. The small investment in land would significantly increase the value of the land by increasing its level of flood protection, thereby justifying the small increase in benefit assessment necessary to provide operations and maintenance by the local agencies. CALFED intends to pursue easements, not fee title, whenever possible. CALFED is exploring ways to allow landowners to use the easements, such as for access roads and equipment staging areas.

All levees that would be affected under the Base Level Protection Plan, which is the largest element of the Levee Program, would be listed in the Long-Term Levee Protection Plan. The actions of the Special Projects Program are subject to periodic analysis for statewide need and therefore are difficult to predict. Actions include general levee improvement, seismic retrofitting, and subsidence correction. The Levee Program currently has no plans to replace or move any levees.

In order to develop a comprehensive Bay-Delta solution that meets the six solution principles, conversion of private land for ecosystem restoration must be based on willing sellers and must be coordinated with the Delta Protection Commission. Because land for ecosystem restoration would be acquired only from willing sellers, there is no "trade off" between ecosystem restoration

and levee maintenance. CALFED will determine what property is available from willing sellers and make choices based on their respective environmental values.

CALFED solutions should result in no significant redirected impacts. Seepage from newly created wetlands would be controlled as needed to prevent negative impacts on adjacent land use and adjacent islands. Land acquisition for Ecosystem Restoration could significantly affect benefit assessments. If the number of taxable acres is reduced to a point where operation of a reclamation district is no longer viable, this impact would be mitigated.

CALFED is pursuing opportunities to convert whole islands or large parcels to high-quality habitat. CALFED will first pursue converting public land and then acquiring private land from willing sellers. CALFED is working with the Delta Protection Commission, Delta landowners, and the Natural Heritage Institute to prepare a list of sites that include public and private land. After a comprehensive list of available land has been prepared, a cost/benefit analysis, as discussed in the Phase I Final Documentation Report, will be used to identify the best sites.

Setback Levees

The Levee Program does not propose the construction of setback levees. Levee centerline alignments may move slightly landward to accommodate levee rehabilitation to the PL 84-99 Delta Specific Standard. Setback levees may be included in the Ecosystem Restoration and Storage and Conveyance programs.

CALFED is concerned about the impacts associated with the development of setback levees. The merits and liabilities of setting back levees will be closely scrutinized. Constructing and maintaining setback levees on Delta soils containing large amounts of peat can be difficult and very costly. Therefore, use of setback levees may not be feasible in many cases. CALFED will balance the need to provide flood protection with the need to protect area landowners.

Levee Program intends to reduce the risk to land use and associated economic activities, water supply, infrastructure, and the ecosystem from catastrophic breaching of Delta levees. Improvements to levees outside the legal Delta are beyond the scope of this effort. However, the Levee Program is coordinating with the Corps and the Board in their efforts on the Sacramento-San Joaquin River Basins Comprehensive Flood Control Study that currently is under way. The comprehensive study may be a more appropriate venue to address improvements to levees outside the legal Delta.

Funding

The Levee Program goals include obtaining sufficient reliable funding to rehabilitate and maintain all levees to the Corps PL 84-99 Delta Specific Standard. In those areas covered by the Levee

Program, local agencies will continue to maintain levees at their costs. CALFED is proposing to reduce the local share of costs for levee maintenance and increase annual appropriation. This would significantly improve the local agency's ability to maintain levees, even if the number of taxable acres is reduced.

A detailed cost estimate for the Levee Program will be included in the next draft of the Long-Term Levee Protection Plan. The benefits of this work are difficult to quantify. However, CALFED has determined that regardless of the benefit to cost ratio, the work is a necessary step in the implementation of any Delta solution.

CALFED concurs that an "ability to pay" assessment is needed, similar to DWR's existing Special Projects Program. CALFED plans to add this provision to the Levee Program.

Subsidence

The Delta must stay basically in its current configuration if CALFED is to achieve its objectives for water quality, ecosystem restoration, and levee integrity. The benefits of maintaining Delta levees are far greater than the value of the privately owned land they protect. Moreover, any attempt to substantially change the configuration would be viewed as non-implementable and therefore would not meet CALFED's solution principles. Over the past 25 years, the existing levee program has demonstrated that levees in the Delta can be stabilized.

CALFED agrees that restoring elevations of subsided Delta islands would reduce the long-term vulnerability of the Delta system. In most cases, however, subsidence reversal is not implementable—due to excessive costs, right-of-way acquisition, land use conversion, and political concerns. CALFED's currently planned Levee Program implementation actions will address subsidence to improve levee integrity.

Subsidence poses a threat to only a portion of the Delta levee system. The Levee Program is addressing subsidence within the levee integrity zone of influence. The Long-Term Levee Protection Plan will identify those areas at risk and will address subsidence as it affects levee stability. Existing geotechnical engineering practices can be applied to safely and economically rehabilitate and maintain existing levees.

Ecosystem Restoration Program actions would prevent or minimize subsidence at some interior island locations. The Water Quality Program is addressing subsidence control as it affects water quality. Efforts to control subsidence would be fully coordinated, and progress in subsidence control and management would be monitored through CALFED's comprehensive monitoring, assessment, and research program (CMARP).

CALFED is very interested in developing subsidence control measures (such as no-till farming) that minimize impacts on the current land use. The Subsidence Control Element of the Levee

Program is proposing to establish a grant program to encourage the development of best management practices for controlling subsidence.

Controlling subsidence in the peat zones of the Delta by creating and flooding 20-acre habitat stewardships could be effective on some public lands but is considered impractical for private land. Flooding lands nearly stops subsidence; however, in most cases, radically changes the land use.

Seismic Risk

The Levee Program convened an expert seismic/geotechnical engineering team to investigate the seismic risk to Delta levees. The effort to quantify the seismic risk is in progress. A report should be available in fall 1998. The preliminary results indicate that the seismic risk to Delta levees is manageable. The team's report will be included in the Long-Term Levee Protection Plan and will quantify estimates of levee vulnerability. A seismic risk management strategy would be developed to address levee failures from seismic loading.

The revised Draft Programmatic EIR/EIS will include a detailed discussion of the seismic vulnerability of Delta levees prepared by an expert panel.

Dredging

CALFED acknowledges that the Levee Program and Ecosystem Restoration Program could benefit from clean dredged material, and that the Storage and Conveyance Program could benefit from dredging Delta channels to increase flow capacity. However, over the past decade it has become increasingly difficult to dredge in the Delta because of work windows to satisfy endangered species requirements and Central Valley Regional Water Quality Control Board (CVRWQCB) waste discharge concerns. CALFED is working with the CVRWQCB to establish waste discharge requirements and obtain general order permits that would allow dredging and reuse of non-saline dredged material. Presently, the use of saline dredged material in the Delta seems a remote possibility.

CALFED's need to dredge and reuse the material is clear. CALFED further agrees that potential partnership opportunities exist with bay dredgers. The Levee Program has been communicating with the Long-Term Management Strategy (LTMS) Program to identify areas where coordination between the programs would be beneficial. Linkages between the Levee Program and the LTMS Program will be discussed in the revised Draft Programmatic EIS/EIR. The availability of needed borrow or dredged material is being investigated on a programmatic level. Implementation will be analyzed on a project-specific level.

Emergency Response

The Delta Emergency Management Plan is a component of the Long-Term Levee Protection Plan. The plan builds on existing emergency management systems, identifies pre-emergency measures and post-disaster recovery measures, and enhances integration of local and regional emergency management agency actions to protect Delta resources in the event of a disaster. Local agencies are acknowledged as first in line to address disaster events. The plan focuses on local agency preparation, coordination, and responsibility to provide enhanced initial response efforts to prevent damages and to provide recovery measures. Emergency response measures will be increased as a part of an overall Risk Management Strategy.

Permit Coordination

CALFED agrees that the existing multi-layered regulatory process must be simplified and coordinated. Toward this end, CALFED is developing a Permit Coordination Program. This program will stress information sharing among permitting agencies to create a more efficient process. The program also will address broad issues to improve the efficiency of permitting, such as general and regional permits and mitigation banks. Regular meetings of senior-level staff from all regulatory agencies is an integral component of the program to coordinate permits. Levee Program permit coordination issues will be addressed under the umbrella of the CALFED Permit Coordination Program.

Total Risk Assessment

There is a need to determine the total risk to Delta levees. An evaluation of seismic vulnerability has been completed, and steps are being taken to evaluate the aggregate risk, of which the seismic vulnerability is a contributor. Until the aggregate risk is quantified, it is difficult to compare the existing risks to the alternatives. Nonetheless, CALFED proposes to deal with the risk to exports through a Risk Management Strategy that is not limited to Levee Program actions. The Draft Programmatic EIR/EIS will quantify the risk to system integrity and outline a risk management strategy. The goal of the strategy is not necessarily to guarantee system integrity but to provide the capability to quickly recover. CALFED is considering the following actions in this overall strategy: (a) improving emergency response, (b) reducing levee fragility, (c) adding south-of-Delta storage, (d) improving through-Delta conveyance, (e) adding north-of-Delta storage, (f) storing extra water upstream of the Delta to dilute or repel intruding saltwater, (g) changing SWP and CVP operations (reduce pumping), (h) temporarily changing through-Delta flow patterns, (i) constructing an isolated facility, and (j) combinations of these measures.

Boat Wakes

The Levee Program recognizes the contribution of boating wakes to erosion of levees. The relative impact depends on the size or energy of the wake, the levee's level of erosion protection, and the levee's exposure to wind-driven wave attack. Rehabilitation of levees to the PL 84-99 Delta Specific Standard should provide increased protection against the effects of boating wakes on levees. In addition, efforts to coordinate levee improvements with habitat improvements may provide improved levee integrity. For instance, the use of attached waterside berms to create shallow-water habitat will serve to dissipate the action of boating wakes on levees.

LONG-TERM LEVEE PROTECTION PLAN

INTRODUCTION

The Sacramento-San Joaquin Delta (Delta) is an area of regional and national importance. Delta levees are the most visible constructed features of the system. The levees are an integral part of the Delta landscape and are critical to preserving and improving the Delta's physical characteristics and processes, including definition of the Delta waterways and islands. To achieve objectives of the Delta Levee System Integrity Program (Levee Program) and other CALFED Bay-Delta Program (CALFED) objectives, in addition to meeting CALFED'S Solution Principles, the Delta levee system must remain generally in its current configuration.

Although the Delta levee system provides a broad array of benefits, many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. The benefits of an improved Delta levee system include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and flood control benefits. The wide range of Levee Program beneficiaries include Delta local agencies; landowners; farmers boaters; wildlife; and operators of railroads, state highways, utilities, and water distribution facilities. Delta water users and exporters also benefit from increased protection to water quality. Federal interests benefit from improvements to navigation, commerce, and the environment and from reduced flood drainage.

The vulnerability of the Delta levee system to failure, especially during earthquakes or periods of high runoff, is a common concern. A levee failure in the central or western Delta would not only flood farmland and habitat but also could disrupt or interrupt water supply deliveries to urban and agricultural users, transportation, and the regional flow of goods and services. Even if the infrastructure and facilities survived the initial effects of inundation, long-term or permanent inundation would result in maintenance and repair being difficult, if not impossible. If a flooded island is not repaired and pumped out, the resulting body of open water may expose adjacent islands to increased wave action and additional subsurface seepage.

Of particular concern is the situation in which a levee fails in a dry or critically-dry water year and one or more key western or central Delta island floods. Under these circumstances, inundation would allow salinity to intrude further upstream into the Delta. In-Delta and export water quality, along with the delicate balance of the brackish water habitat, would be negatively affected. The salinity intrusion could result in water supply interruption for in-Delta and export use by both urban and agricultural users, until the saltwater could be flushed from the Delta. In order to lower salinity in the Delta to acceptable levels and restore ecological balance, flushing flows would need to be released from upstream reservoirs. As a result, water supplies in these reservoirs could be seriously depleted, and the ability to respond to other demands would be diminished.

The above hypothetical situation has a historical counterpart. In the early morning hours of a summer day in 1972, the southern levee protecting Andrus Island gave way. Rushing water poured through the initial break, quickly widened the opening to 300 feet, and eventually to 500 feet. Within 2 hours, Highway 12 was flooded and water began spilling over into the adjacent Brannan Island. During the next 2 days, Andrus and Brannan Islands were flooded with 164,000 acre-feet of water. Federal, state, and local emergency efforts failed to protect the town of Isleton. The water that flooded these islands was not winter floodwater from the major rivers that drain the watershed tributary to the Delta. Tributary inflow to the Delta at that time was mostly storage releases from federal and state reservoirs to supplement low summer unregulated flow. This controlled inflow was not sufficient to supply the sudden draft placed on the Delta's water supply by the levee break. Saline waters rushed in from Suisun Bay to meet the remaining draft, temporarily interrupting the controlled outflow that had been forming a hydraulic barrier to protect the Delta against salinity intrusion. Both the State Water Project (SWP) and federal Central Valley Project (CVP) immediately reduced exports and increased storage releases to restore the hydraulic barrier. In the western Delta, salinity began an immediate downward trend. But in the central and southern Delta, the flushing effect was less effective, and the saltwater needed to be removed by local and export pumping, causing adverse effects on agricultural and domestic water supplies. (DWR 1982, Bulletin 192-82.)

Local reclamation districts are concerned with the cost of maintaining and improving the levee and channel system. A complex array of agencies with planning, regulatory, and permitting authorities over levees makes rehabilitation and maintenance efforts difficult. Regulatory measures that 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. CALFED's role is to reduce the existing conflicts between local agencies responsible for maintenance and regulatory agencies.

DELTA AND LEVEE BACKGROUND INFORMATION

Prior to human intervention, the Delta consisted of low-lying vegetated wetlands separated by a complex of rivers, channels, and sloughs. Along the waterways were slightly higher over-bank deposits of coarser sediments, commonly referred to as "natural levees."

The Delta was reclaimed in two phases. During the first phase (1850-1880), reclamation projects were small-scale efforts using manpower and horsepower to build levees on top of existing natural levees. In the second phase (from 1880 to the early 1900s), levee building was more aggressive and was accomplished with powerful mechanical equipment. Currently, the Delta includes over 700,000 acres, with 700 miles of meandering waterways and approximately 1,100 miles of levees.

In the early 1900s, the Reclamation Board was created and Congress authorized the CVP. The State Water Resources Development Bond Act was approved in 1960, launching the SWP. SWP facilities include levees, control structures, channel improvements, and appurtenant facilities in the Delta that are used for water conservation, water supply, cross-Delta water transfers, and flood

and salinity controls. Also in 1960, the Sacramento River Flood Control Project was completed by the Corps. This project incorporated and improved flood control for a portion of the Delta. In the 1970s, the California Legislature recognized that the Delta levee system benefits many segments and interests of the public and approved a plan to preserve the Delta levee system. In 1986, the CVP-SWP Coordinated Operation Agreement was initiated and the California Supreme Court confirmed the State Water Resources Control Board's authority and discretion over water rights and water quality issues in the Bay-Delta system, including jurisdiction over the federal CVP.

Since the late 1980s, a flurry of activity has shaped the future of the Delta. The Delta Flood Protection Act of 1988; Environmental Mitigation and Protection Requirements; the Delta Protection Act of 1992; the Central Valley Project Improvement Act (CVPIA); and the Safe, Clean, Reliable Water Supply Act were enacted. In 1994-1995, state and federal agencies entered into the historic Bay-Delta Accord, and the CALFED Bay-Delta Program "to fix the Delta" was initiated.

Table 1 (at the end of the report) provides a chronological summary of events important to the Delta.

CURRENT DEFICIENCIES

Delta Levee System Integrity - Problem Statements

The State Reclamation Board (Board) and local agencies have been in partnership to reconstruct Delta levees for over 25 years. Although significant progress has been made in improving Delta levee integrity, several problems remain. If CALFED is to achieve its objectives, these problems must be addressed. This Long-Term Levee Protection Plan develops strategies to address the following problems:

Many Delta levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect. The existing levee program was intended to improve Delta levees up to the Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan (HMP) standard. For the most part, that goal has been accomplished. Because the HMP standard will not assure success of CALFED objectives, a higher standard is needed.

Funding for levee work is insufficient, inconsistent, and often delayed. Under existing programs, local agencies must finance projects up-front and submit claims for reimbursement. Processing time for claims varies greatly as do reimbursement rates. Because funding is inconsistent, project planning by local agencies is difficult. The time lag from work completion to reimbursement poses financial difficulties for local agencies without the financial resources to provide up-front funds for an extended period. Even with reimbursements, many local districts

cannot afford their share of costs under the current cost-sharing arrangements for levee work, without the additional financial burden of proposed levee upgrades.

Dredging to increase channel capacity and to provide material for levee reconstruction and subsidence control has been drastically curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta. Regulatory agencies severely limit dredging in the Delta due to water quality and endangered species concerns. Because insufficient data are available to quantify impacts and establish acceptable dredging criteria, agencies regulate dredging activities more conservatively.

Existing emergency response capabilities need to be continuously refined and funding needs to be increased. The existing emergency response system has been improving over the past several years; however, the system is limited by insufficient dedicated funding. In addition, improvements in command and control need to be continuously improved.

Levee reconstruction and maintenance often conflicts with management of terrestrial and aquatic habitat resources on or around levees. In general, vegetation on levees results in levee maintenance being more difficult. Stakeholders have voiced concern that activities to control levee and channel vegetation sometimes are delayed because of potential impacts on endangered species habitat. Because local agencies often maintain unvegetated levee slopes to avoid the need to contend with endangered species requirements, potential opportunities for quality habitat are lost. Better strategies are needed to allow quality habitat to flourish on or around levees without hampering levee maintenance and construction.

Obtaining permits for levee work can be difficult and time consuming. Historically, obtaining permits for levee work has been difficult. In 1996, the California Department of Fish and Game (DFG) assumed a more active role in assisting local agencies with the regulatory process. This participation is a significant improvement and should continue. However, other regulatory agencies often lack sufficient resources to issue permits without delays. In addition, disagreements exist between regulatory agencies with overlapping jurisdiction. A more efficient permit coordination process is needed.

Subsidence of portions of some Delta islands threatens levee integrity. Subsidence near some levees in the Delta may adversely affect levee integrity.

Seismic loading threatens Delta levees. Earthquakes pose a catastrophic threat to Delta levees. Seismic forces can cause multiple levee failures in a short period. Such a catastrophe could overwhelm the current emergency response system.

VISION

The following is a vision of the future that represents successful implementation of the Levee Program along with other CALFED programs.

System-wide levee stability is improved because all levees meet or exceed the Corps' Public Law (PL) 84-99 Delta Specific Standard. The risk of catastrophic failure is significantly lower. The levees are well maintained and regularly inspected. A reliable and steady stream of funding allows for consistent construction and maintenance of Delta levees, creating an industry in the Delta. The increased availability of materials and equipment also aids emergency response capabilities.

There is little or no conflict with the ecosystem rehabilitation efforts, and for years there has been a net gain in critical habitat. Once threatened species now thrive, partially in response to levee-associated habitat improvements. Permitting new projects is obtained in weeks because of agency coordination and the availability of a Delta-wide comprehensive geographic information systems (GIS) inventory, which facilitates evaluation of project-related impacts. Even with the addition of waterside habitats, the flood-carrying capacity of the system is better and hydraulic impacts upstream and downstream of the Delta have been beneficial.

Islands of particular state or national importance have been provided with increased flood protection and improvements to their seismic survivability resistance. The ongoing seismic and subsidence risk evaluations and monitoring continually provide feedback that improves levee design and reduces system vulnerability. Emergency response capabilities were improved early in the implementation phase and have proven their worth. The now rare isolated levee breach is closed in weeks, and the risk to water supply and water quality from multiple earthquake-induced failures has been reduced significantly as a result of seismic upgrades and improvements to emergency response capabilities.

MISSION

The CALFED mission is to develop a long-term comprehensive plan that will restore ecosystem health and improve water management for beneficial uses of the Bay-Delta system. CALFED fundamentally differs from previous efforts because the program seeks to concurrently address ecosystem restoration, water quality, water supply reliability, and levee and channel integrity. The geographic scope of the problem area consists of the legal Delta, Suisun Bay (extending to the Carquinez Strait), and the Suisun Marsh. The geographic scope of the solution area includes a much broader area that extends upstream and downstream of the Bay-Delta. The foundation of every CALFED alternative includes six common programs: Ecosystem Restoration, Water Use Efficiency, Water Quality, Water Transfers, Watershed Management, and Levee System Integrity. CALFED also includes two variable programs, Storage and Conveyance. Each of the individual common program elements is a major program on its own, and each element represents a significant investment in and improvement to the Bay-Delta system.

Levee Program actions focus primarily on the legal Delta as defined in the Water Code and illustrated in Figure 1. The goal is to provide long-term protection for multiple Delta resources by maintaining and improving the integrity of the Delta levee system. In addition, the Levee Program aims to integrate ecosystem restoration and Delta conveyance actions with levee improvement activities. Improvements in the reliability of water quality will be a natural by-product of the program. Goals of the Levee Program will be achieved through implementation of this Long-Term Levee Protection Plan.

The specific elements of the Levee Program include:

- Delta Levee Base Level Protection Plan,
- Delta Levee Special Improvement Projects,
- Delta Levee Subsidence Control Plan,
- Delta Levee Emergency Management and Response Plan, and
- Delta Levee Seismic Risk Assessment.

PROGRAM ELEMENTS

Delta Levee Base Level Protection Plan

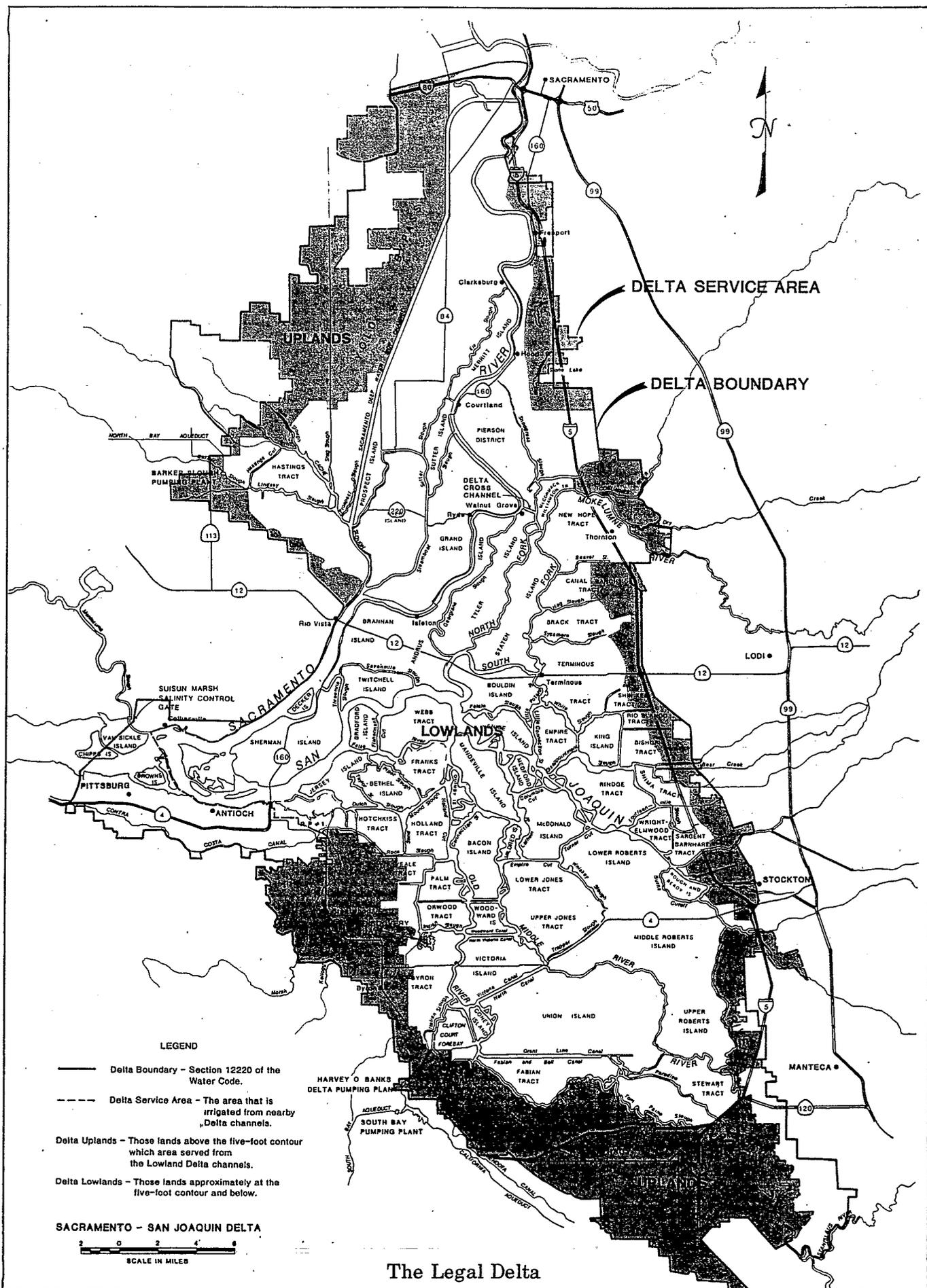
The goal of the Delta Levee Base Level Protection Plan (Base Level Protection) element is to improve all Delta levees to a uniform base level standard. This element is being developed and evaluated at a programmatic level. More focused analysis and documentation of specific targets and actions will occur in subsequent efforts.

INTRODUCTION

In fiscal year 1990-1991, the Delta Flood Protection Fund was created to provide for local assistance under the Delta Levee Maintenance Subventions Program (Subventions Program), and for Special Delta Flood Protection Projects (Special Projects). Currently, the Subventions Program and Special Projects are being carried forward under funding provided by the Safe, Clean, Reliable Water Supply Act, Division 24 of the California Water Code. Delta levee maintenance is described in the California Water Code, Division 6, Part 9 - Delta Levee Maintenance (commencing with Section 12980). (Refer to Appendix C for pertinent excerpts from the California Water Code.) It is the intent of the California Legislature that, to the extent allowed by existing requirements, levee rehabilitation will be consistent with CALFED's Delta ecosystem restoration strategy. (Refer to subsequent discussion of "Funding.")

Table 2 lists implementation objectives, targets, and actions associated with the Base Level Protection element.

Figure 1



LEGEND

- Delta Boundary - Section 12220 of the Water Code.
- - - Delta Service Area - The area that is irrigated from nearby Delta channels.
- Delta Uplands - Those lands above the five-foot contour which area served from the Lowland Delta channels.
- Delta Lowlands - Those lands approximately at the five-foot contour and below.

SACRAMENTO - SAN JOAQUIN DELTA

SCALE IN MILES

0 2 4 6

The Legal Delta

Implementation Objective	Target	Action
Uniformly improve Delta levees	Improve Delta levee system stability to meet PL 84-99 criteria	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, or constructing stability berms
	Maintain Delta levees to the PL 84-99 standard	Develop a long-term maintenance plan
Establish a stable funding source	Provide necessary funding to improve and then maintain Delta levees to the PL 84-99 standard for the CALFED planning horizon	Prepare cost estimates
		Identify beneficiaries to provide equitable distribution of costs
		Develop funding sources
Coordinate the permitting process	Reduce the time required to acquire all necessary permits	Develop a uniform process to coordinate and approve all permits
		Provide regional mitigation banking
		Coordinate with the Ecosystem Restoration Program to provide an environmental enhancement component

Table 2. Implementation Objectives, Targets, and Actions Associated with the Delta Levee Base Level Protection Plan

SCOPE

As mandated by the California legislature and adopted by CALFED, the physical characteristics of the Delta should be preserved essentially in their present form, the key to preserving the Delta's physical characteristics is the levee system. Approximately 385 miles of project levees and 730 miles of non-project levees are located in the legal Delta (Figures 2 and 3). Approximately 385 miles of project levees and 730 miles of non-project levees are located in the legal Delta. "Project levees" are levees that were improved or adopted as part of federal flood control projects. Most of the project levees are along the Sacramento and San Joaquin Rivers in the upper reaches of the Delta. (The California Water Code definition of "Project Levees" is provided in the glossary.) "Non-project levees" are all levees that are not project levees.

At this point, it is assumed that most of the project levees meet or exceed the PL 84-99 standard. The current (1998) cost estimate indicates that approximately 600 miles of levee will need to be rehabilitated and brought up to PL 84-99 standards. All 1,116 miles of levees should be routinely inspected and maintained. Table 3 (at the end of this report) includes an inventory of Delta levees that identifies project and non-project levees, responsible reclamation districts, and the existing levees considered up to the PL 84-99 standard.

Figure 2

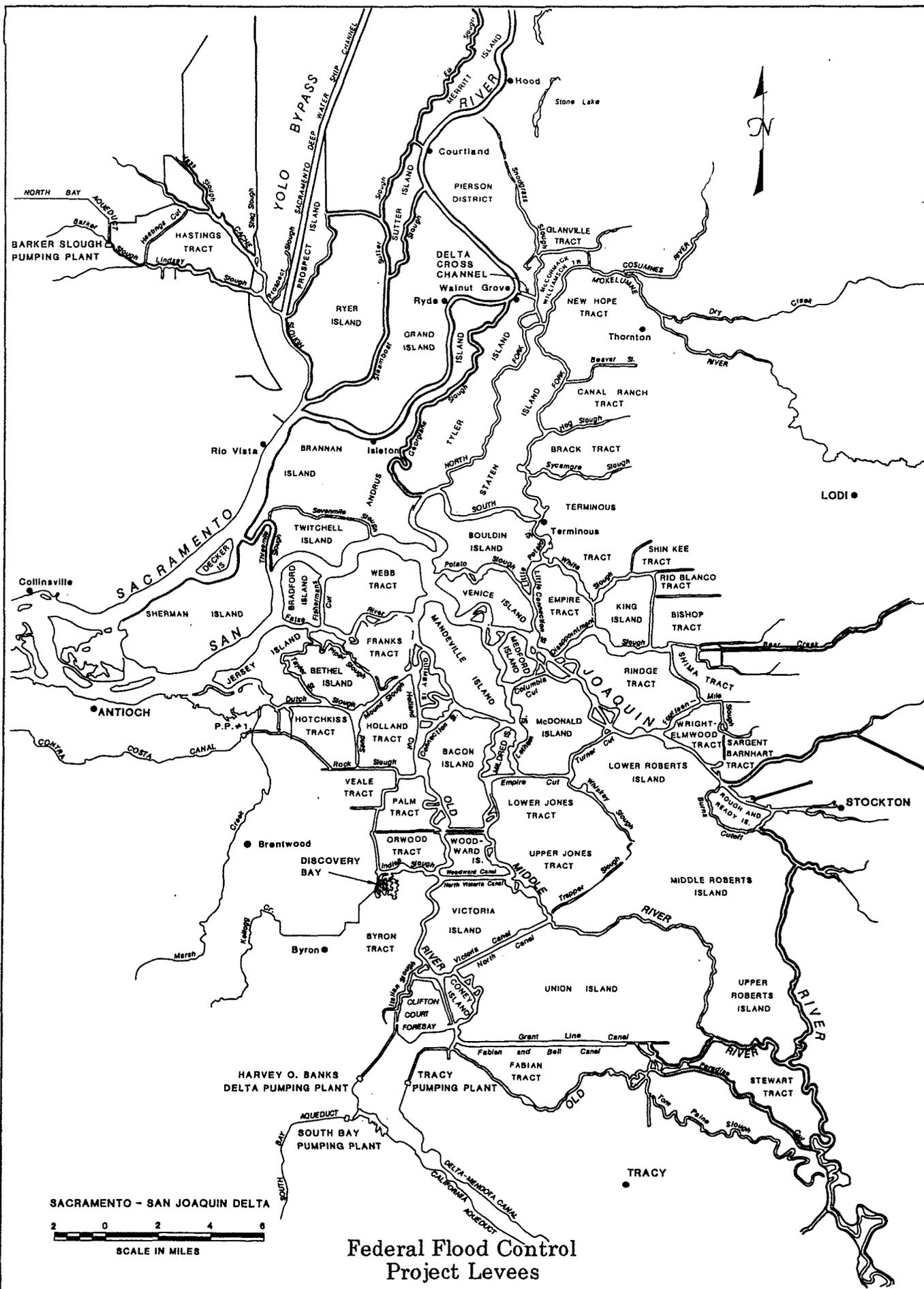
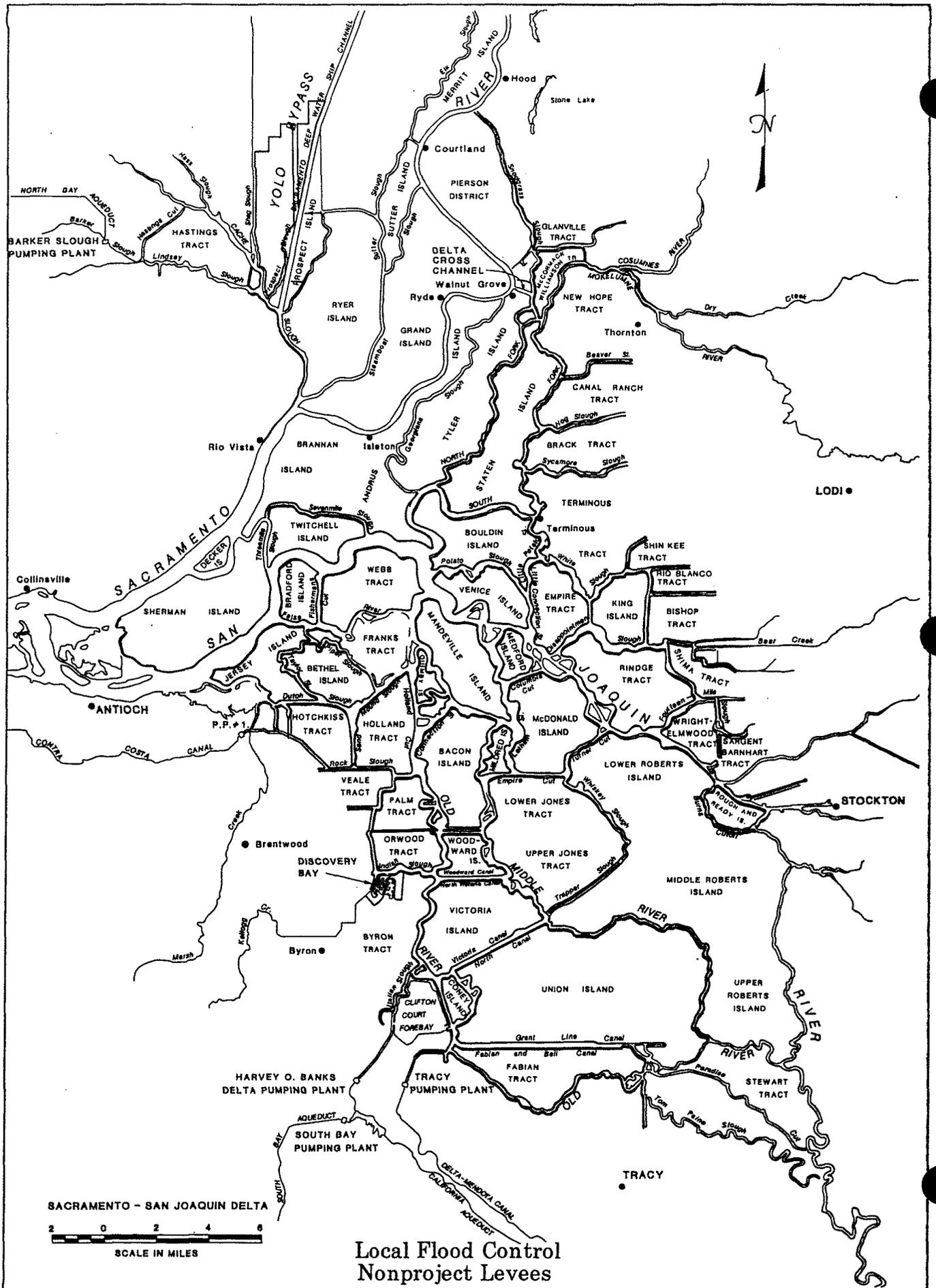


Figure 3



Local Flood Control
Nonproject Levees

Base level protection will be achieved through an extension of the existing Subventions Program defined in the California Water Code, commencing with Section 12980 (refer to Appendix C), except that CALFED recommends selection of the Corps' PL 84-99 Delta Specific Standard as the minimum base level standard. The Delta-specific criteria are contained in the Corps' document titled, "Guidelines For Rehabilitation of Non-Federal Levees in the Sacramento-San Joaquin Legal Delta" (1988). Constructing levees to the PL 84-99 criteria is a prerequisite for, but not a guarantee of, post-flood disaster assistance. (Appendix A contains information on the PL 84-99 Delta Specific Standard.)

Figure 4 compares the PL 84-99 Delta Specific Standard to other levee standards.

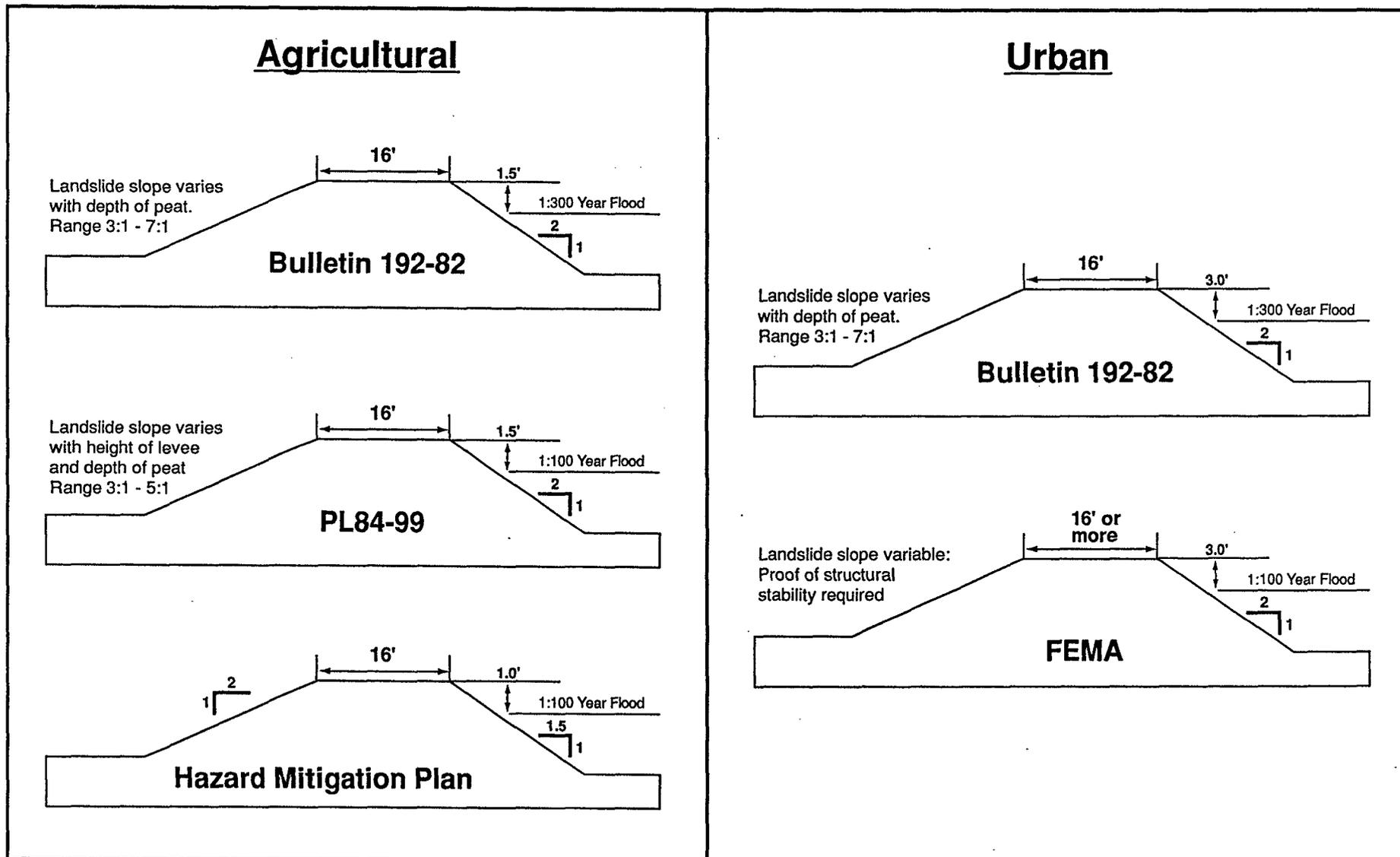
CRITERIA AND PROJECT APPROVAL

The State Reclamation Board (Board) has jurisdiction over all levee rehabilitation and maintenance and will be the local sponsor as required. The Board is authorized to make such rules and regulations that are necessary to carry out its responsibilities, consistent with the California Water Code.

The State will approve plans and inspect work to ensure that levees are effectively rehabilitated and maintained. Under the current code, the California Department of Water Resources (DWR) is responsible for developing the maintenance and rehabilitation criteria for non-project levees. The criteria will vary as required to meet specific conditions, and will embody and implement the "Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta" (most current version) and the "Vegetation Management Guidelines for Local Non-Project Delta Levees" (most current version). PL 84-99 Levee Maintenance standards allow significantly less vegetation than the "Vegetation Management Guidelines for Local, Non-Project Delta Levees," that was approved for the HMP standard. Replacement of the HMP vegetation guidelines with the PL 84-99 vegetation standard on non-project levees likely will result in greater habitat mitigation and enhancement requirements through the AB 360 program. In addition, DWR's Bulletin No. 192, dated May 1975 and updated in 1982, will be used as the conceptual plan guiding the formulation of projects to preserve the integrity of the Delta levee system. The criteria developed by DWR will be submitted to the Board for approval. Prior to adoption of any criteria, the Board will hold public hearings and may revise the criteria as it determines necessary.

The current California Water Code does not address project levee design and maintenance criteria. It is anticipated that the Corps will continue to be responsible for the design of project levees. The State and local agencies will be responsible for maintaining the levees in accordance with the PL 84-99 standard and with guidelines provided in the Corps' "Standard Operation and Maintenance Manual" (most current version) and in each applicable supplement for individual project units.

Figure 4
Levee Standards



DFG will make a written determination as part of its review and approval of a plan or project whether the proposed work is consistent with a net long-term habitat improvement program and whether the project would result in a net benefit for aquatic species in the Delta.

AGREEMENTS

Before any plan is approved, agreement entered into, or state and federal funds expended, the local agency will enter into an agreement with the Board. This agreement will indemnify and hold and save the State, the Board, DWR, and any other agency or department of the State and Federal Governments and their employees free from any and all liability for damages, except that caused by gross negligence, that may arise out of the approvals, agreements, inspections, or work performed. Upon approval of project plans by the Board, the local agencies will enter into an agreement with the Board to perform the maintenance and improvement work, including the annual maintenance work, specified in the plan. Also, the Board will act as the local sponsor to the Corps and give the Corps the same assurances.

PROJECT PRIORITY

Local agencies will prioritize projects based on their individual needs. If applications for funding in any year exceed the funds available, the Board will apportion the funds among those levees or levee segments that are identified by DWR as most critical and beneficial, considering the needs of flood control, water quality, recreation, navigation, habitat improvement, and fish and wildlife.

MAINTENANCE

There may be a conflict between the California Water Code and the Levee Program goal to rehabilitate and maintain levees to PL 84-99 standards. This apparent conflict in maintenance standard will need to be resolved.

Local agencies will be responsible for maintaining project and non-project levees. Local agencies will be eligible for reimbursement upon submission to and approval by the Board of plans for the maintenance and improvement of the project and non-project levees, including plans for the annual maintenance of the levees in accordance with the criteria adopted by the Board. The plans will (1) include provisions to acquire easements along levees that allow for the control and reversal of subsidence in areas where DWR determines that such an easement is desirable to maintain structural stability of the levee, (2) include provisions for protection of the fish and wildlife habitat determined necessary by DFG and that will not reduce the integrity of the levee, and (3) take into account the most recently updated Delta Master Recreation Plan prepared by the Resources Agency.

OVERSIGHT AND INSPECTIONS

DWR will conduct at least one annual inspection of every levee for which maintenance or improvement costs have been paid to the local agencies. In addition, DWR will inspect non-project levees of local agencies to monitor and ascertain the degree of compliance with, or progress toward meeting, the approved and agreed on criteria and standard. Whenever an inspection reveals that the specified and agreed upon maintenance is not being performed, DWR may establish a maintenance area and thereafter annually maintain the non-project levee in accordance with the Board-approved plan.

The Corps may inspect project levees. For non-project levees to become eligible for federal assistance under PL 84-99, a local agency must request and pass an Initial Eligibility Inspection by the Corps. The Corps will inspect the levee to assess the integrity and reliability of the levee. The inspection by the Corps consists of a structural and geotechnical analysis, a hydrologic and hydraulic evaluation, and an operation and maintenance determination.

EMERGENCY RESPONSE

Even with rehabilitation and active levee maintenance, the threat of levee failure will continue to exist. Emergency Management and Response, a critical element of the Long-Term Levee Protection Plan, is discussed in a later section of this plan.

Delta Levee Special Improvement Projects

The goal of the Delta Levee Special Improvement Projects (Special Improvement Projects) element is to provide additional flood protection separate from the Base Level Protection element for Delta islands that protect such public benefits as water quality, the ecosystem, life and personal property, agricultural production, cultural resources, recreation, and local and statewide infrastructure. This element is being developed and evaluated at a programmatic level. More focused analysis and documentation of specific targets and actions will occur in subsequent efforts.

INTRODUCTION

The Special Improvement Projects element of the Long-Term Levee Protection Plan will be carried out through an extension of the existing Special Projects Program as defined in the California Water Code.

In fiscal year 1990-1991, the Delta Flood Protection Fund was created to provide for local assistance under the Delta Levee Maintenance Subventions Program (Subventions Program), and for Special Delta Flood Protection Projects (Special Projects). Currently, the Subventions Program and Special Projects are being carried forward under funding provided by the Safe, Clean, Reliable Water Supply Act, Division 24 of the California Water Code. Special Projects are described in the California Water Code, Division 6, Part 4.8 - Delta Flood Protection, Chapter 2 - Special Flood Control Projects (commencing with Section 12310). Refer to Appendix C for pertinent excerpts from the California Water Code. It is the intent of the Legislature that, to the extent consistent with existing requirements, special projects will be consistent with the Delta ecosystem restoration strategy of the CALFED program.

Funding for the Special Improvement Projects is discussed later in this report. Table 4 lists implementation objectives, targets, and actions associated with the Special Improvement Projects elements.

Implementation Objective	Target	Action
Enhance flood protection for key islands that provide statewide benefits to the ecosystem, water supply, water quality, economics, infrastructure, etc.	Improve levee stability in key Delta locations to a level commensurate with the benefits which the levees protect	Modify levee cross sections by raising levee height, widening levee crown, flattening levee slopes, and/or constructing stability berms in key Delta locations
	Maintain improved levees	Develop a long-term maintenance plan
Establish a stable funding source	Provide necessary funding to improve and then maintain key levees for the CALFED planning horizon	Prepare cost estimates
		Identify beneficiaries to provide equitable distribution of costs
		Develop funding sources
Coordinate the permitting process	Reduce the time required to acquire all necessary permits	Develop a uniform process to coordinate and approve all permits
		Provide regional mitigation banking
		Coordinate with the Ecosystem Restoration Program to provide an environmental enhancement component

Table 4. Implementation Objectives, Targets, and Actions Associated with the Delta Levee Special Improvement Projects

SCOPE

DWR is responsible for the existing state Special Projects program and would continue to develop and implement the Special Improvement Projects element of the Levee Program. The primary

purpose of the existing and proposed programs is to protect discrete and identifiable public benefits, including public highways and roads, utility lines and conduits, urbanized areas, water quality, recreation, navigation, and fish and wildlife habitat. Special Improvement Projects include flood control projects for (1) all the Delta islands, but primarily the eight western and central islands of Bethel, Bradford, Holland, Hotchkiss, Jersery, Sherman, Twitchel, and Webb; (2) the Towns of Thorton and Walnut Grove; and (3) approximately 12 (more like 18) miles of levees on the islands bordering Northern Suisun Bay from Van Sickle Island to Montezuma Slough. The Special Improvement Projects Program also must provide for a net long-term habitat improvement.

Project plans may include, or be a combination of, the improvement, rehabilitation, or modification of existing levees, and the conveyance of interests in land to limit or to modify land management practices that negatively affect flood control facilities. Easements will be obtained for the control and reversal of subsidence in areas along the levees where DWR determines that such an easement is desirable to maintain the structural stability of the levee. Project plans must include provisions for the protection of fish and wildlife habitat determined necessary by DFG and that do not reduce the integrity of flood control works.

PROJECT PRIORITY. In accordance with the California Water Code (Section 12313), DWR is required to develop, in consultation with appropriate federal, state, and local agencies, a list of areas where flood control work is needed to protect public facilities or provide public benefits. Priority of projects is to be based on the importance or degree of public benefit needing protection and the need for flood protective work. The list is subject to the approval of the California Water Commission.

Special Improvement Projects could be prioritized based on a matrix of objectives and island attributes. Such a matrix was developed by DWR with input from CALFED's Levee and Channel Technical Team. Table 5 presents such a matrix. A more detailed "Special Projects Information Matrix" is presented in Appendix D. This information demonstrates the scope and complexity involved in objectively prioritizing islands and projects. The matrix with objectives, attributes, and priorities should be evaluated regularly to adapt to the changing Delta environment.

APPROVAL OF PLANS FOR SPECIAL IMPROVEMENT PROJECTS. Project plans will be developed by DWR in cooperation with the local agency, the public beneficiary, and DFG. Project plans will be subject to the approval of the appropriate public agency or agencies, and DFG. DFG will make a written determination as part of its review and approval of a plan or project whether the proposed expenditures are consistent with a net long-term habitat improvement program and would result in a net benefit for aquatic species in the Delta.

EXECUTION OF PLANS. Special improvement projects will be undertaken and completed in accordance with the approved project plans. Project works may be undertaken by DWR or, at DWR's option, by the local agency pursuant to an agreement with DWR.

In addition to any obligations assumed under an agreement with DWR and to the extent consistent with that agreement, the local participating agency will (1) provide construction access

Objective	Island Attribute
Life and personal property	Residential lands Long-term salinity intrusion induced Critical to water quality (Senate Bill 34) Island volume
Water quality	Total agricultural lands Value of damagable crops
Agricultural production	State or regional parks Recreation lands Recreation resorts/marinas
Recreation	Known prehistoric sites Potential historic sites
Cultural resources	Native vegetation Wetlands Riparian habitats
Ecosystems	Agricultural waterfowl habitats Known special-status plant occurrences Known special-status wildlife occurrences
Infrastructure of local concern	County roads Commercial lands Industrial lands
Infrastructure of statewide concern	Acreage protected per levee mile Federal and state highways Water supply conveyance Railroad mainlines
Adjacent island resources	Natural gas pipelines Natural gas fields and storage Power transmission lines Adjacent levees at risk Seepage risk
Permanent population	
Towns	
Housing units	

Table 5. Special Projects Matrix of Objectives and Attributes

to lands or rights-of-way that it owns or maintains for flood control purposes or for purposes that are compatible with the project's required use and necessary to complete the project; (2) maintain the completed project; (3) apply for federal disaster assistance, whenever eligible, under PL 93-288; (4) hold and save the State and its employees free from any and all liability for damages, except that caused by gross negligence, that may arise out of the construction, operation, or maintenance of the project; (5) acquire easements; (6) comply with habitat mitigation and improvement requirements; and (7) use subsidence control alternatives.

MAINTENANCE. *(There is an apparent conflict in the California Water Code because of the change that included project levees in the Special Projects Program. See paragraph below. There is also an apparent conflict between the California Water Code and the Levee Protection Plan goal to rehabilitate and maintain levees to PL 84-99 standards. These apparent conflicts will need to be resolved.)*

Completed special improvement projects will be maintained by the local cooperating agency pursuant to maintenance criteria adopted in accordance with Section 12984 of the California Water Code. This section requires DWR to develop and submit for approval by the Board, criteria for the maintenance and improvement of levees. The criteria will be adapted to meet specific conditions; be multipurpose; and include environmental considerations, when feasible. The non-project levee maintenance criteria will embody and implement the mitigation plan set forth in the "Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta" and the "Vegetation Management Guidelines for Local Non-Project Delta Levees." Project levee maintenance criteria also will comply with the PL 84-99 Delta Specific Standard, the Corps' "Standard Operation and Maintenance Manual," and each applicable supplemental agreement. Prior to the adoption of any maintenance criteria, the Board will hold public hearings and revise the criteria as deemed necessary.

Delta Levee Subsidence Control Plan

The goal of the Delta Levee Subsidence Control Plan (Subsidence Control) element is to reduce or eliminate the risk to levee integrity from subsidence. This element is being developed and evaluated at a programmatic level. The Subsidence Subteam was asked to evaluate subsidence and its effect on levee integrity. Appendix E contains the Subsidence Subteam report. The report discusses the effect of subsidence on levee integrity, presents a preliminary subsidence mitigation plan for levee integrity, and delineates target areas for subsidence control based on the best available information.

INTRODUCTION

Subsidence issues, concerns, and solutions are addressed in both the Levee Program and the Ecosystem Restoration Program. The Long-Term Levee Protection Plan focuses on subsidence

that affects the levee system. The Ecosystem Restoration Program addresses interior island subsidence in association with habitat restoration. Subsidence management is covered under the existing "Special Flood Control Project" and "Delta Levee Maintenance" portions of the California Water Code (refer to Appendix C).

BACKGROUND

Subsidence has substantially contributed to the Delta islands current condition of relatively tall levees protecting interiors below sea level. Recently, however, the importance of subsidence to levee stability has diminished. Land management practices have improved, and subsidence rates have decreased. In addition, the Subsidence Subteam has determined that a zone of influence (ZOI) extends from the levee crest to some distance inland, beyond which subsidence will not affect levee integrity.

Although the ZOI for a reach of levee can be determined with site-specific data, the Subsidence Subteam has estimated the ZOI for planning purposes. Based on available information and engineering judgement, the ZOI is estimated to range from 0 to 500 feet from the levee crest, depending on site-specific conditions. The Subsidence Control element addresses subsidence as it affects levee integrity within the ZOI adjacent to levees.

Table 6 lists implementation objectives, targets, and actions associated with the Subsidence Control element.

Implementation Objective	Target	Action
Reduce the risk to levee stability from subsidence	Reduce, eliminate, or reverse subsidence adjacent to affected levees	Fund grant projects to develop BMP's that address subsidence as it affects levee integrity
Streamline and consolidate the permitting process	Reduce the time required to acquire all necessary permits	Develop a uniform process to coordinate and approve all permits
		Provide regional mitigation banking
		Coordinate with the Ecosystem Restoration Program to provide an environmental enhancement component

Table 6. Implementation Objectives, Targets, and Actions Associated with the Delta Island Subsidence Control Plan

REMEDIAL ACTION AND PREVENTION

Potential levee subsidence mitigation actions that should be considered include:

- Geotechnical engineering principles and practices in conjunction with proven construction methods should be applied. Levee subsidence will continue as long as levee building and repair continue to add loads onto weak, compressible foundations.
- Seepage control, dewatering efforts, excavations, and land management activities near levees should be modified to minimize adverse impacts on levee integrity.
- Stability and drainage berms should be strategically located and sequentially constructed to minimize or prevent levee deformation.
- Land leveling and other ground surface modifications (for example, ditching) should be restricted within the ZOI. High groundwater levels and vegetative growth could be tolerated in some areas to accommodate measures aimed at reducing subsidence due to oxidation.

As long as subsidence is adequately managed within the ZOI, levee integrity should be unaffected. Subsidence control and monitoring are most important for the western and central Delta islands, where the depth of organic soils are the greatest and the organic content of the deposits are commonly high. Previous attempts at prioritizing areas and islands, based on depth of peat and organic matter content, provide a good starting point for the development of a subsidence monitoring, control, and prevention program.

The levees identified as target areas for subsidence remedial action and prevention would require screening and integration with other issues affecting levees, such as seismic stability requirements and Delta water operations. This integration would allow a better prioritization of future subsidence remediation of Delta levees.

CURRENT PROGRAM

The California Water Code's Special Flood Control Projects Program states that local agencies will acquire easements from the crown along levees for the control and reversal of subsidence in areas where DWR determines that such an easement is desirable to maintain structural stability of the levee. The easement would: (1) restrict the use of the land to open space uses, non-tillable crops, the propagation of wildlife habitat, and other compatible uses; (2) provide full access to the local agency for levee maintenance and improvement purposes; and (3) allow the owner to retain reasonable rights of ingress and egress, as well as reasonable rights of access to the waterways for water supply and drainage. In addition, the current program states that local agencies will use subsidence control alternatives, where appropriate, to reduce long-term maintenance and improvement costs.

PROPOSED PROGRAM

CALFED will implement a subsidence monitoring program. Subsidence monitoring would begin with an evaluation of existing soils and their distribution in the Delta, and a determination of land surface elevation. Efforts would be directed to areas on and adjacent to the levees, within the ZOI. From a new, continually updated database, a target list of levees and islands being affected by subsidence could be maintained. Monitoring would allow subsidence control to be adaptively managed as levees are rehabilitated. This monitoring effort would be coordinated through CALFED's Comprehensive Monitoring And Research Program (CMARP).

In addition, through the existing special projects program, CALFED will implement grant projects to develop best management practices (BMPs) that restore interior island elevations.

Delta Levee Emergency Management and Response Plan

The goal of the Delta Levee Emergency Management and Response Plan (Emergency Management Plan) element is to enhance existing emergency management response capabilities in order to protect critical Delta resources in the event of a disaster. This element has not changed significantly from previous drafts because an Emergency Response Subteam has only recently been reformed. More focused analysis and documentation of specific targets and actions will occur in subsequent efforts.

INTRODUCTION

The existing emergency response capabilities need to be continuously refined, and funding needs to be increased. The creation of an effective emergency response plan is a cornerstone of the Levee Program. The Emergency Management Plan will build on existing state, federal, and local agency emergency management. It will propose specific actions that will improve response flexibility to ensure that appropriate resources are available and properly deployed, and provide for effective disaster recovery measures.

Table 7 lists implementation objectives, targets, and action associated with the Emergency Management Plan element.

BACKGROUND

The most recognizable threat to Delta islands and resources is inundation due to winter flood events. Other potential disasters that threaten these same resources include seismic events, burrowing animals, toxic spills, fire, and levee failure during low-flow periods.

Implementation Objective	Target	Action
Enhance emergency response capabilities and resource allocation	Develop the capability to efficiently respond to multiple concurrent levee breaks within the Delta	Develop a Delta-focused multi-agency emergency response team
		Implement the recommendations made in the FEAT Report dated May 10, 1997
		Develop SEMS/ICS organization and implementation criteria
		Purchase materials in advance and place in strategic locations
		Develop standardized contracts with contractors for forces and equipment to respond with short notice
Develop a stable funding source for emergency response	Provide funding for a well defined Disaster Assistance Program	Improve site access and develop mobilization strategy
		Prepare cost estimates
		Identify beneficiaries to provide equitable distribution of costs
		Develop funding sources

Table 7. Implementation Objectives, Targets, and Actions Associated with the Delta Levee Emergency Management and Response Plan Element

Current emergency response procedures could be streamlined to reduce delays in mobilizing resources. A quick response can prevent costly levee failures. In addition, the tendency to focus emergency response measures on those sites facing imminent failure can result in neglecting actions that could prevent threatened sites from escalating into emergencies .

CURRENT PROGRAM

When the Governor declares a State of Emergency, the Governor's Office of Emergency Services coordinates state agency responses. When an incident appears to potentially exceed the resources of the local responsible agency, emergency personnel conduct on-site evaluations to determine what, if any, additional emergency support is warranted. Cities and counties can proclaim local disaster events and, in general, local or maintaining agencies are first in line for responsibility to address disaster events. Although certain agencies may have resources to provide initial emergency action, typically they cannot provide a sustained effort during a large disaster event. Most local agencies do not have the resources to address major disaster events, and existing agreements may provide a means for sharing additional resources from surrounding areas. The federal government provides financial assistance through FEMA under a presidential declaration of disaster; however, other federal agencies such as the Corps may provide assistance or resources under existing authorities.

The existing emergency management structure is designed to coordinate activities of multiple state, federal, and local agencies with varying responsibilities to provide emergency assistance in the event of a disaster. The Standardized Emergency Management System (SEMS) provides a framework for coordinating state and local government emergency response in California, using the incident command system and mutual aid agreements. SEMS facilitates setting priorities, cooperation among agencies, and the efficient flow of resources and information.

PROPOSED PROGRAM

CALFED's Emergency Response Subteam will consider the following actions and will propose additional actions in the development of the Emergency Management Plan:

- Establishing a \$10 million Emergency Response Revolving Fund,
- Improving existing command and control systems,
- Collecting and strategically placing flood-fighting materials,
- Developing criteria that triggers asset deployment,
- Establishing standardized contracts, and
- Identifying post-flood recovery measures.

Program staff will work with stakeholders, the public, and state and federal agencies, to create an Emergency Management Plan that identifies pre-emergency, emergency, and post-disaster recovery measures. The plan may include the following components:

- Establish a Delta emergency management team consisting of existing state, federal, and local agency personnel from agencies with disaster-related authorities and responsibilities. This team will promote coordination and implementation of emergency actions for protecting Delta resources consistent with CALFED objectives. Actions will focus on local agency preparation, coordination, and responsibility to provide initial response efforts in order to prevent damages and implement recovery measures. The Emergency Management Plan will provide flexibility within each agency for specific implementation of emergency actions based on resource availability, type of disaster, and extent of disaster.
- Identify criteria and emergency actions consistent with CALFED objectives to ensure protection of Delta resources. Separate criteria will be needed for various types of disasters, and criteria will be needed for emergency actions prior to, during, and after a disaster. Criteria such as stages or flows in certain Delta channels or seepage flows will determine specific emergency actions. Criteria for threatening situations, such as imminent levee failure, would identify equipment and manpower to prevent such failure. Criteria for post-disaster situations would identify clean-up or other recovery actions. For example, criteria such as depth of flooding or salinity intrusion may identify such post-emergency measures as water management operations and levee rehabilitation.
- Identify pro-active measures to improve the efficiency of implementing emergency actions. Initial emergency actions should be identified and resources made available in advance.

Examples of preventive measures include identification of potential staging areas, advance collection and strategic placement of materials, and identification of specific emergency actions.

- Identify recovery measures to prevent damages to adjacent areas and reduce long-term damages of affected areas. Examples of recovery measures include toxic spill clean-up, levee rehabilitation, and habitat restoration. Implementation of recovery measures to protect Delta resources will be consistent with Levee Program objectives.

Delta Levee Seismic Risk Assessment

The goal of the Delta Levee Seismic Risk Assessment is to identify the risk to Delta levees from seismic events and develop recommendations to reduce levee vulnerability and improve their seismic stability. A Seismic Subteam was formed to assess the seismic risk to Delta levees. This subteam, composed of seismic experts and geotechnical engineers with experience in the Delta, evaluated levee fragility and assessed the seismic vulnerability of the current levee system. The subteam is developing a report that will present their findings and conclusions. The subteam's completed Seismic Risk Assessment will be an appendix to subsequent drafts of this report.

INTRODUCTION

The vulnerability of the Delta levee system to failure during earthquakes is a concern. Although levee failure from a seismic event has never been documented, the Delta has not experienced a significant seismic event since the levees reached their current size. However, levee failures from a seismic event may result in multiple level failures on more than one island.

BACKGROUND

In the late 1980s, DWR's Division of Engineering embarked on a long-term, three-phase seismic stability evaluation of Delta levees. In 1992, DWR completed the Phase I effort and published a report titled, "Seismic Stability Evaluation of the Sacramento-San Joaquin Delta Levees, Volume I." Subsequently, DWR developed and began work on the Phase II program. The Phase II work is nearly complete and the report is pending.

PROPOSED PROGRAM

CALFED staff has identified the following potential seismic risk management options:

- Improve emergency response capabilities,
- Develop storage south of the Delta,
- Reduce fragility of the levees,
- Improve through-Delta conveyance
- Release more water stored north of the Delta,
- Curtail Delta diversions, and
- Construct an isolated facility.

Program staff will work with stakeholders, the public, and state and federal agencies to build on the subteam's assessment and an overall risk assessment in order to prepare an implementation plan. This plan will identify outstanding issues requiring subsequent action, then coordinate and implement recommendations with other Levee Program actions.

The Levee Program will address seismic risk issues through refinement and implementation of the objectives, targets, and actions identified in Table 8.

Implementation Objective	Target	Action
Quantify Delta levee seismic risk and compare it to other failure modes	Document findings in a report to CALFED	Continue to gather baseline seismic information Perform dynamic testing of levee material properties, and levee stability analysis Assemble a board of seismic and geotechnical experts (Delta Levee Consulting Board) to make recommendations to CALFED decision makers on the potential impact of seismic loading on Delta levees and how it compares with other failure modes
Determine how Delta levees can best be improved to reduce their susceptibility to damage/failure from seismic loading	Document findings in the report to CALFED	Delta Levee Consulting Board will make recommendations to CALFED on the potential for seismic retrofitting of Delta levees
NOTE:		
This assessment identifies the risk to Delta resources during catastrophic seismic events and develops recommendations to improve the stability of Delta levees. The Department of Water Resources' Seismic Investigation is being continued. This investigation consists of installing strong-motion accelerometers at sites in the Delta; ongoing field and laboratory testing to better determine the static and dynamic properties of organic soils; field and laboratory testing to better determine liquefaction potential; and continuing evaluation of the potential activity of the Coast Range/Sierra Nevada Boundary Zone.		

Table 8. Implementation Objectives, Targets, and Actions Associated with the Delta Levee Seismic Risk Assessment

ECOSYSTEM RESTORATION PROGRAM/ LEVEE PROGRAM COORDINATION

Levee maintenance activities often conflict with management of terrestrial and aquatic habitat resources on or around levees. For instance, vegetation provides valuable habitat but can complicate levee maintenance activities. A common stakeholder concern is that actions to control levee and channel vegetation are often delayed or precluded because of potential impacts on endangered species. Although in some cases vegetation may provide erosion control benefits, in general, vegetation on levees is not desirable for maintenance purposes. Bare levees are easier to inspect. Vegetation may conceal evidence of instability, such as erosion damage or burrow holes. In addition, the vegetation may provide shelter for, and foster the establishment of, burrowing animals. Deep-rooting plants may threaten the integrity of the structural cross section. When deep-rooting plants are pulled away by wave action or high winds, they can leave gaping holes in levee cross sections, leading to failure of the levee. Although vegetation on levees is not precluded by the Office of Emergency Services or FEMA, vegetation may hamper flood fighting by impeding the application of sand bags or plastic membrane to levees. Vegetation on levees may require more labor-intensive levee maintenance activities. The application of riprap or other erosion protection materials may require clearing established vegetation. In addition, vegetation may make use of some levee maintenance equipment difficult or impossible, requiring more physical labor.

The value of riparian habitat as a critical resource for many fish and wildlife species must be respected; however, many issues regarding vegetation on levees require resolution. Sometimes when vegetation on the levee is feasible or even desirable for erosion control, local agencies maintain unvegetated levee slopes in order to avoid the need to contend with endangered species requirements. This conflict contributes to reducing the environmental quality in the Delta.

Current Program

This section discusses actions in the existing Subventions Program to address potential conflicts between restoration and maintenance efforts. Actions have been taken to ensure that levee maintenance and reconstruction does not work against efforts to protect and establish fish and wildlife habitat in the Delta. The Delta Levee Subventions Program as amended by Senate Bill 1065 contained a requirement that levee maintenance result in "no net habitat loss." The Program was further amended by AB 360, which established that levee maintenance work funded under the Delta Levee Subventions Program must result in net habitat **improvement**. Subsequently, a memorandum of understanding (MOU) was negotiated among DWR, the Board, The Resources Agency, and DFG. DWR and DFG have developed mechanisms to implement the habitat requirements of the Subventions Program, including collecting data to create an environmental database using GIS technology, identifying sites for habitat restoration, and coordinating with local agencies to develop methods to document restoration efforts.

In addition, California Water Code Section 12300 requires that projects funded under the Delta Levee Subventions and Special Projects Programs, currently administered by DWR, be consistent with CALFED's Delta ecosystem restoration strategy. DWR and DFG have coordinated with the near-term Restoration Coordination Program (Category III) and have championed several Category III projects furthering levee and habitat restoration coordination.

Proposed Program

This section presents CALFED's strategy to address conflicts between the Levee Program and the Ecosystem Restoration Program. The Levee Program will build on the success of existing programs, such as the AB 360 program, in developing methods for successful levee and ecosystem coordination. Levee Program and Ecosystem Restoration Program staff are working in close coordination to develop additional strategies in order to minimize conflicts between goals of the two programs. Program staff jointly developed cross sections that would minimize potential conflicts. Figure 5 (at the end of the report) illustrates possible strategies for levee and habitat improvements. Figures 6a through 6e (at the end of the report) depict the strategies selected for future analysis and development. Additional guidelines to successfully integrate habitat and levee integrity concerns are discussed below.

In general, it is desirable to provide separation of the habitat from the levee cross section. An existing environmental baseline must be set, and all existing habitat should be relocated off the levee structural cross section where possible. Vegetation on the levees must not impinge on the structural levee section. The structural section is the minimum section required for levee integrity; therefore, additional material must be placed on top of the levee structural section to accommodate vegetation. For instance, deep-rooting plants should not be allowed on levee sections unless the levee is oversized. Also, the use of setback levees to create new riparian and wetland habitat is not a preferred method because of the high cost of building new levees on peat. Peat is generally weak and highly compressible; therefore, levees built on peat will subside substantially and may require many years to stabilize. Instead, maximum use will be made of in-channel islands and waterside berms for such opportunities.

The Levee Program seeks to minimize habitat-related conflicts with local maintenance agencies. Levee Program staff are working with other regulatory agency staff to determine whether "safe-harbor" type provisions for levee maintenance can be developed as part of the CALFED conservation strategy: Levee-maintaining agencies will be encouraged to allow high-grade upland terrestrial habitat to be reestablished on portions of the levees. In exchange, the levee-maintaining agencies will be able to maintain the levees as they deem necessary, free from environmental regulatory conditions on the reestablished habitat. The AB 360 program has in place some "sustainable yield" routine maintenance agreements that implement "safe-harbor"-type provisions, and the Levee Program will seek broader application of these types of principles. Also, the inclusion of multi-use improvements, such as access roads or staging areas for local agencies on the levee sections, will be encouraged where feasible. These improvements will provide incentives so that local agencies allow vegetation growth on their levees. This coordination could benefit both levee maintenance efforts and habitat development.

Levee Program and Ecosystem Program staff interface with staff from the AB 360 program who have identified many potential restoration sites in the Delta. In addition, the Levee Program is working to coordinate the selection of Ecosystem Restoration Program levee habitat restoration sites with local residents who have greatest knowledge of the Delta terrain. A small task force, including representatives of North, Central, and South Delta Water Agencies; the Delta Protection Commission; and the National Heritage Institute assembled to identify attractive sites for habitat restoration. Their efforts resulted in a report titled, "Alternative Proposals for CALFED Ecosystem Restoration Program in the Delta". Appendix H, "Proposals for Ecosystem Restoration," presents this report in which possible Ecosystem Restoration Program/Levee Program coordination sites are identified.

In addition, the Levee Program made a public outreach effort, soliciting input from local landowners and reclamation districts in identifying desirable sites for Ecosystem Restoration Program/Levee Program coordination. Letters were sent to all Delta local agencies describing the program goals and asking for recommended locations to create the desired habitats along the levees. The Levee Program received several responses from local agencies. These responses included a proposal to use the dredger cut along the San Joaquin River reach on Webb Tract and to consider the levee on the southern edge of Faye Island for habitat development. The Levee Program and Ecosystem Restoration Program will consider the use of these sites, as well as the sites recommended by the task force for Levee Program/Ecosystem Restoration Program coordination.

PERMIT COORDINATION

To ensure successful implementation of all CALFED programs, a coordinated permit process will be established. The process will anticipate the numerous permit requirements for actions approved as part of CALFED. Coordinated permitting will not result in relaxation of permitting requirements but will facilitate information sharing among regulatory agencies to streamline the permitting process. It is expected that the coordinated permit process and framework will include a permit assistance team to aid the project proponents in understanding and obtaining required permits, a regulatory permit review team dedicated to CALFED projects, and a regulatory steering review team that could set and review policy when problems arise. The regulatory team, (comprised of management staff from regulatory agencies responsible for permitting) would expedite review of environmental documentation, provide interagency coordination, and develop mitigation measures and monitoring requirements. The permit coordination framework also would be designed to address broad issues in order to improve the efficiency of such processes as general and regional permits and mitigation banks.

Permit coordination for the Levee Program will be addressed under the umbrella of the CALFED permit coordination program. CALFED has attempted to incorporate broad stakeholder and agency input into development of that program. For example, the Levees and Channels Technical Team, a team of agency staff and stakeholders that provides technical input to the Levee Program, contributed to developing the program concerning current levee maintenance issues.

Table 9 identifies the Levee Program permit coordination issues that will be included in the overall CALFED coordinated permit process.

- Work windows for in-channel work developed by U.S. Fish and Wildlife Service and National Marine Fisheries Service (NMFS) as part of Section 7 federal involvement restrict and affect the maintenance of levees.
- Lack of real-time data prevents permit agencies from granting variances for work within the windows.
- The Federal Government (U.S. Environmental Protection Agency in coordination with the U.S. Army Corps of Engineers) recently released the "Inland Waters Testing Manual," which presents testing methodologies for in-water dredged material disposal. If the federal testing standards differ from the state standards, costs may increase due to additional testing requirements.
- The Regional Board requires testing of materials to be dredged, but a general order has not yet been issued. Uncertainty and lack of scientific information on applicable standards exist.
- The term "net habitat enhancement" as required by Assembly Bill 360 needs to be clearly defined.
- A clear definition of "impacting activities" is needed, and these activities need to be classified according to the level of impact (for example, minimal or substantial).
- Lack of agency staffing and frequent regulatory agency staff turnover hinder permit processing.
- Memoranda of Understanding are desirable, such as the one between the State Lands Commission and local agencies that allows the districts to conduct dredging to obtain materials for levee maintenance under certain conditions.
- Multi-year and programmatic agreements are desirable.
- Trust and team building are needed in permit coordination.
- A system of centralized permit tracking is needed, including follow through for permit actions.
- The process of Endangered Species Act consultation is uncertain, including lack of NMFS/CALFED coordination, lack of established monitoring protocols, and potential impacts caused by monitoring.
- A suite of designs for allowable in-water work and monitoring is needed.
- Upper management support and oversight of the program are needed.

Table 9. Delta Levee Program Permit Coordination Issues

In addition to providing input for the development of the coordinated permit process, the Levee Program seeks to resolve existing permit issues, where possible. A current issue of concern is dredge permitting. The ability to dredge is important because dredging maintains channel capacity for water supply and flood control, and dredged material is reused for levee construction as well as to create shallow water habitat. Historically, the process of obtaining permits for levee and channel work has been problematic. A lack of staff resources has hindered the RWQCB in processing dredging permits. Processing times for individual dredge permits are long, sometimes

over 1 year. Issuance of a general order for dredging by the RWQCB would greatly expedite the dredge permit process. The RWQCB has been unable to process a general order for dredging, which requires an EIR, due to lack of RWQCB resources as well as lack of scientific information. This lack of scientific information also causes the RWQCB to issue individual permits more conservatively (with greater restrictions).

The Levee Program and CALFED upper management are developing an administrative plan for CALFED to obtain a general order for WDRs that would apply to dredging and sediment reuse in the Delta for all CALFED implementation actions. Where possible, the Levee Program will promote opportunities for investigations, directed by federal and state water quality decisionmakers such as the RWQCB, that will provide scientific background for establishing guidelines by which maintaining agencies can dredge Delta channels. An example of this is a current near-term ecosystem (Category III) focused grant for research that will address sediment toxicity. The Levee Program has provided input and coordinated with members of the Delta Levees and Habitat Advisory Committee, DFG, and the near-term ecosystem restoration program in the design of this research project that will provide much-needed information regarding sediment toxicity and develop a comprehensive strategy for Delta sediments. Also, the Levee Program seeks to incorporate monitoring for sediment toxicity and sediment characterization into the CMARP (see later discussion under "Monitoring and Research").

LINKAGES

Many issues and concerns overlap between the Levee Program and other CALFED components, and between the Levee Program and ongoing programs of other agencies. The Levee Program strives to identify all possible connections and areas of overlap, to coordinate with other programs to the maximum possible extent for mutual benefit, and to ensure that Levee Program objectives do not conflict with other programs.

Many linkages exist between the Levee Program and the Ecosystem Restoration Program. As discussed earlier, the Levee Program seeks to reduce the conflict between protection of wildlife habitat that occurs on levees and maintenance of the levees to prevent their failure. The Levee Program and the Ecosystem Restoration Program have collaborated extensively to develop strategies in order to minimize potential conflicts and to identify key areas where Ecosystem Restoration Program/Levee Program efforts can be coordinated. (For detailed discussion of this issue, refer to the earlier section, "Ecosystem Restoration Program/Levee Coordination".)

Another area of overlap between the Levee Program and the Ecosystem Restoration Program concerns efforts to reduce or reverse subsidence and actions to restore habitat. Both the Delta ecosystem and levee system stability can benefit from reducing land surface subsidence adjacent to levees. The creation of shallow-wetland habitat serves to reduce or reverse subsidence. Dredge permitting is a common area of concern for the Levee Program, the Ecosystem Restoration Program, and the Water Storage and Conveyance Program. Dredge permitting issues addressed by the Levee Program (as discussed in detail in the "Permit Coordination" section) also affect the

Ecosystem Restoration Program. The Ecosystem Restoration Program will require dredge permits in order to use dredged materials to create shallow-water habitat. Thus, the Levee Program's efforts to resolve dredge permitting issues also will benefit the Ecosystem Restoration Program.

Water quality and water supply reliability are closely tied to the integrity of the levee system. The consequences of a levee breach to water quality and water supply reliability can be catastrophic. Improvements to levee system integrity provided in the Levee Program also serve to provide better protection for water quality and water supply reliability. The Emergency Management and Response element of the Levee Program also will serve to better protect water quality and water supply reliability in the event of a levee breach or similar disaster, such as a toxic spill, by providing for a more immediate and organized response. An area of common concern for the Levee Program and Water Quality Program is toxicity of sediments and water quality impacts from dredging. Research advocated by the Levee Program to resolve dredge permitting issues also will provide useful information for the Water Quality program.

There are many significant linkages between levee system integrity and water storage and conveyance. Reservoir storage and levees function as a system with regard to flood control. For example, setback levees can provide additional benefits to flood control by increasing channel capacity. However, constructing and maintaining setback levees on Delta soils containing large amounts of peat can be difficult and expensive. For these reasons, the Levee Program generally does not advocate construction of setback levees in the Delta. All CALFED proposals for setback levees are included in the Ecosystem Restoration Program and Water Storage and Conveyance Program. The hydraulic impacts of levee maintenance and construction work included in the Levee Program will be examined on a project-specific basis. As with the Ecosystem Restoration Program and Water Quality Program, dredge permitting issues resolved by the Levee Program would benefit the Water Storage and Conveyance Program. The Water Storage and Conveyance Program will require dredge permits for dredging to increase channel capacities for conveyance and flood control. Thus, the Levee Program's efforts to resolve dredge permitting issue will also benefit the Water Storage and Conveyance Program.

Levee system integrity also is linked to watershed management. Many proposed watershed management actions may reduce the risk of levee failures by moving the timing, variability, and duration of floodplain inundation and water table elevation closer to an undisturbed condition through meadow restoration and wetland development.

In addition to coordination with other CALFED programs, the Levee Program is working in conjunction with efforts outside CALFED, where feasible. The Levee Program is working in coordination with the Corps on a "Delta Special Study" that will address rehabilitation and improvement of levees in the Delta. These coordination efforts could develop into a long-term Delta levee reconstruction program, with cost-sharing agreements among the Corps, State, and local agencies.

CALFED also is coordinating with the Corps and the Board in their efforts on the "Sacramento-San Joaquin River Basins Comprehensive Flood Control Study" currently under way. Because

the comprehensive flood control study area includes major tributaries into the Delta, CALFED actions need to be compatible with all comprehensive study actions.

The Levee Program has been communicating with representatives of the Long-Term Management Strategy (LTMS) Program to identify areas where coordination between the programs would be beneficial. The LTMS Program was launched in the Bay area to identify technically feasible and environmentally acceptable dredging and disposal options, and to develop a research program leading to a long-term management plan for dredging and disposal in the Bay Area. Information sharing between the two programs is beneficial in that the programs face many similar regulatory issues. In addition, many areas of technical information overlap, although the usefulness of the LTMS Program data to CALFED is limited by the greater salinity of the LTMS program environment. The Levee Program also has considered the use of dredged materials from the LTMS Program for levee construction and subsidence control. Currently, however, use of saline dredged material in the Delta seems only a remote possibility.

ADAPTIVE MANAGEMENT

Adaptive management is a fundamental concept of CALFED. For the Levee Program, adaptive management is in part a philosophical approach toward implementing some Levee Program actions in that it acknowledges that a better understanding of Levee Program issues is needed to succeed in program implementation. Adaptive management is also a structured decision-making process that includes monitoring, research, staged implementation of the program; a feedback process to integrate knowledge gained from monitoring and research; and the flexibility to change the program in response to new information. Under adaptive management, actions are designed, at least in part, to provide new information about the system. Areas where the adaptive management approach will be especially useful in Levee Program implementation include seismic risk assessment, subsidence, and levee and ecosystem restoration coordination. All of these issues are components of the CMARP (refer to later discussion of the CMARP under "Monitoring and Research").

Adaptive management also may be relevant in institutional arrangements and funding scenarios for levee construction and maintenance. For example, the Levee Program will use information gained from observing the successes and shortcomings of the current Delta Levee Subventions and Special Projects Programs to develop funding and administrative scenarios for levee maintenance and construction covered under the Levee Program. As conditions change in the Delta and more is learned about the system and how it responds to program actions, these actions may be adjusted to ensure that Levee Program objectives are met and the solution is durable.

MONITORING AND RESEARCH

Monitoring and research are key inputs to CALFED's adaptive management process. Monitoring gauge the success of individual Levee Program actions and provide feedback necessary for successful Levee Program implementation. Research also will provide information necessary for successful Levee Program implementation. Levee program monitoring and research will be developed largely within the context of the CMARP, which is developing a comprehensive monitoring and research program for CALFED as a whole. A panel of experts with a collective technical experience representative of all the different elements of the Levee Program has convened to develop the Levee Program component of the CMARP. Levee program monitoring and research under the CMARP will address monitoring for levee cross section compliance, subsidence, seismic activity, and success of environmental mitigation, as well as research on sediment toxicity and characterization. The CMARP will coordinate with existing programs such as the San Francisco Estuary Institute, Interagency Ecological Program, and LTMS to avoid duplication in developing research and monitoring efforts, and to build on existing monitoring and research programs where possible. (For a more complete discussion of the CMARP effort, see the CMARP appendix to the CALFED Bay-Delta Draft Programmatic EIS/EIR.)

In addition, the Levee Program is coordinating with the current near-term ecosystem (Category III) focused grant for research that will address sediment toxicity. The Levee Program has provided input and coordinated with members of the Delta Levees and Habitat Advisory Committee, Department of Fish and Game, and the near-term ecosystem restoration program in the design of this research project that will provide much needed information regarding sediment toxicity and develop a Comprehensive Strategy for Delta sediments.

COST ESTIMATE

The following preliminary costs include estimates for all elements of the Long-Term Levee Protection Plan. (Refer to the "Funding" section and Appendix B, "Cost Estimate Backup and Report" for additional information.)

Delta Levee Base Level Protection Plan

This estimate is for the total cost to rehabilitate and maintain project and non-project levees in the legal Delta up to the PL 84-99 standard. The estimate assumes major rehabilitation or reconstruction work will be performed on approximately 600 of the 1,116 miles of levee in the Delta. The remaining levees are assumed to meet or exceed the PL 84-99 standard. The estimate includes costs for engineering planning and design; geotechnical analyses; construction inspection; contract administration; obtaining environmental permits and dealing with regulatory

requirements; funding for the CMARP; erosion protection; environmental mitigation; maintenance; an overall contingency; and lands, easements, rights of way, relocations, and disposal areas (LERDS).

Because unit costs of Delta levee work vary substantially, a low and high cost estimate were provided to evaluate projects. The preliminary cost estimate to achieve the base level protection ranges from \$600 to \$1,300 million.

Assumptions:

The estimate assumes that:

- A majority of the design, construction, and right-of-way acquisition will be accomplished with local resources.
- Local borrow is readily available on the islands and beneficial reuse of dredged materials will be maximized.

Delta Levee Special Improvement Projects

The preliminary cost estimate to add Special Improvement Projects is \$360 million. The estimate is based on DWR Central District's request for approximately \$12 to \$15 million a year to support Special Projects. Central District has been requested to provide additional information on scope, schedule, and costs.

Assumptions:

The estimate assumes that:

- Special improvement projects will enhance the base level flood control improvements.
- A majority of the design, construction, and right-of-way acquisition will be accomplished with local resources.
- Local borrow is readily available on the islands.
- Beneficial reuse of dredged materials will be maximized.

Assumptions:

The estimate assumes that:

- Subsidence projects will be directed at control and management of subsidence as it affects levee system integrity.
- A majority of the design, construction, and right-of-way acquisition will be accomplished with local resources.
- Local borrow is readily available on the islands.
- Beneficial reuse of dredged materials will be maximized.

Delta Levee Emergency Management and Response Plan

The preliminary cost estimate for the Emergency Management and Response element is \$60 million.

Assumptions:

The estimate assumes that:

- Emergency management and response will be accomplished through existing programs.
- A \$10 million emergency response fund will be established and maintained.

Delta Levee Seismic Risk Assessment

The preliminary cost estimate for continuing the Seismic Risk Assessment element is \$5 million.

Assumptions:

The estimate assumes that:

- DWR will continue to lead the evaluation of seismic risk.
- Projects and research will include updates to area seismicity, evaluation of ground motion response, determination of soil parameters, and continuous site monitoring.

FUNDING

The Levee Program funding model must be consistent with the CALFED benefits-based approach to funding. The benefits of improved Delta levee system integrity include greater protection to Delta agricultural resources, municipalities, infrastructure, wildlife habitat, and water quality as well as navigation and flood control benefits. A funding model that includes federal, state, and local contributions allows costs to be shared by all beneficiaries.

The Long-Term Levee Protection Plan will be implemented over a 30-year period at an estimated cost of \$1.5 billion. Based on the current estimate, the funding will be approximately distributed as follows:

Base Level Protection	\$1,000 million
Special Improvements Projects	\$ 360 million
Subsidence Control	\$ 70 million
Emergency Management and Response	\$ 60 million
Seismic Risk Assessment	\$ 5 million
	\$1,495 million

The following problems related to funding the existing levee program will be addressed by the Levee Program:

- Funding for levee work is insufficient and inconsistent. Reimbursement to local agencies often is delayed, made at an insufficient rate, or not made at all—leaving bank loans, engineers, and contractors unpaid.
- Many local agencies cannot afford their share of costs under the current cost-sharing arrangements for levee maintenance work, without the additional financial burden of proposed levee upgrades.
- Dredging equipment and trained manpower have left the Delta, thereby reducing levee emergency response capabilities.

Reliable near- and long-term funding is paramount to the success of the Levee Program. Lack of adequate funding for levee maintenance and construction will impede the success of the Base Level Protection Plan and other elements of the Levee Program. For example, the success of the emergency response component of the program partially depends on the existence of an industry in the Delta to provide needed equipment for emergency response. It was assumed that continued funding for the Levee Program will recreate such an industry in the Delta so that these resources will be readily available when needed.

The Levee Program will obtain long-term federal and state funding authority, and develop appropriate cost-sharing scenarios between state, federal, and other interests. In developing funding models, the Levee Program will build on the strengths of, and seek continuity with,

existing funding programs such as the Subventions Program and Special Projects Program. In addition, the Levee Program will seek to resolve problems in current funding strategies and identify mechanisms that best secure long-term funding.

Under the existing State levee programs, local districts have financed projects in anticipation of reimbursements. The Subventions Program annually administers available funds, distributing funds on an equal basis to all participants in accordance with funding priorities approved by the Board. Each fiscal year, districts are notified of the available funding but cannot be sure what their final reimbursement will be until all claims are received and processed.

The uncertainty and time lag from work performance to reimbursement poses financial difficulties for many local agencies, as most districts lack the financial resources to provide funds up-front for an extended period. In some cases, the agencies incur high debt service charges or must delay payments to contractors. Consequently, contractors' reluctance to perform levee work drives up costs.

The Special Projects Program receives applications and enters into agreements with participants to fund specific projects. Projects eligible for funding must be in accordance with priorities approved by the California Water Commission. Once projects are deemed eligible, agreements are executed and local agencies can receive timely payments as work progresses. The lack of adequate and consistent appropriations in the Subventions and Special Projects Programs poses a challenge for local districts to complete planned maintenance and rehabilitation projects.

Additionally, many districts have experienced difficulty in rebounding from the long-term financial debt that was incurred while they waited for resolution of the 1980-1986 state and federal disaster assistance claims. The more recent 1995, 1997, and 1998 floods also have strained local financial resources. The overall financial health of these districts has significantly affected their ability to maintain their levee systems and limited their ability to upgrade their levees to a long-term levee standard.

Any of these funding issues can deter performance of adequate levee work. Therefore, the Levee Program will seek a means to provide up-front state and federal contributions for levee work. Adequate funding will enable districts to plan and finance their work with greater certainty of reimbursement. The Levee Program will work in conjunction with other programs to negotiate mutually beneficial funding arrangements. For instance, California Water Code Section 12995 indicates a federal interest in Delta levee rehabilitation due to benefits to navigation, commerce, and the environment and increased flood control. As discussed earlier, Levee Program coordination efforts on the "Delta Special Study" being prepared by the Corps could develop into a long-term Delta levee reconstruction program with cost-sharing agreements between the Corps, State, and local agencies.

The following principles also will guide development of Levee Program funding:

- Local sources will provide LERDS. Use of local sources is cost effective and allows maintenance work to proceed more smoothly. Local agencies will continue to ensure that costs are distributed equitably among their members.

- The Ecosystem Restoration Program will provide funds for net habitat enhancement requirements under current statutes, and the Levee Program will fund all mitigation necessary for levee construction.
- Funds for any necessary mitigation for levee construction work are included in the overall cost for the Levee Program and were assumed to be 10%. Federal, state, and local cost-sharing percentages include mitigation costs.

Delta Levee Base Level Protection Plan Funding

CURRENT FUNDING PROVISIONS

As discussed earlier, current programs that fund levee maintenance and construction often are insufficient or inconsistent. Many Delta interests cannot afford their share of costs under the current programs, without the additional financial burden of proposed levee upgrades. Problems with current funding provisions are discussed under "Delta Levee System – Integrity Problem Statement."

Levee work currently is funded up front by the local agencies and reimbursed up to 75% by the State through DWR under the Subventions Program. California Water Code Section 12300 authorizes \$6 million a year to be appropriated to the Delta Flood Protection Fund from the California Water Fund for the Subventions Program until July 1, 2006. Historically, less has been appropriated yearly. No funds currently are appropriated for the program past June 30, 1999.

PROPOSED FUNDING PROVISIONS

The Base Level Protection element will incorporate the levees currently covered under the existing Subventions Program. Proposed cost sharing for the Base Level Component will be 65% Federal/ 25% State/ and 10% local for construction to PL 84-99. Local agencies also will contribute LERDs. Planning costs will be cost shared at 50% Federal/50% State. Funding for maintenance will be provided 100% by the local agencies up to \$3,000 per mile of levee improvement. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Base Level Protection element are included in Tables 10 and 11.

Year(s)	Base Level Protection Plan Funding/Year ^a				Special Projects Funding/Year				Emergency Response ^c				Total Funding
	Fed	State	User ^b	Sub- total	Fed	State	User ^b	Sub- total	Fed	State	User ^b	Sub- total	
1	6	3	1	10	6	4	0	10	5	5	0	10	30
↑ RAMP 2	7	3	1	11	8	4	0	12	1	1	0	2	25
3	9	3	1	13	8	4	0	12	1	1	0	2	27
4	11	4	2	17	8	4	0	12	1	1	0	2	31
5	13	5	2	20	8	4	0	12	1	1	0	2	34
↓ 6	14	5	2	21	8	4	0	12	1	1	0	2	35
7	<u>14</u>	<u>5</u>	<u>2</u>	<u>21</u>	<u>8</u>	<u>4</u>	<u>0</u>	<u>12</u>	<u>1</u>	<u>1</u>	<u>0</u>	<u>2</u>	<u>35</u>
Totals	74	28	11	113	54	28	0	82	11	11	0	22	217

NOTES:

Funding in millions (1998 \$).

^a Includes subsidence control funding.

^b User to provide lands, easements, rights-of-way, relocations, and disposal areas.

^c Includes \$10 million first-year start-up costs.

Table 10. Proposed Levee Program 7-Year Cost Sharing Construction

Program Action	Federal	State	User ^a
Base Level Protection, Special Projects, and Subsidence Control			
Planning ^b	50%	50%	Entry permits
Construction ^c	65%	25%	10% plus LERRDs
Maintenance ^d	0%	0%	All costs (up to \$3,000/mile)
Emergency Management and Response			
First Response	0%	0%	100% (exhaust resources)
Secondary Response	50%	50%	LERRDs

NOTES:

LERRD = Lands, easements, right-of-way, relocations, and disposal areas.

^a Subject to an "ability to pay analysis."

^b Planning includes all activities required up to giving the construction contractor a "Notice to Proceed," including but not limited to environmental documentation and obtaining permits.

^c Construction is defined as eligible levee work over and above \$3,000/mile.

^d Maintenance includes routine preventative actions up to \$3,000/mile.

Table 11. Levee System Integrity Program Proposed Cost Sharing

Delta Levee Special Improvement Project Funding

CURRENT FUNDING PROVISIONS

Problems with current funding provisions are similar to those described for the Base Level Protection element.

As discussed previously, construction on levees included in the existing Special Projects Program is funded up front by local agencies and reimbursed by the State through DWR. DWR generally pays 100% of Special Project Program costs. Although no federal cost-sharing agreements exist for the Special Projects Program, the California Water Code encourages DWR to seek cost sharing with, or financial assistance from, federal agencies with programs applicable to or an interest in flood protection projects. California Water Code Section 12300 authorizes \$6 million a year to be appropriated to the Delta Flood Protection Fund from the California Water Fund for the Special Projects Program until July 1, 2006. Historically, less has been appropriated yearly. As with the Base Level Protection element, no funds currently are appropriated for the program past June 30, 1999.

PROPOSED FUNDING PROVISIONS

The Special Improvements Project element will adopt the goals of the existing Special Projects Program. Funding for this element of the Levee Program will be cost shared at 65% Federal/ 25% State/ and 10% local for construction. As in the Base Level Protection element, local agencies will contribute LERDs. Planning costs will be cost shared at 50% Federal/50% State. Funding for maintenance will be provided 100% by the local agencies up to \$3,000 per mile of improved levee. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Special Projects Program are shown in Tables 10 and 11.

Delta Levee Subsidence Control Plan Funding

CURRENT FUNDING PROVISIONS

No existing formal separate program provides funding for subsidence; however, subsidence research currently is funded under the existing Special Projects Program.

PROPOSED FUNDING PROVISIONS

Funding for the Subsidence Control element of the Levee Program will be cost shared at 65% Federal/ 25% State/ and 10% local. Local agencies will contribute necessary LERDs. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Subsidence Control Program are shown in Tables 10 and 11.

Delta Levee Emergency Management and Response Plan Funding

CURRENT FUNDING PROVISIONS

No existing formal program provides funding for initial emergency response, which is provided by local resources. The State provides assistance and funding when local resources are exhausted. If the governor declares an emergency and requests emergency assistance, federally funded emergency assistance is provided.

PROPOSED FUNDING PROVISIONS

Funds for the Emergency Management and Response element will be provided 100% by local interests for initial response. After local resources have been exhausted, secondary response funds will be cost shared at 50% Federal/50% State. After the established State funds are exhausted, funding will be 100% Federal. First-year start-up costs to establish a \$10 million Emergency Response Fund will be cost shared at 50% Federal/50% State. After the Emergency Response Fund is exhausted, the Federal Government will provide tertiary response funds through the Corps. Local agencies will contribute any necessary LERDs. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Emergency response element are shown in Tables 10 and 11.

Delta Levee Seismic Risk Assessment Funding

CURRENT FUNDING PROVISIONS

No existing formal program provides funding for seismic risk assessment.

PROPOSED FUNDING PROVISION

Funds for the Seismic Risk Assessment element will be covered under Special Improvement Projects funding, as described earlier. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Seismic Risk Assessment are shown in Tables 10 and 11 under Special Projects Funding.

The Levee Program will pursue long-term authority for state and federal funding for these cost-sharing scenarios. This will involve amending the sections of the California Water Code that pertain to Delta levee maintenance and construction funding. The Levee Program also will seek a mechanism to provide up-front funding to the local agencies.

STAKEHOLDER/SCIENCE REVIEW

Implementation of the Levee Program requires input from stakeholders, the technical community, and the public. A Levee Implementation Group (LIG) would be formed to provide recommendations to the Levee Program Manager on implementation policies, priorities, technical issues, and stakeholder concerns. The composition of the LIG is illustrated in Table 12.

Position	Agency/Stakeholder	Number of Staff
Chair	Levee Program Manager	One
CALFED Lead Agency Representatives	U.S. Environmental Protection Agency	One
	California Department of Fish and Game	One
	U.S. Fish and Wildlife Service	One
	National Marine Fisheries Service	One
	State and Regional Water Quality Control Boards	One
	U.S. Bureau of Reclamation	One
	California Department of Water Resources	One
	U.S. Army Corps of Engineers	One
Other Agency Representatives	California Department of Health Services	One
	California Department of Food and Agriculture	One
	U.S. Geological Survey	One
Stakeholder Representatives	Environmental	Two
	Urban	Two
	Agricultural	Two
	Dischargers	One
	Business	One
	Recreational	One

Table 12. Composition of Levee Implementation Group

Currently, the Levees and Channels Technical Team provides technical guidance to the Levee Program. The team meets monthly and is comprised of stakeholders, the technical community, and the public. Several subteams address specific Levee Program concerns in detail, including the Seismic Assessment Subteam, the Subsidence Subteam, and the Emergency Response Subteam. The LIG would supercede the Levees and Channels Technical Team. Most likely, many members of the existing Levees and Channels Technical Team would serve on the proposed LIG.

IMPLEMENTATION STRATEGY

The Levee Program objective 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 catastrophic failure can be reduced by implementing an integrated and comprehensive management program for levees.

Implementation objectives, targets, and actions for the individual Levee Program elements are presented in Tables 6 through 8.

Staged implementation and staged decision making will be part of the implementation strategy as they support the adaptive management process (refer to the discussion under "Adaptive Management"). The program will be implemented in stages according to major program milestones. The first stage is 7 years long, will start in 2000, and includes the following actions:

1. Develop and implement an outreach, coordination, and partnering program with local landowners, including individuals, local agencies, resource conservation districts, water authorities, irrigation districts, farm bureaus, and other local agencies to ensure local participation in planning design, implementation, and management of levee projects. (Year 1.)
2. Obtain short-term federal and state funding authority as a bridge between the existing Delta Flood Protection Authority (AB 360) and long-term levee funding. (Years 1-5.)
3. Obtain long-term federal and state funding authority. For example, the current Corps' "Delta Special Study" would develop into a long-term Delta levee reconstruction program with the Board as the local cost-sharing partner. (Years 1-7.)
4. Maintain current federal cost sharing of 65% and establish state and local cost-sharing percentages for all Levee Program work. (Year 1.)
5. Conduct project-level environmental documentation and obtain appropriate permits. (Years 1-7.)

6. Implement demonstration projects for levee designs that minimize the need for continuous disruption of habitat from levee maintenance and minimize the need for ongoing mitigation from disrupted habitat. (Years 1-7.)
7. Coordinate Delta levee improvements with ecosystem restoration improvements. For example, coordinate improvements, modify maintenance manuals as appropriate to accommodate Ecosystem Restoration Program actions near levees, and separately track levee mitigation costs and Ecosystem Restoration Program costs. (Years 1-7.)
8. Fund levee improvements up to the PL 84-99 standard—approximately \$114 million [\$74 million during years 1-5 and \$40 million during years 6-7] in Stage 1. For example, proportionally distribute available funds to entities making application for cost sharing of Delta levee improvements. (Years 1-7.)
9. Further improve levees with significant statewide benefits—approximately \$82 million (\$58 million during years 1-5 and \$24 million during years 6-7) in Stage 1. For example, *improve levees with* statewide benefits to water quality or highways. (Years 1-7.)
10. Coordinate Delta levee improvements with Stage 1 water conveyance improvements and with potential conveyance improvements in subsequent stages. (Years 1-7.)
11. Institute the Emergency Management Plan. For example, establish a \$10 million revolving fund, refine command and control protocol, stockpile flood-fighting supplies, establish standardized contracts for flood-fighting and recovery operations, and outline environmental considerations during an emergency. (Years 1-7.)
12. Initiate a subsidence control program to develop and implement BMPs for lands adjacent to levees—approximately \$11 million for Stage 1. (Years 1-7.)
13. Continue evaluating the seismic risk to the integrity of the levee system and developing effective ways to mitigate that risk. (Years 1-7.)

Knowledge gained from monitoring and research will be incorporated into staged implementation and decisionmaking through a feedback process as part of adaptive management. The CMARP will play a key role in the adaptive management approach to Levee Program implementation.

Other key points for Levee Program implementation include:

- The Levee Program will need to coordinate the planning, regulatory, and permitting processes that affect the levee system and to provide a reliable funding source.
- The Levee Program will be built on a foundation of existing state, federal, and local laws and agency programs. The Levee Program will supplement and improve these existing programs, eliminate deficiencies, and enhance opportunities to improve levee system integrity.

- In keeping with CALFED's commitment to improve broad problem areas, every effort will be made to integrate Levee Program actions in such a way as to provide opportunities for resolution of multiple problems in the Delta and to coordinate Levee Program actions with other CALFED actions. For instance, levee improvements will be coordinated with ecosystem restoration and conveyance improvements to protect existing Delta characteristics and processes.
- The Levee Program will seek to reduce conflicts where possible.

SUISUN MARSH LEVEE SYSTEM

CALFED has added the Suisun Marsh levee system to the Levee Program as an optional strategy to achieve its Objectives. Efforts to clarify linkages of these actions to the Objectives is ongoing.

Introduction

The Suisun Marsh consists of approximately 57,000 acres of marshland and 27,000 acres of bays and waterways. Waterways include a network of tidal sloughs, principally tributaries of Suisun and Montezuma Sloughs, together with many drainage sloughs. Major streams carrying runoff from surrounding hills and flood plains include Green Valley, Suisun, Ledge wood, Laurel, McCoy, Union, and Denver ton Creeks.

The Suisun Marsh is one of the few major marshes remaining in California and furnishes habitat for a variety of plants and animals. The Suisun Marsh serves as a principal waterfowl wintering area and also is highly valued for fishing and recreation. Despite reclamation improvements in the late 1800s and early 1900s, agricultural development in the Suisun Marsh has been largely unsuccessful due to poor drainage and salt accumulation in the soil. Limited cattle production and dry farming of grain crops occurs today where suitable soils exist. For the most part, however, the marshlands have been converted to private duck clubs and state wildlife management areas. Continued management of the Suisun Marsh for waterfowl and recreational activities is threatened by periodic flooding and the problem of maintaining a proper salt balance.

The Suisun Marsh is an area of regional and national importance, providing a broad array of benefits that include recreation use and fish and wildlife habitat. The Suisun Marsh's 230 miles of exterior levees are an integral part of its landscape and are key to preserving the Suisun Marsh's physical characteristics and processes.

The focus of the Suisun Marsh component of the Levee Program is to provide long-term protection for multiple Suisun Marsh resources by maintaining and improving the integrity of the Suisun Marsh levee system. The Suisun Marsh component of the Levee Program focuses on the legally defined Suisun Marsh.

Background Information

Suisun Marsh islands provide many benefits, including recreation uses and fish and wildlife habitat. Most of the Suisun Marsh land surface elevations are below sea level. Suisun Marsh levees are vulnerable to failure, especially during floods, because of poor levee construction and inadequate maintenance.

A chronological summary of reclamation and water management activities that influenced the current Suisun Marsh is provided in Table 13. The Suisun Marsh includes over 84,000 acres, 150 miles of meandering waterways, and over 230 miles of exterior levees. AB 360 currently includes only selected exterior levees in the Suisun Marsh.

Time	Event
1850s	Settlers began to build low sod levees to "reclaim" tidal wetlands in the Suisun Marsh for agricultural uses.
1860s	Levee construction increased and over 20 reclamation districts were formed in the Suisun Marsh.
1930	By this date, approximately 44,600 acres of tidal wetlands had been converted to commercial agricultural purposes in the Suisun Marsh.
1950s	By this date, the majority of the diked lands in the Suisun Marsh had been converted from agriculture to seasonal managed wetlands and duck clubs.
1972	Passage of the Federal Coastal Zone Management Act.
1977	Passage of the Suisun Marsh Preservation Act triggered a series of actions to more aggressively protect the Suisun Marsh and its fish and wildlife values.

Table 13. Chronological Summary of Events Important to the Suisun Marsh

Inundation of one or more islands in the Suisun Marsh can disrupt wildlife habitat and other land uses either permanently or until repairs can be made. Inundation of roads, electric power lines, telephone lines, gas mains, and other infrastructure can cause lengthy delays in service. Several Suisun Marsh roads run along levees that are vulnerable to collapse due to erosion or overtopping. 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 additional seepage.

Preliminary modeling studies of the Suisun Marsh indicate that large-scale levee failure in the Suisun Marsh can degrade western Delta channel water quality. Studies also show that small-scale breaks could improve western Delta channel water quality. These modeling studies currently are being refined.

Cost Estimate

Most of the Suisun Marsh lies at a level near or below mean tide elevation. To protect marshland from uncontrolled tidal inundation and flooding, human-made levees have been added over the years to supplement the natural levees throughout the Suisun Marsh. Approximately 90% of the marshland now is enclosed by a system of low levees, ranging in height from 4 to 8 feet above ground level. This system of levees is critical to the management of water quality and waterfowl habitat in the Suisun Marsh.

To prepare estimates, the levee classification strategy developed by Ramlit (1983) was used. This report is entitled "Suisun Marsh Levee Evaluation" and was submitted to the Corps, San Francisco District in February 1983. The levee types and classes used in the following discussion are based on the Ramlit evaluation. Levees were identified according to adjacent waterways and grouped in the following classes:

- Class I. Nine exterior levees protecting all islands and along primary sloughs (Montezuma, Suisun, and Nurse).
- Class II. Exterior levees along all secondary sloughs (Goodyear, Cordelia, and Hill).
- Class III. Dead-end sloughs (Wells, Sheldrake, and Boynton).

Levees also were classified based on the extent of the repairs that would be needed to bring them to Suisun Resource Conservation District (SRCD) standards. Type A levees required the most significant reconstruction effort and could entail the use of imported fill and phased construction. Type D levees would require only limited amounts of repair. Approximately one-third of the Suisun Marsh levees were classified as Type A levees.

The following preliminary cost estimates are for the Suisun Marsh Levee Base Level Protection Plan and the Suisun Marsh Levee Special Improvement Projects Plan without Ecosystem Restoration Program Plan actions.

The estimate is for the total cost to reconstruct Class I A, B, C, and D, and Class II A and B levees in the Suisun Marsh up to the SRCD standard. This estimate assumes work will be performed on approximately 155 of the 229 miles of levee in the Suisun Marsh. The estimate includes costs for design, construction, and LERDS.

Methods to prepare the cost estimates focused primarily on the unit costs estimated by Ramlit (1983). Those costs were updated using indices from the Engineering News Record to account for inflation and construction cost increases. Tables 17 and 18 in the Ramlit evaluation were used to calculate the cost estimates for the Suisun Marsh Levee Base Level Protection Plan and Suisun Marsh Levee Special Improvement Projects Plan.

A summary of rehabilitation costs by general waterway classes is given in Table 17. Levees along Class I waterways represent the bulk of the total estimated repair cost (71%). Repair costs for levees on Class II and III waterways amount respectively to 18% to 11% of the total.

Table 18 provides a breakdown of estimated costs according to the five general levee types. The percentage of total rehabilitation costs attributable to each levee type are as follows: Type A - 36%; Type B - 8%; Type C - 50%; and Type D - 6%.

The preliminary cost estimate for rehabilitating 155 miles of levees in the Suisun Marsh is estimated at \$60 million (all costs are at March 1998 price level).

Annual Maintenance

The preliminary cost estimate for annual maintenance costs for the exterior levee system was computed at approximately \$350,000.

Assumptions:

The estimate assumes that:

- Quantities are based on a "typical" levee section for non-project levees and proposed levee improvement cross sections.
- A majority of the design, construction, and right-of-way acquisition will be accomplished with local resources.
- Local borrow is readily available on the islands.
- Beneficial reuse of dredged materials will be maximized.

These estimates are preliminary and are being developed and evaluated at a programmatic level. CALFED staff is continuing to refine these costs. More focused analysis and detailed estimates will occur in subsequent refinement efforts.

Funding

Under the proposed program for the Suisun Marsh, funding would be provided and equitably distributed to federal and state governments, and participating local agencies or public wetland managers such as DFG.