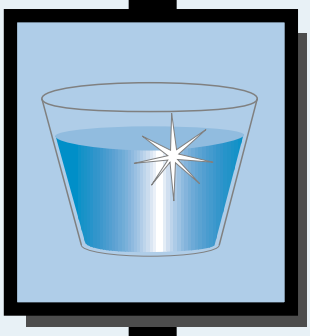

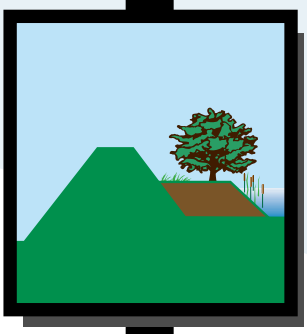

CALFED
BAY-DELTA
PROGRAM

Levee System Integrity Program Plan

Final Programmatic EIS/EIR Technical Appendix

July 2000

Levee System Integrity Program Plan
July 2000

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

CALFED
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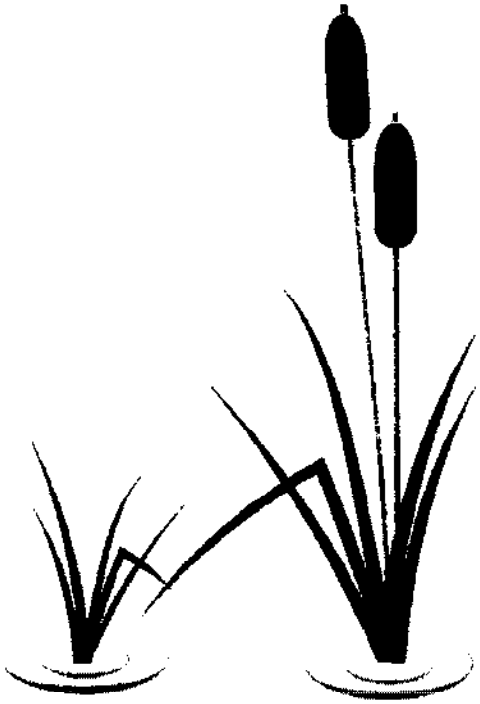
FOREWORD

The Delta Levee System Integrity Program, like all components of the CALFED Bay-Delta Program (Program), is being developed and evaluated at a programmatic level. The Program is currently in what is referred to as Phase II, in which the CALFED agencies are developing a Preferred Program Alternative that will be subject to a comprehensive programmatic environmental review. This report describes both the long-term programmatic actions that are assessed in the June 1999 Draft Programmatic Environmental Impact Statement/ Environmental Impact Report (EIS/EIR), as well as certain more specific actions that may be carried out during implementation of the Program. The programmatic actions in a long-term program of this scope necessarily are described generally and without detailed site-specific information. More detailed information will be analyzed as the Program is refined in its next phase.

Implementation of Phase III is expected to begin in 2000, after the Programmatic EIS/EIR is finalized and adopted. Because of the size and complexity of the alternatives, the Program likely will be implemented over a period of 30 or more years. Program actions will be refined as implementation proceeds, initially focusing on the first 7 years (Stage 1). Subsequent site-specific proposals that involve potentially significant environmental impacts will require site-specific environmental review that tiers off the Programmatic EIS/EIR. Some actions, such as levee rehabilitation, also will be subject to permit approval from regulatory agencies.



EXECUTIVE SUMMARY

This Levee System Integrity Program Plan 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 conveyance 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 conveyance, navigation, commerce, and the environment and from reduced flood damage.

> This document formulates an effective strategy to achieve the Levee System Integrity Program objective and is indeed necessary to facilitate all CALFED objectives. The Levee System Integrity Program Plan would be implemented over a period of 30 or more years and cost approximately $1.5 billion (1998 dollars).

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.

Over the past 10 years, staff from the California Department of Water Resources (DWR), California Department of Fish and Game (DFG), 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 three supply depots 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 and economic issues to enable expanded dredging and beneficial reuse of dredged material,
- Further improving existing emergency response capabilities,
- Reducing conflicts between levee maintenance and terrestrial and aquatic habitat resources on levees,
- Improving permit coordination,
- Incorporating subsidence control, and
- Continuing to quantify risks to levees 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. As mandated by the California State Legislature and adopted by CALFED, the physical characteristics of the Delta should be preserved essentially in their present form. This is necessary to protect the beneficial uses of the Delta. The key to preserving the Delta's physical characteristics and to achieving CALFED's objectives is the levee system. Over the next 30 or more years, CALFED will invest billions of dollars in the Delta. The levees must protect this investment.

The existing levee program was intended to improve Delta levees up to the California/ Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan (HMP) standard. As of January 1998, 36 of 62 (58%) Delta islands and tracts were in compliance with the HMP standard. This has resulted in a significant improvement in the ability to protect the beneficial uses of the Delta. However, as CALFED invests in the Delta, more is at risk. Therefore, CALFED has chosen to improve Delta levees to a higher level.

The CALFED Levee Program will institute a program that is cost-shared among the beneficial users, to reconstruct Delta levees to the Corps' PL 84-99 Delta Specific Standard. This action will increase levee reliability and reduce emergency repair costs. In addition, levee districts meeting this levee standard are eligible for federal emergency assistance under PL 84-99.

The CALFED Levee Program also will continue the existing Special Flood Control Projects effort to provide additional flood protection for key Delta levees that protect public benefits of statewide significance.

The CALFED Levee Program will institute a program that is cost-shared among the beneficial users, to reconstruct Delta levees to the Corps' PL 84-99 Delta Specific Standard.

Funding for levee work is insufficient, inconsistent, and often delayed. Under the existing State levee programs, local agencies finance projects in anticipation of reimbursements. The Delta Levees Maintenance Subventions Program (Subventions Program) annually distributes available state funds on an equal basis to all participants as 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 rehabilitation projects.

Under the existing State levee programs, local agencies finance projects in anticipation of reimbursements.

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 have 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' "Sacramento-San Joaquin Delta Special Study" could be used to establish a federal authority and subsequent federal funding. The Levee Program will establish consistent adequate funding for the Subventions and Special Projects Programs 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, habitat restoration and creation, and subsidence control has been curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta. Regulatory agencies limit dredging in the Delta due to water quality and endangered species concerns. The dredged material can be relocated to suitable habitat development sites such as in-channel islands, waterside berms, or on-island areas, configured with different topographic features, and planted with selected vegetation to produce and/or improve diverse habitat types. Because insufficient data are 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.

Regulatory agencies limit dredging in the Delta due to water quality and endangered species concerns.

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 significantly improved over the past several years. The State Office of Emergency Services (OES) continues to work with other emergency response organizations, including DWR, local Delta agencies, counties, FEMA, and the Corps to improve the emergency response system. However, the system is limited by insufficient dedicated Delta funding. Command and control procedures also need to be continuously refined using adaptive management principles.

CALFED plans to build on the existing emergency response system. CALFED's Emergency Response Subteam determined that an effective Delta levee emergency response program should be concentrated in seven areas:

- Funding;
- Response by state and federal agencies;
- Availability of flood fight resources;
- Integrated response;
- Clarification of regulatory procedures;
- Clarification of program eligibility, inspection, documentation, auditing, and reimbursement procedures; and
- Dispute resolution.

Levee reconstruction and maintenance sometimes 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 keep vegetation off of 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.

In general, vegetation on levees results in more difficult levee maintenance.

CALFED will coordinate with state and local agencies to develop updated environmental baseline values. When reconstructing levees, mitigation and enhancement of existing habitat must be relocated outside the minimum section required for levee integrity (structural cross section) when possible. CALFED will work to establish a conservation strategy that encourages levee managers to allow critical habitat to grow on levees while giving assurances that levee managers will be able to maintain their levees.

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 often exist between regulatory agencies with overlapping jurisdiction. A more efficient permit coordination process is needed.

Historically, obtaining permits for levee work has been difficult.

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 relax permitting requirements but will include information sharing among regulatory agencies to coordinate the permitting process. The permit coordination process also would be designed to address broad issues in order to improve the efficiency of such processes as general and regional permits, mitigation banks, and habitat improvement areas.

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 land use.

Subsidence near some levees in the Delta may adversely affect levee integrity.

Seismic loading threatens Delta levees. Some CALFED stakeholders are concerned that earthquakes may pose a catastrophic threat to Delta levees, that seismic forces could cause multiple levee failures in a short time, and that such a catastrophe could overwhelm the current emergency response system.

CALFED agrees that earthquakes pose a potential threat. In addition, Delta levees are at risk from floods, seepage, subsidence, and other threats. To address this concern, CALFED has begun a risk assessment to quantify these risks and develop a risk management strategy.

Earthquakes pose a potential threat. In addition, Delta levees are at risk from floods, seepage, subsidence, and other threats.

Over the past year, the Seismic Risk Assessment Subteam quantified the seismic risk to Delta levees. CALFED is continuing its risk assessment of floods, seepage, subsidence, and other threats.

Several risk management options have been developed for inclusion in the CALFED Preferred Program Alternative. The available risk management options include, but are not limited to:

- Improving emergency response capabilities,
- Reducing the fragility of the levees,
- Improving through-Delta conveyance,
- Constructing an isolated facility,
- Developing storage south of the Delta,
- Releasing more water stored north of the Delta,
- Restoring tidal wetlands,
- Controlling and reversing island subsidence,
- Curtailing Delta diversions, and
- Continuing to monitor and analyze total risk.

The final Risk Management Plan may include a combination of these options.

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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.

CMARP. Comprehensive Monitoring, Assessment, and Research Program.

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.

Freeboard. The vertical distance between the levee crest and the design water surface elevation.

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.

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.

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.

GLOSSARY (CONTINUED)

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. Subsidence is discussed in terms of levee subsidence or settlement and interior island subsidence.

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 legal 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
EOS	earth observation system
EPA	U.S. Environmental Protection Agency
FEMA	Federal Emergency Management Act
GIS	geographic information system
GPS	global position system
HMP	Hazard Mitigation Plan
LERRDs	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
OES	Office of Emergency Services
PL	Public Law
RWQCB	Regional Water Quality Control Board
SEMS	Standardized Emergency Management System
SB	Senate Bill
Special Projects	Special Delta Flood Protection Projects

LIST OF ACRONYMS (CONTINUED)

SRCD	Suisun Resource Conservation District
Subsidence Control	Delta Levee Subsidence Control Plan
Subventions Program	Delta Levee Maintenance Subventions Program
SWP	State Water Project
WDRs	Waste Discharge Requirements
ZOI	zone of influence

1. 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.

Levees are critical to preserving and improving the Delta's physical characteristics and processes, including definition of the Delta waterways and islands. Many levees do not provide a level of flood protection commensurate with the high value of beneficial uses they protect.

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 conveyance 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. The federal government benefits from improvements to navigation, commerce, conveyance, and the environment and from reduced flood damage.

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 infra-structure 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. (California Department of Water Resources 1982, Bulle-tin 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.

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.

1.1 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.

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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 U.S. Army Corps of Engineers (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.

1.2 CURRENT DEFICIENCIES - 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 Levee System Integrity Program Plan develops strategies to address the following problems.

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.

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 California/Federal Emergency Management Agency (FEMA) Hazard Mitigation Plan (HMP) standard. As of January 1998, 36 of 62 (58%) Delta islands and tracts were in compliance with the HMP standard. 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 curtailed due to regulatory constraints, causing dredging equipment and trained manpower to leave the Delta. Regulatory agencies 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 significantly improved over the past several years; however, the system is limited by insufficient dedicated Delta funding. In addition, improvements in command and control need to be continuously refined.

Levee reconstruction and maintenance sometimes 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 keep vegetation off of 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.

1.3 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.

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 system (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.

1.4 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 CALFED problem area consists of the legal Delta, Suisun Bay (extending to the Carquinez Strait), and the Suisun Marsh. The geographic scope of the CALFED 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.

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.

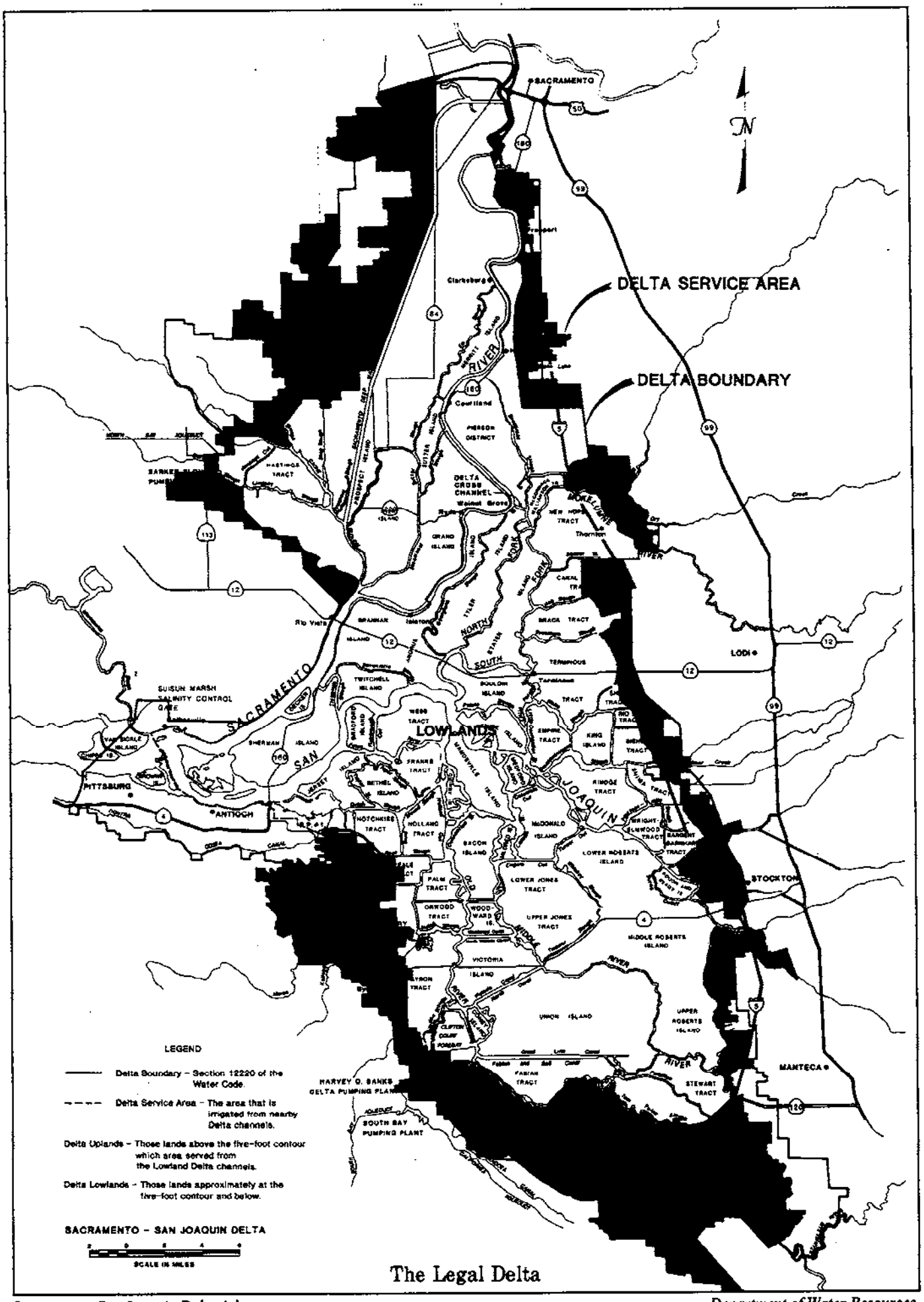
The overall Levee Program objective is to reduce the risk to land use and associated economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees. Levee Program actions focus primarily on the legal Delta as defined in the Water Code and illustrated in Figure 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. Levee Program goals will be achieved through implementation of this Levee System Integrity Program Plan.

The goal is to provide long-term protection for multiple Delta resources by maintaining and improving the integrity of the Delta levee system. The Levee Program aims to integrate ecosystem restoration and Delta conveyance actions with levee improvement activities.

The specific elements of the Levee Program include the:

- 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 Risk Assessment and Risk Management Strategy.

Figure 1



The Legal Delta

2. Program Elements

2.1 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.

The goal of the Delta Levee Base Level Protection Plan element is to improve all Delta levees to a uniform base level standard.

2.1.1 INTRODUCTION

The Delta Levee Maintenance Subventions Program was established in 1973 and amended by the Delta Flood Protection Act of 1988. 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.

2.1.2 SCOPE

Approximately 385 miles of project levees and 715 miles of non-project levees are located in the legal Delta (Figures 2 and 3). "Project levees" are levees that were improved or adopted as part of federal flood control projects. Most of the project levees are along the

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

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

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.

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 520 miles of levee will need to be rehabilitated and brought up to PL 84-99 standards. All 1,100 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.

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, postflood 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.

Figure 2

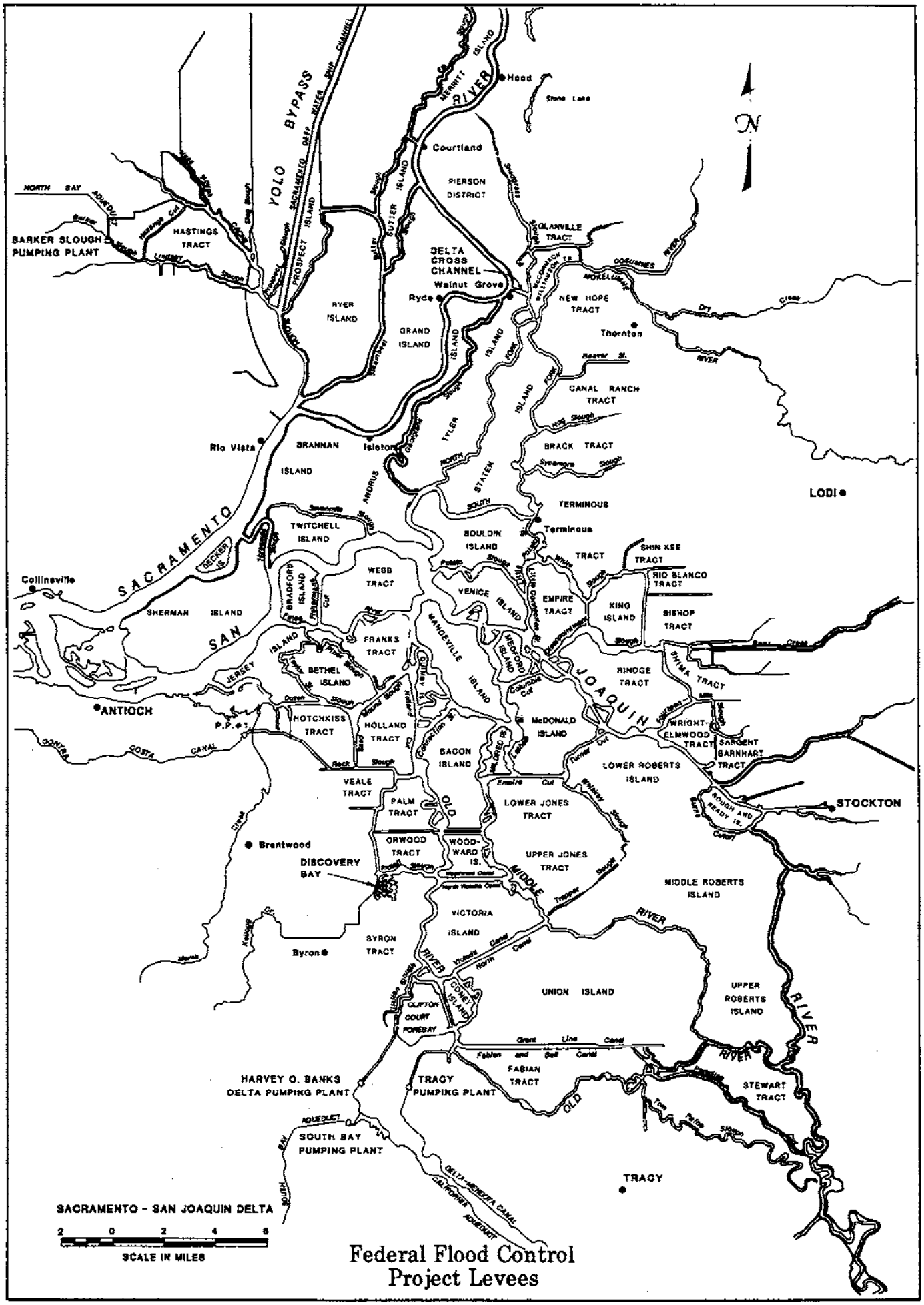
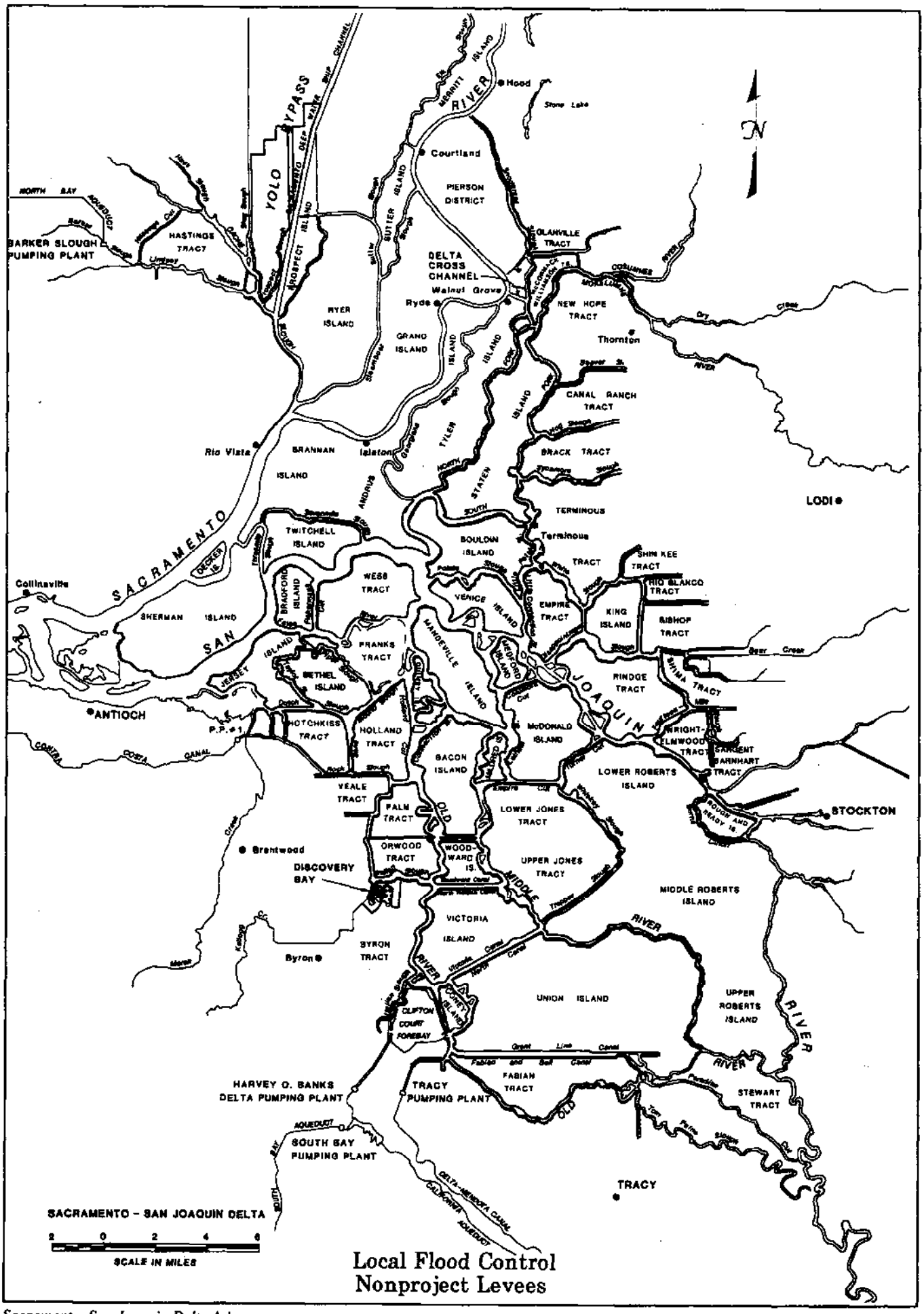

Federal Flood Control
Project Levees
SACRAMENTO - SAN JOAQUIN DELTA
SCALE IN MILES
2 0 2 4 6
N
SACRAMENTO
SAN JOAQUIN
YOLO BYPASS
RIVER
Hood
Courtland
Walnut Grove
Ryde
Rio Vista
Isleton
Terminous
Thornton
Collinsville
ANTIOCH
Brentwood
Byron
STOCKTON
LODI
TRACY
DISCOVERY BAY
BARKER SLOUGH PUMPING PLANT
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
SOUTH BAY PUMPING PLANT
DELTA CROSS CHANNEL
PIERSON DISTRICT
HASTINGS TRACT
RYER ISLAND
GRAND ISLAND
BRANNAN ISLAND
TWITCHELL ISLAND
SHERMAN ISLAND
BRADFORD ISLAND
WEBB TRACT
FRANKS TRACT
BETHEL ISLAND
HOTCHKISS TRACT
HOLLAND TRACT
VEALE TRACT
PALM TRACT
ORWOOD TRACT
WOODWARD IS.
VICTORIA ISLAND
BYRON TRACT
CLIFTON COURT FOREBAY
UNION ISLAND
FABIAN TRACT
BACON ISLAND
McDONALD ISLAND
LOWER JONES TRACT
UPPER JONES TRACT
LOWER ROBERTS ISLAND
MIDDLE ROBERTS ISLAND
UPPER ROBERTS ISLAND
STEWART TRACT
RINDGE TRACT
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
ROUGH AND READY IS.
BISHOP TRACT
KING ISLAND
EMPIRE TRACT
VENICE ISLAND
MANDEVILLE ISLAND
BACON ISLAND
BOULDIN ISLAND
BRACK TRACT
CANAL RANCH TRACT
NEW HOPE TRACT
GLANVILLE TRACT
TERMINOUS TRACT
SHIN KEE TRACT
RIO BLANCO TRACT
SHIMA TRACT
DECKER IS.
CONTRA COSTA CANAL
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT

Figure 3


Local Flood Control
Nonproject Levees
SACRAMENTO - SAN JOAQUIN DELTA
SCALE IN MILES
2 0 2 4 6
N
SACRAMENTO
SAN JOAQUIN
RIVER
YOLO BYPASS
DELTA CROSS CHANNEL
BARKER SLOUGH PUMPING PLANT
NORTH BAY AQUEDUCT
HASTINGS TRACT
PIERSON DISTRICT
OLANVILLE TRACT
NEW HOPE TRACT
Thornton
Hood
Courtland
Walnut Grove
Ryde
RYER ISLAND
GRAND ISLAND
BUTTER ISLAND
CANAL RANCH TRACT
BRACK TRACT
TERMINOUS
Terminous
Rio Vista
BRANNAN ISLAND
Isleton
TWITCHELL ISLAND
BOULDIN ISLAND
SHIN KEE TRACT
RIO BLANCO TRACT
EMPIRE TRACT
KING ISLAND
BISHOP TRACT
LODI
Collinsville
SHERMAN ISLAND
WEBB TRACT
VENICE ISLAND
FRANKS TRACT
BETHEL ISLAND
MANDEVILLE ISLAND
BEDFORD ISLAND
RINDGE TRACT
SHIMA TRACT
ANTIOCH
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HOTCHKISS TRACT
HOLLAND TRACT
McDONALD ISLAND
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
BACON ISLAND
LOWER ROBERTS ISLAND
VEALE TRACT
PALM TRACT
LOWER JONES TRACT
STOCKTON
ROUSH AND READY IS.
Brentwood
ORWOOD TRACT
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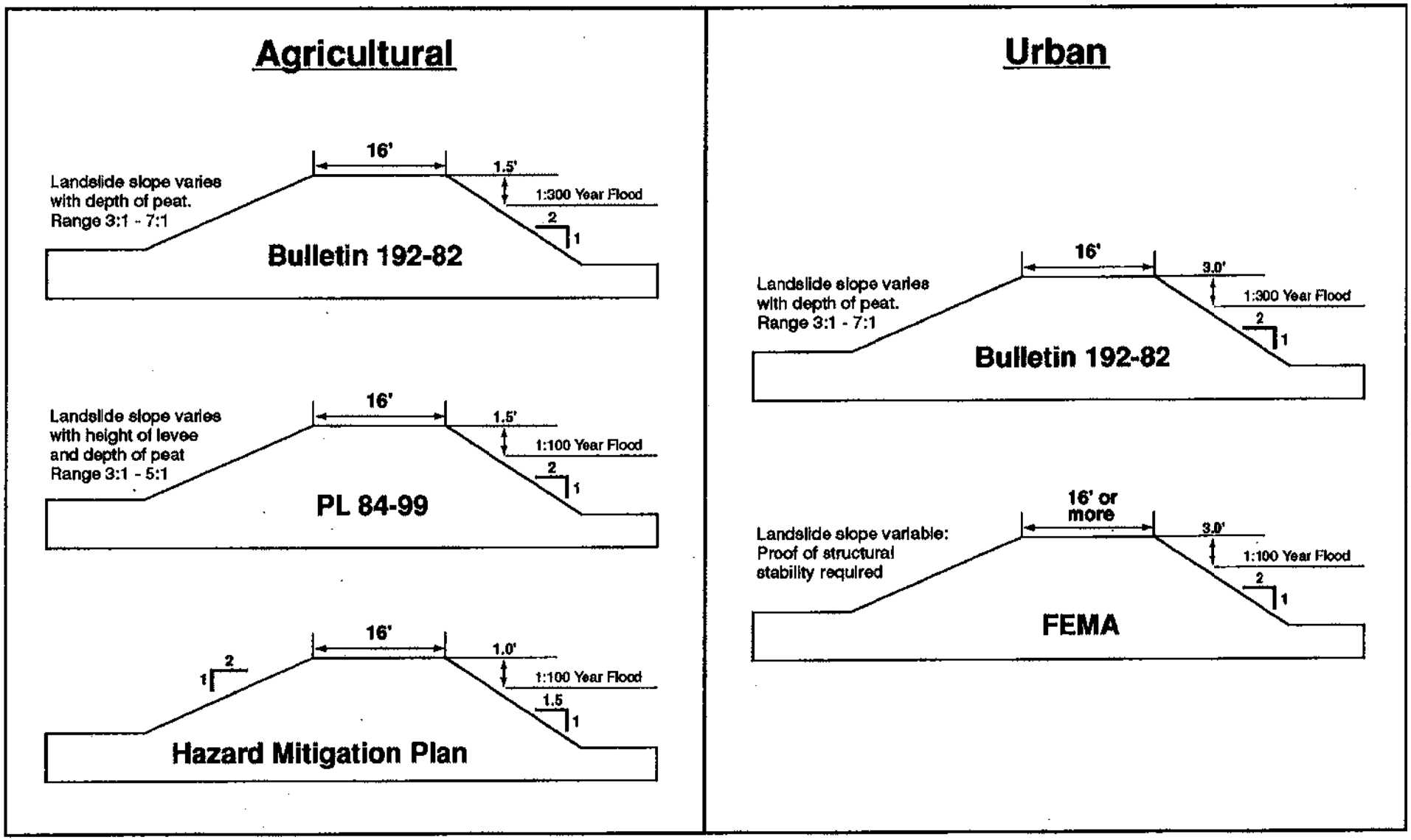
DISCOVERY BAY
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
BYRON TRACT
Byron
UNION ISLAND
UPPER ROBERTS ISLAND
CLIFTON COURT FOREBAY
CLIFTON COURT ISLAND
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
FABIAN TRACT
STEWART TRACT
SOUTH BAY PUMPING PLANT
TRACY
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT

Figure 4

Levee Standards



2.1.3 CRITERIA AND PROJECT APPROVAL

The State Reclamation 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). In addition, DWR's Bulletin 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.

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.

2.1.4 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.

2.1.5 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,

Local agencies will prioritize projects based on their individual needs.

considering the needs of flood control, water quality, recreation, navigation, habitat improvement, and fish and wildlife.

2.1.6 MAINTENANCE

There is a difference between the maintenance standard as defined by the California Water Code and the PL 84-99 maintenance standard. This difference in maintenance standards may result in greater habitat mitigation and enhancement requirements.

The PL 84-99 maintenance standards may result in greater habitat mitigation and enhancement requirements.

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.

2.1.7 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.

DWR will conduct at least one annual inspection of every levee for which maintenance or improvement costs have been paid to the local agencies.

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.

2.1.8 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 Levee System Integrity Program Plan, is discussed in a later section of this plan.

2.2 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 protects 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.

The goal of the Delta Levee Special Improvement Projects element is to provide additional flood protection separate from the Base Level Protection element for Delta islands that protects such public benefits as water quality, the ecosystem, life and personal property, agricultural production, cultural resources, recreation, and local and statewide infrastructure.

2.2.1 INTRODUCTION

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

The Delta Flood Protection Act of 1988 created the Special Flood Control Project Program. 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 24f 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.

2.2.2 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 key 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.

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.

2.2.3 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 now subject to the approval of the California Water Commission.

However, for the CALFED Program to achieve its objectives, this authority must be coordinated with the CALFED Program. The following change in the Water Code is suggested:

- The Levee Implementation Group (LIG), as established by CALFED, will develop a priority list of Special Improvement Projects consistent with the CALFED objectives and the primary purpose of the Special Flood Control Projects authority. The LIG is comprised of CALFED agencies and stakeholders to provide a forum for stakeholder and science review and to coordinate Levee Program actions with all other CALFED actions.

- The priority list will be approved by the CALFED Policy Group (or new CALFED umbrella authority).

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 existing matrix of objectives and island attributes (see Table 5) and the more detailed Special Projects information matrix (see Appendix D) presented in this Levee System Integrity Program Plan, would supplement a new CALFED priority matrix developed to support the CALFED objectives. The matrix of objectives, attributes, and priorities should be evaluated regularly to adapt to the changing Delta environment.

Special Improvement Projects could be prioritized based on a matrix of objectives and island attributes.

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

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

2.2.4 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 local 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.

2.2.5 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 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

Table 5. Special Projects Matrix of Objectives and Attributes

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

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.

2.2.6 MAINTENANCE

Prior to the adoption of any maintenance criteria, the Board will hold public hearings and revise the criteria as deemed necessary.

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 and eligible non-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. 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. Prior to the adoption of any maintenance criteria, the Board will hold public hearings and revise the criteria as deemed necessary.

2.3 DELTA LEVEE SUBSIDENCE CONTROL PLAN

The goals of the Delta Levee Subsidence Control Plan (Subsidence Control) element are to reduce or eliminate the risk to levee integrity from subsidence and assist in the coordination of subsidence-related linkages with other CALFED programs. This element is being developed and evaluated at a programmatic level. Appendix E contains two subsidence reports developed by the Subsidence Subteam. One report discusses the effects 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. The other report presents a broader perspective in an evaluation of subsidence as it affects all CALFED objectives.

The goals of the Delta Levee Subsidence Control Plan element are to reduce or eliminate the risk to levee integrity from subsidence and assist in the coordination of subsidence-related linkages with other CALFED programs.

2.3.1 INTRODUCTION

Subsidence issues, concerns, and solutions are addressed in both the Levee Program and the Ecosystem Restoration Program. The Levee System Integrity Program Plan focuses on subsidence that affects the levee system. Subsidence management is covered under the existing "Special Flood Control Project" portion of the California Water Code (refer to Appendix C).

2.3.2 BACKGROUND

Subsidence has substantially contributed to the Delta islands current condition of relatively tall levees that protect interiors below sea level. Recently, however, the importance of subsidence to levee stability has diminished. Land management and levee maintenance 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.

Subsidence has substantially contributed to the Delta islands current condition of relatively tall levees that protect interiors below sea level.

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 roughly 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.

2.3.3 REMEDIAL ACTION AND PREVENTION

Potential levee settlement/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.

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.

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.

2.3.4 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

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

Implementation Objective	Target	Action
Reduce the risk to levee integrity from subsidence	Reduce, eliminate, or reverse subsidence adjacent to affected levees	Implement current BMPs to correct subsidence effects on levees Fund grant projects to develop BMPs that address subsidence as it affects levee integrity
Improve 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
Coordinate subsidence-related linkages with other CALFED programs	Develop and implement BMPs to facilitate CALFED objectives	Assist CMARP activities to quantify the effect and extent of inner-island subsidence and its linkages to all CALFED objectives

Notes:

BMPs = Best management practices.
CMARP = Comprehensive Monitoring, Assessment, and Research Program.

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.

2.3.5 PROPOSED PROGRAM

CALFED will implement a subsidence control and monitoring program. Subsidence control measures will be incorporated into base level and special improvement projects. 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, Assessment, and Research Program (CMARP).

Subsidence monitoring would begin with an evaluation of existing soils and their distribution in the Delta, and a determination of land surface elevation.

In addition, because the linkages of inner-island subsidence to CALFED objectives needs more study, the Levee Program recommends that CMARP quantify the extent and effect of inner-island subsidence. CALFED may implement grant projects to develop best management practices (BMPs) that restore interior island elevations.

The Levee Program recommends that CMARP quantify the extent and effect of inner-island subsidence.

2.4 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 and limit any interruption of services and supplies to 6 months or less in the event of a disaster. More focused analysis and documentation of specific targets and actions will occur in subsequent efforts.

The goal of the Delta Levee Emergency Management and Response Plan element is to enhance existing emergency management response capabilities in order to protect critical Delta resources and limit any interruption of services and supplies to 6 months or less in the event of a disaster.

2.4.1 INTRODUCTION

The existing emergency response capabilities need to be continuously refined, and funding needs to be increased. 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 actions associated with the Emergency Management and Response Plan element.

2.4.2 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 and levee failure during low-flow periods.

The most recognizable threat to Delta islands and resources is inundation due to winter flood events.

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.

2.4.3 CURRENT PROGRAM

The Governor's Office of Emergency Services (OES) 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.

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

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 and limit interruption of services to 6 months or less	Implement a comprehensive reconstruction, repair, and maintenance program for Delta levees
		Review, clarify, and refine command and control protocol; develop an Integrated Response Plan in conformance with SEMS/ICS
		Define agency responsibilities to ensure environmental compliance
		Purchase materials in advance and place in strategic locations
		Execute pre-negotiated contracts with contractors for forces and equipment to respond with short notice
		Clarify program eligibility, inspection, documentation, dispute resolution, auditing, and reimbursement procedures
Develop a stable funding source for emergency response	Provide funding for a well-defined Disaster Assistance Program	Prepare cost estimates
		Identify beneficiaries to provide equitable distribution of costs
		Develop funding sources

Notes:

ICS = Incident Command System.
SEMS = Standardized Emergency Management System.

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 (ICS) and mutual aid agreements. SEMS facilitates setting priorities, cooperation among agencies, and the efficient flow of resources and information.

2.4.4 PROPOSED PROGRAM

CALFED plans to build on the existing emergency response system. CALFED's Emergency Response Subteam determined that an effective Delta levee emergency response program should be concentrated in seven areas:

CALFED plans to build on the existing emergency response system.

- Funding;
- Response by state and federal agencies;
- Availability of flood fight resources;
- Integrated response;
- Clarification of regulatory procedures;
- Clarification of program eligibility, inspection, documentation, auditing, and reimbursement procedures; and
- Dispute resolution.

Funding

The vulnerability of the levee system can be reduced by implementing an integrated and comprehensive reconstruction, repair, and maintenance program for Delta levees and channels, as described and recommended under the Levee System Integrity Program. Implementation can be accomplished only by supplementing local funding capability through state and federal cost-sharing at adequate and consistent levels.

Response by State and Federal Agencies

- DWR's authority to respond should be clarified and expanded to include all instances where levees or other flood control structures are in danger of failure, regardless of whether the danger is due to storms, floods, earthquakes, rodents, vessel impacts, or any other cause. The funding for support of DWR's efforts should be ample and clearly committed for a comprehensive emergency response.

  The role of the Corps also should be clarified and confirmed, to eliminate delay in response and avoid any dispute concerning whether the local and state responses are sufficient.

- DWR should be given the mandate, authority, and funding to carry out the repair of damage to Delta non-project levees due to floods, storms, and levee failure incidents—including de-watering flooded areas. All FEMA and OES funds related to such work should go directly to DWR.

Availability of Flood Fight Resources

Specialized Equipment and Operators

A revitalized levee maintenance capability under the Levee System Integrity Program will establish a fleet of specialized equipment essential to a rapid emergency response but will not ensure its availability during emergencies that can widely range in geographic extent. Pre-emergency contracting for specialized equipment will secure the availability of the equipment and experienced operators and will establish the pricing for emergency services.

A revitalized levee maintenance capability under the Levee System Integrity Program will establish a fleet of specialized equipment essential to a rapid emergency response but will not ensure its availability during emergencies that can widely range in geographic extent.

Material Stockpiles

DWR (Central District) has established stockpiles for flood-fighting material (such as sandbags, plastic, stakes, light equipment, and pumps) at three locations in the north, south, and west Delta. The program should include assurance of a supply or stockpiling of sand, drain rock, and riprap.

Staffing for Emergency Assistance

Formalizing arrangements with the California Department of Forestry and Fire Prevention, as well as with the California Conservation Corps and the State Prison System, for emergency assistance should be considered.

Integrated Response

A detailed response plan should be developed for the Delta that would allow an immediate, simultaneous response to a serious incident by all levels of government within a single integrated organizational structure. The plan would identify common needs and functions of all agencies (for example, housing, food, transportation, supplies [including rock and sand], equipment, and contracted services) and would assign the most capable agency or jurisdiction to perform each action on behalf of all agencies. The detailed response plans would provide the basis for pre-identifying and assigning specific responsibilities for each agency, as well as the level of resources that the individual local agency would be expected to provide in response to the emergency. With detailed assignment of responsibilities, an organizational structure for the "area command" could be delineated to ensure that the "incident commands" were coordinated.

A detailed response plan should be developed for the Delta that would allow an immediate, simultaneous response to a serious incident by all levels of government within a single integrated organizational structure.

Clarification of Regulatory Procedures

Although both state and federal laws suspend environmental regulation during emergencies, some clarifications are desirable.

- A consistent definition of "emergency" should be developed for response and regulatory activities. It is especially important that the defined duration of the emergency be consistent for both purposes.

- Mitigation measures that are expected during post-emergency recovery work should be defined, to rapidly define and implement "appropriate" mitigation and to avoid

unnecessary delays of post-emergency recovery work. Fish and Game Code Section 1600 outlines only general obligations.

Clarification of Program Eligibility, Inspection, Documentation, Auditing, and Reimbursement Procedures

The requirements of state and federal programs need to be standardized to be consistent with one another, be well communicated to the local agencies without delays, and avoid changes or re-interpretation during the reimbursement process.

Dispute Resolution

A binding arbitration procedure, conducted by knowledgeable but impartial arbiters, should be established. The procedure should encompass state and federal programs.

2.5 DELTA LEVEE RISK ASSESSMENT AND RISK MANAGEMENT STRATEGY

Delta levees and islands are at risk of failure from floods, seepage, subsidence, earthquakes, and other threats. A key management decision will be made at the end of Stage 1 implementation regarding the effectiveness of the CALFED Preferred Program Alternative. The following key levee-related question must be answered at the end of Stage 1: "Are the risks to export water supply from levee failure acceptable, or are other actions required?" To address these needs, CALFED will develop and implement an appropriate risk management strategy during Stage 1. The goal of the Delta Levee Risk Assessment and Risk Management Strategy is to quantify the risks to Delta levees, evaluate the consequences, and develop an appropriate risk management strategy.

The goal of the Delta Levee Risk Assessment and Risk Management Strategy element is to quantify the risks to Delta levees, evaluate the consequences, and develop an appropriate risk managements strategy.

2.5.1 INTRODUCTION

Many CALFED agencies and stakeholders have voiced concern over the need to quantify Delta levee risk, to determine the consequences of failure, and to implement an appropriate risk management strategy.

The greatest threat to Delta levees is overtopping and seepage during flood flows. Since their reclamation, numerous Delta islands have flooded at least once. Over the past 50 years, dozens of islands have flooded. Some islands have flooded many times. Some islands were never reclaimed. The vulnerability of the Delta levee system to failure during earthquakes is also 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. The risk to Delta resources must be managed if the CALFED objectives are to be achieved. Appendix D lists the major resources in the Delta.

2.5.2 PAST AND PRESENT EFFORTS

Over the past 12 years, the existing Delta levee program has reduced the risk of flood and seepage by improving Delta levees.

Research and demonstration projects are being conducted to quantify the effects of subsidence and determine how to reduce its threat to Delta levees.

In the late 1980s, DWR's Division of Engineering embarked on a long-term seismic stability evaluation of Delta levees. Strong-motion accelerometers were installed at several sites in the Delta. Field and laboratory testing is being done to better determine the static and dynamic properties of organic soils and to better determine their liquefaction potential. The potential activity of the Coast Range/Sierra Nevada Boundary Zone is being evaluated. In 1992, DWR published a report titled, "Seismic Stability Evaluation of the Sacramento-San Joaquin Delta Levees - Volume I." DWR's seismic investigation is being continued. DWR continues to collect data from their seismic monitoring instruments, and continues field and laboratory testing. These data will be published in future reports.

In 1998, a Seismic Vulnerability Subteam began a seismic risk assessment of Delta levees. The sub-team was comprised of a group of experts in the fields of seismology and geotechnical engineering. The assessment identifies the risk to Delta resources during catastrophic seismic events and comments on the general feasibility of various actions to reduce exposure to the risk. The Seismic Vulnerability Subteam's report, "Seismic Vulnerability of the Sacramento-San Joaquin Delta Levees," dated April 2000, is included in Appendix G of this document.

Over the past 12 years, the existing Delta levee program has reduced the risk of flood and seepage by improving Delta levees.

"... A significant seismic risk is present; however, improved preparedness can reduce the potential damage."

2.5.3 PROPOSED RISK ASSESSMENT

As part of CALFED's Stage 1 actions, CALFED staff will work with stakeholders, the public, and state and federal agencies to develop and implement a Delta Levee Risk Assessment and Risk Management Strategy. CALFED will incorporate the findings from the Seismic Vulnerability Subteam's assessment into an overall risk assessment. Once the risk to Delta levees is quantified and the consequences are evaluated, CALFED will develop and implement an appropriate risk management strategy.

Several risk management options have been developed for inclusion in the CALFED Preferred Program Alternative. The available risk management options include, but are not limited to:

- Improving emergency response capabilities,
- Reducing the fragility of the levees,
- Improving through-Delta conveyance,
- Constructing an isolated facility,
- Developing storage south of the Delta,
- Releasing more water stored north of the Delta,
- Restoring tidal wetlands,
- Controlling and reversing island subsidence,
- Curtailing Delta diversions, and
- Continuing to monitor and analyze total risk.

CALFED staff will work with stakeholders, the public, and state and federal agencies to develop and implement a Delta Levee Risk Assessment and Risk Management Strategy.

The final Risk Management Plan will include a combination of these options and others identified as a result of the risk assessment.

Table 8 lists implementation objectives, targets, and actions associated with the Delta Levee Risk Assessment and Risk Management Strategy Element.

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

Implementation Objective	Target	Action
Prepare a Delta Levee Risk Assessment and Risk Management Strategy	Document findings in a report to CALFED	Assemble a Levee Risk Assessment Team Quantify risks to Delta levees from earthquakes, overtopping, seepage, and subsidence Quantify the consequences to resources at risk Develop potential risk management strategies that are consistent with CALFED's Preferred Program Alternative; coordinate with CALFED program managers, agencies, and stakeholders; develop viable funding methodologies Make recommendations to CALFED on specific risk management actions and funding methodologies
Implement appropriate risk management strategies	Integrate risk management strategies into CALFED's Preferred Program Alternative	CALFED to take appropriate action on selected risk management actions

3. Sea-Level Rise

3.1 INTRODUCTION

Most researchers agree that sea level is currently rising and has been since the end of the last ice age about 17,000 years ago (Scientific American August 1998). The evidence for rising sea levels comes from direct measurements of the ocean water column, the geologic record, changes in the earth's angular momentum, and melting glaciers. Thermal expansion of ocean water due to increased surface warming and an increased water supply from glacial melt are the two main causes of increased sea level.

Tectonic sinking and human-induced sinking of the ground (for example, by hydrocarbon extraction, ground water pumping, or settlement of Delta levees) also may cause relative sea-level rise. When combined with rising sea levels due to climatic and oceanic factors, a total sea-level rise may be obtained for any given area where measurements are available.

Only the long-term rise in sea levels due to fresh-water influx from melting glaciers and oceanic thermal expansion factors are considered here. Site-specific amounts of total sea-level rise may be calculated as needed and are beyond the scope of this work.

Since near the beginning of this century, the rate of sea-level rise has been from about 1 to 3 millimeters per year (mm/yr). If the sea level continues to rise at the present rate, low-lying beaches, wetlands, and critical infrastructure such as levees will become further inundated and threatened by increased water surface levels, wave erosion, and associated problems. Since much of the Bay-Delta system is at or near sea level, it is likely to be directly affected by rising sea levels. Levee height determinations may need to be increased to prevent levee overtopping and subsequent levee failure.

If sea level continues to rise at the present rate, low-lying beaches, wetlands, and critical infrastructure such as levees will become further inundated and threatened by increased water surface levels, wave erosion, and associated problems.

3.2 ATMOSPHERIC WARMING AND SEA-LEVEL RISE

One of the major causes of rising sea levels is an increase in atmospheric temperatures. Increasing atmospheric temperatures heat ocean waters and cause them to rise by thermal expansion. Warmer temperatures also are responsible for the increase in melting of terrestrial and oceanic glaciers. Average atmospheric temperatures have risen about 1 degree Fahrenheit (0.6 degree Celsius) since the turn of the century (Titus and Narayanan, EPA 1996). Warming trends are not the same on all continents and in all oceans, but rather are

an average of global climate trends. Local climates may actually be cooling, as discussed by the National Oceanic and Atmospheric Agency (NOAA) at **http://www.ncdc.noaa.gov/ol/climate/globalwarming.html#Q1**. Many climate experts believe that the overall warming trend is a result of an increase of anthropogenic carbon dioxide and other so-called "greenhouse gasses."

One of the major causes of rising sea levels is an increase in atmospheric temperatures.

There is considerable debate on the effects of greenhouse gases. For example, Curt Suplee at **http://www.Globalwarming.org** reports that increases in carbon dioxide concentrations may actually follow warming trends. However, the uncertainty of the cause of warming is high, and much more research is needed to resolve the issue. While earth-based instruments show a distinct warming trend, space-based measurements of atmospheric temperatures over the past decade or so show no such trend and instead show a small cooling trend in some cases. However, it is also possible that the climate system does not react instantly to increases in greenhouse gases. The effects of the input of such gases to the atmosphere may not be linear and possibly may not be felt until a future time. This view is detailed at **http://www.artsci.wustl.edu/~rjniemie/hewterm.html.**

Research into atmospheric warming is continuing. Instruments such as those aboard the currently planned CloudSat satellite will better enable scientists to determine whether the atmosphere is getting warmer (Space News May 1999).

3.2.1 MELTING GLACIERS AND SEA-LEVEL RISE

Besides thermal warming of ocean waters, the other major input to sea-level rise is glacial melt water. While no glaciers are present in the project area and no volumes have been estimated, relatively rapidly melting glaciers are a current phenomena in many other places. Terrestrial glaciers are melting at a seemingly accelerated pace throughout the world. The web sites referencing this melting are:

Besides thermal warming of ocean waters, the other major input to sea-level rise is glacial melt water.

- **http://www.tv.cbc.ca/national/pgminfo/glacier/index.html** shows photographs of the retreating Athabascan Glacier.
- **http://www.enn.com/enn-news-archive/1998/05/052798/glacier.asp** gives a discussion of the melting of glaciers at various locations.
- **http://www.greenpeace.org/~climate/database/records/zgpz0212.html** shows the amount of glacial retreat at various locations.
- **http://spacelink.nasa.gov/NASA.News/NASA.News.Releases/Previous.News.Releases/99.News.Releases/99-03.News.Releases/99-03-04.Greenland.Glaciers.Shrinking** reports the unexpected recent change in the Greenland Ice Sheet.

Continued measurements over the next decade will expand the amount of factual information concerning glacial melting. This would be especially important in the case of a possible breakup and melting of very large glaciers, for example, on Greenland or in the Antarctic ice system.

The April 1999 Scientific American reports that the glaciers of Glacier National Park in Montana will run dry within the next 50 years. For comparison, about 6% of the world's ice is contained in mountain glaciers. The Antarctica and Greenland Ice Sheets contain about

90% of the world's fresh water. Melting of the ice sheets could sharply accelerate sea-level rise. Photographs showing the breakup of the Larsen Ice Shelf in the Antarctic can be found at **http://www-nsidc.colorado.edu/NSIDC/ICESHELVES/ lars_wilk_news**. The rapid retreat of summer sea ice in the Beaufort Sea north of Alaska is detailed in the February 1999 Science News.

3.2.2 MEASURING THE AMOUNT OF SEA-LEVEL RISE

Measuring sea-level rise is complex. Seaborne measurements over the last 100-150 years indicate that globally, the sea level has been rising at the rate of about 2 mm/yr. This amount will vary with location. The global average from tide gage records (Gornitz 1994) is from about 1 to 3 mm/yr.

Tide gages provide the most direct measurements of sea-level rise; however, tide gages usually are placed on piers near a geodetic benchmark. Some serious problems are associated with tide gage measurements. Local movements caused by postglacial rebound or subsidence greatly modifies the rate of relative sea-level rise or lowering, as may be the case. Tide gages also must be resurveyed periodically to correct for changes in gage platform mountings. The length of record is important, with 50 years of record probably being the minimum length for accurate measures. A detailed discussion of tide gage measurement accuracy can be found at **http://www.agu.org/revgeophys/dougla01/ node3.html#SECTION00030000000000000000.**

Tide gages provide the most direct measurements of sea-level rise; however, tide gages usually are placed on piers near a geodetic benchmark.

Modern electronic measurements such as GPS- (global position system-) based measures, and laser and satellite altimetry offer the most consistent and accurate methods available to measure sea-level fluctuations. Problems with these techniques can occur from various kinds of instrument noise and interference, but they can be resolved. Over time, these techniques will provide very accurate measures of sea surface changes. Since electronic techniques are relatively new, they do not offer the history of measurements provided by tide gage data. Nevertheless, when combined with computer models over the next decade, the measurements should provide good baseline sea-level data and better insight to sea-level changes over time.

Plans now call for launching a series of earth observation system (EOS) observatories. LandSat 7 was launched in April 1999, with more instruments scheduled to be placed in orbit steadily through 1999 and the coming years. European Space Agency and Japanese platforms also will be launched. Measurements will extend beyond the first decade of the 21st century, providing 10- to 15-year data sets. Scientists believe they can obtain important insights into how the earth system collectively works and provide a quantitative basis for 10- to 100-year predictions of global change. See NASA Facts Online at **http://pao.gsfc. nasa.gov/gsfc/service/gallery/fact_sheets/earthsci/eosund.htm** for discussion. Mission descriptions and launch schedules may be linked at **http://www.earth.nasa.gov/missions/ index.html**.

Current space-based projections of short-term sea levels have been made with some accuracy in the case of the 1997 El Niño and 1998 La Niña events. The TOPEX-Poseiden home page at **http://topex-www.jpl.nasa.gov** links to color plots of sea-level heights determined from satellite altimetry.

Not all researchers agree on the amount that sea level might rise over a given time span or in a geographic location. For this report, a survey was made of nine current sea-level rise projections. The average of these projections shows that the global sea level could rise about 3.4 inches over the next 50 years, not including additional rise caused by increased warming. (If the sea level continued to rise at the rate of about 1.8 mm/yr for the next 50 years, by 2050 the ocean would have risen on average 3.4 inches.) This rate of sea-level rise is close to historical average rates of rise and varies with location.

The average rate above does not include a possible increased rate of rise due to increased climate warming and resultant thermal expansion. The trend of warming and sea-level rise is predicted by many to be non-linear in the next century. When increased rates of warming are included, the average of surveyed projections of sea-level rise shows that global sea level could rise 7.2 inches by 2050 and 17.2 inches by 2100.

Predictions of sea-level rise are based on historical data, satellite and GPS measurements, seaborne measures, and mathematical models. It is important to note that future trends in sea-level rise may not be linear. Sea-level observations and models are being calibrated as techniques and technologies improve over time. The U.S. Environmental Protection Agency (EPA) is at the forefront of research on global warming and sea-level rise. The EPA has included recent global warming projections in their model; results show that by 2050, global sea levels might be expected to rise 5.9 inches. The same models show that by 2100, sea levels might rise by about 13.4 inches. These results may be viewed at **http://www.epa.gov/docs/oppeoee1/globalwarming/reports/pubs/sealevel/probofsea/index.html#toc**.

Predictions of sea-level rise are based on historical data, satellite and GPS measurements, seaborne measures, and mathematical models.

3.2.3 EFFECTS ON THE BAY-DELTA SYSTEM

Ground elevations in the Bay-Delta system vary from at or near sea level in the San Francisco Bay area to 10 feet and more in the Sacramento area. The effects of a rising sea level on inland areas will be in direct proportion to the amount of ocean rise. Effects will scale down to very little in the far northeast and southeast reaches of the Delta, where tide effects are diminished along with increasing river and waterway elevations.

Ground elevations in the Bay-Delta system vary from at or near sea level in the San Francisco Bay area to 10 feet and more in the Sacramento area. The effects of a rising sea level on inland areas will be in direct proportion to the amount of ocean rise.

Climate warming does not appear to be occurring as fast as predicted in the late 1980s and early 1990s. In 1996, the EPA published "The Probability of Sea Level Rise," which lowered the climatic warming projections and published a set of tables to be used in the projection of sea-level rise numbers at various locations in the coastal United States. The average rate of rise for the San Francisco Bay Area is given as 1.3 mm/yr. This average alone would result in a rate of rise of 2.6 inches in 50 years. An additional component of sea-level rise due to increased warming is given as 3.9 inches (10 cm) by 2050. Combining these terms gives a total projected EPA sea-level rise of 6.5 inches by 2050 for the San Francisco Bay Area. The EPA method is found at **http://www.epa.gov/docs/oppeoee1/globalwarming/reports/pubs/sealevel/probofsea/Chpt9.pdf**.

This projection is for the average trend and warming only, and does not contain a component for the addition of water from melting glaciers. The EPA report does contain discussion and diagnosis-level quantities for a Greenland contribution.

Other agencies in the Bay-Delta area have considered the possible effects of sea-level rise. For example, the Bay Area Conservation and Development Commission (BCDC) in 1987

commissioned the report, "Sea Level Rise Predictions and Implications for San Francisco Bay."

The report is detailed and provides total sea-level rise projections for 2006 and 2036. Sea-level rise projections due to thermal expansion were based on a 1.8-mm/yr average taken linearly over the period of interest. This Bay Area rate was higher than the century-long average global sea-level rise of 1.2-mm/yr cited in the report. For comparison, the EPA uses 1.3 mm/yr for the Bay Area, not including the warming component. The BCDC used only average rates and did not consider a warming component in its projections, relying on a long period of record at the Presidio gage.

Based on a continuous record since 1855 at the Presidio, the rate of rise was 0.0039 ft/yr, or 1.2 mm/yr. During the most recent 19-year tide period (1967-1985), the rate was estimated at 0.0072 ft/yr, or 1.8 mm/yr. The greater rate in this period of measure was in part caused by inclusion of the 1983 El Niño event. Even without the El Niño component, however, the rate was 0.0059 ft/yr, or 1.5 mm/yr. The rate of sea-level rise appears to be increasing over time. These rates give a projected 3.5-inch rise over a 50-year period with no El Niño component, and a 4.3-inch rise over 50 years including the El Niño component. The rate with the El Niño component was used as a working average in the BCDC report. Table 9 compares the rates discussed.

Considering the projections of sea-level rise in Table 9, it is estimated that sea level will rise from 3 to 6 inches near the Golden Gate Bridge by 2050. Using the upper end of this range, the effects on the Bay-Delta system might range from 6 inches of increased water surface elevation near the Golden Gate Bridge, to 4 inches of rise in the area of Venice Island in the mid-Delta, to no rise at the "H" Street Bridge in Sacramento. Again, these figures are based on the upper end of the range, or 6 inches of rise by 2050 near the Golden Gate Bridge. If the lower end of the range is assumed (3 inches of rise by 2050 near the Golden Gate Bridge), these projections would be half at all locations. The far right column of Table 10 shows the estimated upper end of the projected sea-level rise by location.

Considering the projections of sea-level rise in Table 9, it is estimated that sea level will rise from 3 to 6 inches near the Golden Gate Bridge by 2050.

3.2.4 EFFECTS ON DELTA LEVEES

A major goal of the Long-Term Levee Protection Plan is to reconstruct and maintain all Delta levees to the PL 84-99 standard. This standard is based on the Corps' Delta-specific 100-year flood elevation. This standard is affected by the elevation of sea level. If this goal is to be achieved, therefore, projected sea-level changes must be considered.

Projected sea-level changes must be considered in meeting the PL 84-99 levee standard.

Table 10 shows changes in the amount of projected sea-level rise with tide gage location.

3.3 CONCLUSIONS AND RECOMMENDATIONS

Local land settlement, expansion of ocean water, and the addition of water through glacial melting cause sea levels to rise. Increased atmospheric temperatures, measured over the past century, are causing thermal expansion of ocean water. Although glaciers are melting and

Local land settlement, expansion of ocean water, and the addition of water through glacial melting cause sea levels to rise. Increased atmospheric temperatures, measured over the past century, are causing thermal expansion of ocean water.

Table 9. Amount of Projected Sea-Level Rise: A Comparison of Historical Average and Projected Increased Warming-Induced Sea-Level Rise Components and Totals

Location and Component of Projection	Average Rate/Year (mm)	Number of Years	Average Rise Component	Projected Warming Component	Sea-Level Rise (mm)	Sea-Level Rise (inches)
Bay Area						
EPA historical average	1.3	50	65	0	65	2.6
EPA projected warming component	-	50	0	100	100	3.9
EPA average + warming component	-	50	65	165	165	6.5
BCDC historical average	2.2	50	109	0	109	4.3
Global						
Other agencies historical average	1.8	50	88	0	88	3.4
Other agencies average + warming component	-	50	-	-	183	7.2
Other agencies average + warming component	-	100	-	-	437	17.2
EPA average + warming component	-	100	-	-	340	13.4

Notes:

Various other investigative agencies report different amounts of sea-level rise. The amounts have been averaged. EPA amounts are lower than other agency amounts due to decreased amounts of projected global warming.

BCDC = Bay Area Conservation and Development Commission
EPA = U.S. Environmental Protection Agency
mm = millimeters

receding worldwide, the contribution of glacial-melt water to sea-level rise has not been well quantified. The increase in temperatures has not been conclusively linked to the increase in anthropogenic greenhouse gases. The research into global greenhouse warming is continuing. Current measures and computer models already have lowered warming projections made in the late 1980s and early 1990s.

Current measures and computer models already have lowered warming projections made in the late 1980s and early 1990s. As more space-based instruments are used in the coming decade, the accuracy of sea-level measurements will increase.

The methods used to measure sea-level rise have traditionally been land-based. As more space-based instruments are used in the coming decade, the accuracy of sea-level measurements will increase. A series of sophisticated space-based instruments soon will be placed into orbit for the purpose of measuring and understanding the complex interactions of the climate systems of the earth. Understanding these systems will have a direct bearing on civil works programs such as the Levee System Integrity Program Plan.

Table 10. Amount of Projected Sea-Level Rise at Bay Area and Delta Tide Gage Stations

Tide Gage Station Location	Approximate Daily Tide Fluctuation (feet)	Tide Decrease Factor	Adjusted Sea-Level Rise (feet)	Adjusted Sea-Level Rise (Estimated Upper End) (inches)
Golden Gate	5.8	1.1	0.5	6
Martinez	5.6	1.0	0.5	6
Rio Vista	4.8	0.9	0.4	5
Roaring River	4.4	0.8	0.4	5
Mallard Island	5.1	0.9	0.5	6
Antioch	4.3	0.8	0.4	5
Tracy	3.0	0.5	0.3	3
Venice Island	3.8	0.7	0.3	4
Freeport	1.7	0.3	0.2	2
Thornton	1.5	0.3	0.1	2
"I" Street Bridge	1.1	0.2	0.1	1
"H" Street Bridge	0.0	0.0	0.0	0

It is recommended that a 3- to 6-inch sea-level rise be assumed for a 50-year planning horizon for the San Francisco Bay Area. The assumed sea-level rise will decrease to 0 in the far northeast and southeast reaches (see Table 10) of the Delta, where tide effects are eliminated by increasing river and waterway elevations. For comparison, the Corps' New Orleans District (Britsch, personal communication May 1999) is using about 6 inches per year for projected sea-level rise due to thermal expansion. As more accurate sea-level rise projections become available, CALFED will make adjustments accordingly.

It is recommended that a 3- to 6-inch sea-level rise be assumed for a 50-year planning horizon for the San Francisco Bay Area.

4. Ecosystem Restoration Program/Levee Program Coordination

Levee maintenance activities sometimes conflict with management of terrestrial and aquatic habitat resources on or around levees.

Levee maintenance activities sometimes 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 and emergency response purposes. Bare levees are easier to inspect. Vegetation may conceal evidence of instability, erosion damage, and 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 OES or FEMA, vegetation may hamper flood fighting by impeding the application of sand bags or plastic membrane to levees. Vegetation on levees may make use of some levee maintenance equipment difficult or impossible; therefore, vegetated levees may require more labor-intensive levee maintenance activities. The application of riprap or other erosion protection materials may require clearing established vegetation.

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.

4.1 CURRENT PROGRAM

This section discusses actions in the existing Subventions Program to address potential conflicts between environmental restoration and levee 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 existing Delta Levee Subventions Program established by Senate Bill (SB) 34 and amended by SB 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**. A memorandum of understanding (MOU) has been 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 environ-mental database using GIS technology, identifying sites for habitat restoration, and coordinat-ing 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.

4.2 PROPOSED PROGRAM

This section presents the Levee Program'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 that will 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.

Levee Program and Ecosystem Restoration Program staff are working in close coordination to develop additional strategies that will minimize conflicts between goals of the two programs.

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 required to meet AB360 habitat goals should be relocated off the levee structural cross section where possible. Other 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 above and beyond the levee structural section to accommodate vegetation. For instance, deep-rooting plants should not be allowed on levee sections unless the levee is larger than the required stable cross section. Also, the use of setback levees to create new riparian and wetland habitat in areas underlain with peat is not recommended 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

The use of setback levees to create new riparian and wetland habitat in areas underlain with peat is not recommended because of the high cost of building new levees on peat.

such opportunities. Setback levees could be considered along the edges of the Delta where mineral soil or thin, shallow peat layers are found.

The Levee Program seeks to minimize habitat-related conflicts with local maintenance agencies. Levee Program staff are working with Ecosystem Restoration Program staff and regulatory agency staff to determine whether a tool similar to the safe harbor policy as written in draft federal regulations can be developed as part of the CALFED conservation strategy. 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 local agencies incentives to allow some vegetation growth on their levees. This coordination could benefit both levee maintenance efforts and habitat development.

CALFED Levee Program and Ecosystem Restoration Program staff coordinate with DFG staff, 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.

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.

5. Permit Coordination

To ensure successful implementation of all CALFED programs, a coordinated permit process is being 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 refine the permitting process. 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, mitigation banks, and enhancement sites.

Coordinated permitting will not result in relaxation of permitting requirements but will facilitate information sharing among regulatory agencies to refine the permitting process.

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.

Table11 identifies the Levee Program permit coordination issues that will be included in the overall CALFED coordinated permit process.

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 Regional Water Quality Control Board (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).

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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 decision makers such as the RWQCB, that will provide scientific background for establishing guidelines by which maintaining agencies can dredge Delta channels. An

Table 11. Delta Levee Program Permit Coordination Issues

Areas of Concern

- 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.
- Trust and team building are needed in permit coordination.
- 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.

Avenues for Better Permit Coordination

- 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.
- A system of centralized permit tracking is needed, including follow through for permit actions.

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").

6. 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.

One issue of concern to the Levee Program, as well as to numerous agencies and stakeholders, is the need for a well-maintained common datum in the Delta.

One issue of concern to the Levee Program, as well as to numerous agencies and stakeholders, is the need for a well-maintained common datum in the Delta. A group composed of the U.S. Geological Survey, National Geodetic Survey, U.S. Bureau of Reclamation, DWR, and others recently completed efforts to establish a set of elevations in the Delta consistent with the National Vertical Datum (NAVD88) geodetic network for vertical control. The network consists of 100 benchmarks spaced at approximately 7 kilometers. The Levee Program is seeking ways to support tie-in to the common datum by Levee Program participants, as well as by agencies and other Delta interests.

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 a detailed discussion of this issue, refer to the earlier section, "Ecosystem Restoration Program/Levee Program 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 several CALFED programs.

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 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.

The consequences of a levee breach to water quality and water supply reliability can be catastrophic.

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. CALFED proposals for setback levees are included in the Ecosystem Restoration Program and Water Storage and Conveyance Program. Hydraulic impacts on levees caused by construction of setback levees and other storage and conveyance modifications, such as changed operation of flow control structures, will be examined. 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.

Reservoir storage and levees function as a system with regard to flood control.

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.

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.

7. 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").

A better understanding of Levee Program issues is needed to succeed in program implementation.

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.

8. Monitoring and Research

Monitoring and research are key inputs to CALFED's adaptive management process. Monitoring gauges the success of individual Levee Program actions and provides 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, assessment, 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 document).

Levee Program monitoring and research will be developed largely within the context of the CMARP.

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, 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.

9. Cost Estimate

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

9.1 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 that major rehabilitation or reconstruction work will be performed on approximately 520 of the 1,100 miles of levee in the Delta. The remaining levees are assumed to meet or exceed the PL 84-99 standard. Seismic stability upgrades are not included in the Base Level Protection Plan, although some minor reduction in levee fragility is expected. 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-related costs; erosion protection; environmental mitigation; maintenance; an overall contingency; and lands, easements, rights of way, relocations, and disposal areas (LERRDS).

The estimate assumes that major rehabilitation or reconstruction work will be performed on approximately 520 of the 1,100 miles of levee in the Delta.

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.

9.1.1 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 where economically feasible.

9.2 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. Special Improvement Projects could include seismic stability upgrades to selected levees.

Special Improvement Projects could include seismic stability upgrades to selected levees.

9.2.1 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.

9.3 DELTA LEVEE SUBSIDENCE CONTROL

The primary cost estimate for subsidence control and management is $70 million.

9.3.1 ASSUMPTIONS:

The estimate assumes that:

- Subsidence projects will be directed at control and management of subsidence as it affects levee system integrity.
- Subsidence control measures will be incorporated with base level and Special Improvement Projects to upgrade levees.
- 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 where economically feasible.

9.4 DELTA LEVEE EMERGENCY MANAGEMENT AND RESPONSE PLAN

The preliminary cost estimate for the Emergency Management and Response element is $68 million.

9.4.1 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.

The estimate assumes that emergency management and response will be accomplished through existing programs.

9.5 DELTA LEVEE SEISMIC RISK ASSESSMENT

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

9.5.1 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.

DWR will continue to lead the evaluation of seismic risk.

10. 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.

A funding model that includes federal, state, and local contributions allows costs to be shared by all beneficiaries.

The proposed funding provisions outlined herein are those recommended to CALFED by the CALFED Levees and Channels Technical Team. CALFED staff will use this recommendation to prepare a benefits-based funding recommendation for approval by the CALFED Policy Group.

The Levee System Integrity Program Plan will be implemented over a period of 30 years or more, at an estimated cost of $1.5 billion (1998 $). This cost is based on the detailed cost estimate for the Base Level Protection Element provided in Appendix B, "Cost Estimate Backup and Report," and cost estimates for all program elements discussed in the "Cost Estimate" section. Based on the current estimate, the funding in 1998 dollars 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	68 million
Seismic Risk Assessment	$ 5 million
	$1,503 million

This funding does not include any funds required to implement the CMARP Program. The following problems related to funding the existing levee program will be addressed by the Levee Program:

Reliable near- and long-term funding is paramount to the success of 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 work, much less the additional financial burden of proposed levee upgrades.

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 is 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 agencies 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, local agencies 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 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.

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 agencies 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 local agencies 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.

The Levee Program will seek a means to provide up-front state and federal contributions for levee work.

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

- Local agencies will provide LERRDS. 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. Federal, state, and local cost-sharing percentages include mitigation costs.

- 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.

10.1 DELTA LEVEE BASE LEVEL PROTECTION PLAN FUNDING

10.1.1 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, much less the additional financial burden of proposed levee upgrades. Problems with current funding provisions are discussed under "Delta Levee System Integrity–Problem Statements."

Many Delta interests cannot afford their share of costs under the current programs, much less the additional financial burden of proposed levee upgrades.

Levee work is currently 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 are currently appropriated for the program past June 30, 1999.

10.1.2 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 can contribute LERRDs toward their 10% share. Planning costs will be cost shared at 50% federal/ 25% state/ 25% local. Funding for maintenance will be provided 100% by the local agencies up to $1,000 per mile of levee improvement. Costs above $1,000 per mile of

levee improvement will be cost-shared 65% federal/ 25% state/ and 10% local, and will be considered reconstruction. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Base Level Protection element are included in Tables 12 and 13.

Table 12. Proposed Levee Program 7-Year Cost Sharing

	Base Level Protection Plan Funding/Year[a]				Special Projects Funding/Year[c]				Emergency Response[d]				
Year(s)	Fed	State	User[b]	Sub-total	Fed	State	User[b]	Sub-total	Fed	State	User[b]	Sub-total	Total Funding
1	5	3	2	10	7	5	0	12	5	5	1	11	33
2	6	3	2	11	7	5	0	12	1	1	1	3	26
3	7	4	2	13	7	5	0	12	1	1	1	3	28
4	9	5	3	17	7	5	0	12	1	1	1	3	32
5	11	5	4	20	7	5	0	12	1	1	1	3	35
6	22	11	7	40	7	5	0	12	1	1	1	3	55
7	22	11	7	40	7	5	0	12	1	1	1	3	55
Totals	**82**	**42**	**27**	**151**	**49**	**35**	**0**	**84**	**11**	**11**	**7**	**29**	**264**

RAMP ↓

Notes:

Funding in millions (1998 $). Totals are rounded to the nearest million.

[a] Includes subsidence control funding.
[b] User to provide lands, easements, rights-of-way, relocations, and disposal areas.
[c] Includes Levee Risk Assessment.
[d] Includes $10 million first-year start-up costs.

10.2 DELTA LEVEE SPECIAL IMPROVEMENT PROJECT FUNDING

10.2.1 CURRENT FUNDING PROVISIONS

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

Cost-sharing percentages under the existing Special Projects Program vary from 75 to 100% state funds, depending on "ability-to-pay" analysis completed for each participating local agency. 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 are currently appropriated for the program past June 30, 1999.

Table 13. Levee System Integrity Program Proposed Cost Sharing

Program Action	Federal	State	User [a]
Base Level Protection and Subsidence Control			
Planning [b]	50%	25%	25%
Construction [c]	65%	25%	10%
Maintenance [d]	0%	0%	All costs (up to $1,000/mile)
Special Improvement Projects			
Planning [b]	50%	50%	To be determined
Construction [c]	65%	35%	To be determined
Maintenance [d]	0%	100%	To be determined
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 feasibility studies, environmental documentation, and obtaining permits.
[c] Construction is defined as eligible levee work above $1,000/mile.
[d] Maintenance includes routine preventative actions up to $1,000/mile.

10.2.2 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/ 35% state. The State will seek a local cost-sharing partner. If a local cost-sharing partner is found, the cost-sharing will be the same as that for the Base Level Protection Element. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Special Projects Program are shown in Tables 12 and 13.

10.3 DELTA LEVEE SUBSIDENCE CONTROL PLAN FUNDING

10.3.1 CURRENT FUNDING PROVISIONS

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

10.3.2 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 LERRDS in addition to the 10% share. Summaries of cost sharing and approximate state, federal, and local dollar contributions for the Subsidence Control Program are shown in Tables 12 and 13.

10.4 DELTA LEVEE EMERGENCY MANAGEMENT AND RESPONSE PLAN FUNDING

10.4.1 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.

No existing formal program provides funding for initial emergency response, which is provided by local resources.

10.4.2 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 funds through the Corps. Local agencies will contribute any necessary LERRDS. Summaries of cost-sharing and approximate state, federal, and user dollar contributions for the Emergency response element are shown in Tables 12 and 13. The user contribution assumes that the annual initial response is $1 million.

10.5 DELTA LEVEE RISK ASSESSMENT FUNDING

10.5.1 CURRENT FUNDING PROVISIONS

DWR currently funds a Seismic Stability Evaluation for Delta levees.

10.5.2 PROPOSED FUNDING PROVISIONS

CALFED has expanded the scope of this element to include all major risks, not only seismic risks. CALFED will use existing planning funds to develop this Risk Assessment and Risk Management Strategy, which is considered a necessary part of CALFED's overall program development.

CALFED has expanded the scope of this element to include all major risks, not only seismic risks.

11. Stakeholder/Science Review

Implementation of the Levee Program will require regular input from stakeholders, the technical community, and the public. A Levee Program Coordination Group would be formed at the beginning of Stage 1 implementation to coordinate technical and non-technical issues between the CALFED Advisory Council and the CALFED Policy Group. The Group would also coordinate levee actions with all other CALFED actions. The composition of the Group is illustrated in Table 14.

Implementation of the Levee Program will require regular input from stakeholders, the technical community, and the public.

Table 14. Composition and Roles of the Levee Program Coordination Group

CALFED Staff/Agency/Stakeholder	Role
Staff	
Levee Program	Chair meetings, coordinate: funding, permits, policy, project priorities, conflict resolution, and project performance; report to Policy Group
Ecosystem Restoration Program	Coordinate Ecosystem Restoration Program actions with levee and conveyance actions
Conveyance	Coordinate conveyance actions with Levee and Ecosystem Restoration Program actions
Comprehensive Monitoring, Assessment, and Research Program (CMARP)	Coordinate CMARP levee actions with other CMARP actions
Agency	
California Department of Fish and Game (DFG)	Coordinate DFG permits and levee maintenance agreements
U.S. Fish and Wildlife Service (USFWS)	Coordinate USFWS permits and levee maintenance agreements

Table 14. Composition and Roles of the Levee Program Coordination Group (continued)

CALFED Staff/Agency/Stakeholder	Role
Agency (continued)	
National Marine Fisheries Service (NMFS)	Coordinate NMFS permits
Central Valley Regional Water Quality Control Board (CVRWQCB)	Coordinate water quality certification for dredging and water-side work
California Department of Water Resources (DWR)	Represent the Reclamation Board, coordinate Levee Program administration
DWR	Coordinate Comprehensive Study
DWR	Represent DWR, coordinate emergency response actions
U.S. Army Corps of Engineers (Corps)	Represent the Corps on non-regulatory implementation issues
Corps	Coordinate Comprehensive Study
Corps	Coordinate Corps permits for dredging, beneficial reuse, and levee work
Delta Protection Commission (DPC)	Coordinate Levee Program actions with DPC Delta Resources Management Plan
Stakeholder	
Environmental	Coordinate Levee Program actions with environmental interests concerns
Water exporters - State Water Project (SWP)	Coordinate Levee Program actions with SWP contractors concerns
Water exporters - Central Valley Project (CVP)	Coordinate Levee Program actions with CVP contractors concerns
Delta interests - North Delta Water Agency (NDWA)	Coordinate Levee Program actions with in-Delta water user concerns
Delta interests - Central Delta Water Agency (CDWA)	Coordinate Levee Program actions with in-Delta water user concerns
Delta interests - South Delta Water Agency (SDWA)	Coordinate Levee Program actions with in-Delta water user concerns

12. 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 static and dynamic failure can be reduced by implementing an integrated and comprehensive management program for levees.

The vulnerability of the levee system to both static and dynamic 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 2, 4, 6, 7, and 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. Stage 1 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 (e.g., the Corps' current "Delta Special Study" could develop into a long-term Delta levee reconstruction program and the State would be the local cost-sharing partner). (Years 1-7.)

4. Conduct project level environmental documentation and obtain appropriate permits for each bundle (package) of Stage 1 actions. (Years 1-7.)

5. 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.)

6. Coordinate Delta levee improvements with ecosystem restoration improvements (e.g., 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.)

7. Fund levee improvements up to the PL 84-99 standard, approximately $151 million ($71 million during Years 1-5 and $80 million during Years 6-7) in Stage 1 (e.g., proportionally distribute available funds to entities making application for cost sharing of Delta levee improvements). (Years 1-7.)

8. Further improve levees with significant statewide benefits, approximately $84 million ($60 million during years 1-5 and $24 million during Years 6-7) in Stage 1 (e.g., improve levees with statewide benefits to ecosystem, water supply, economy, water quality, and infrastructure). (Years 1-7.)

9. Coordinate Delta levee improvements with Stage 1 water conveyance improvements and with potential conveyance improvements in subsequent stages. (Years 1-7.)

10. Enhance existing emergency response plans, approximately $29 million in Stage 1 (e.g., establish a $10 million revolving fund, continue to refine command and control protocol, stockpile flood-fighting supplies, establish pre-negotiated contracts for flood-fighting and recovery operations, and outline environmental considerations during an emergency). (Years 1-7.)

11. Implement current BMPs to correct subsidence effects on levees. Develop and implement BMPs to facilitate CALFED objectives. Assist CMARP activities to quantify the effect and extent of inner-island subsidence and its linkages to all CALFED objectives. (Years 1-7.)

12. Complete total risk assessment for Delta levees and develop and begin implementation of risk management options as appropriate to mitigate potential consequences. (Years 1-7.) Available CALFED risk management options may 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,
    - Restoring tidal wetlands,
    - Controlling and reversing island subsidence,
    - Curtailing Delta diversions,
    - Continuing to monitor and analyze total risk, and
    - Constructing an isolated facility.

Knowledge gained from monitoring and research will be incorporated into staged implementation and decision making 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.

Knowledge gained from monitoring and research will be incorporated into staged implementation and decision making through a feedback process as part of adaptive management.

Other key points for Levee Program implementation include:

- The Levee Program will need to coordinate and provide a reliable funding source for the planning, regulatory, and permitting processes that affect the levee system.

- 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 concurrently make broad improvements in many 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. 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.

- Implementation of Stage 1 actions is contingent on successful completion of appropriate environmental documentation.

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.

13. Suisun Marsh Levee System

CALFED has added the Suisun Marsh levee system to the Levee Program to achieve ecosystem quality, water supply reliability, and water quality objectives. Efforts to clarify linkages of these actions to the CALFED objectives are ongoing and will be completed during early Stage 1 as listed in the CALFED Implementation Plan.

Ensuring the integrity of the exterior levees in the Suisun Marsh is critical to sustaining seasonal wetland values provided by the marsh's managed wetlands. Improved levees would ensure that conversion to tidal wetlands will not be due to levee failure but instead will be planned with consideration of landowner support Ecosystem Restoration Program targets, regional wetland goals, endangered species recovery plans, and Delta water quality objectives.

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.

13.1 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 floodplains include Green Valley, Suisun, Ledgewood, Laurel, McCoy, Union, and Denverton 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

approximately 229 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.

13.2 BACKGROUND INFORMATION

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.

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 15. AB 360 currently includes only selected exterior levees in 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.

Table 15. Chronological Summary of Events Important to 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.

Preliminary modeling studies of the Suisun Marsh indicate that levee failure in the Suisun Marsh may affect western Delta channel water quality. Modeling studies currently are being refined.

13.3 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, 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.

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 LERRDS.

The cost estimate assumes work will be performed on approximately 155 of the 229 miles of levee in the Suisun Marsh.

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.

Table18 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).

13.4 ANNUAL MAINTENANCE

The preliminary cost estimate for annual maintenance costs for the 229 miles of exterior levees was computed at approximately $350,000.

13.5 ASSUMPTIONS

The estimate assumes that:

- Quantities are based on a "typical" levee section for existing levees and proposed levee improvement cross sections.
- A majority of the design, construction, and right-of-way acquisition will be accomplished with local resources.
- 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.

These estimates are preliminary, and are being developed and evaluated at a programmatic level.

13.6 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.

FIGURES

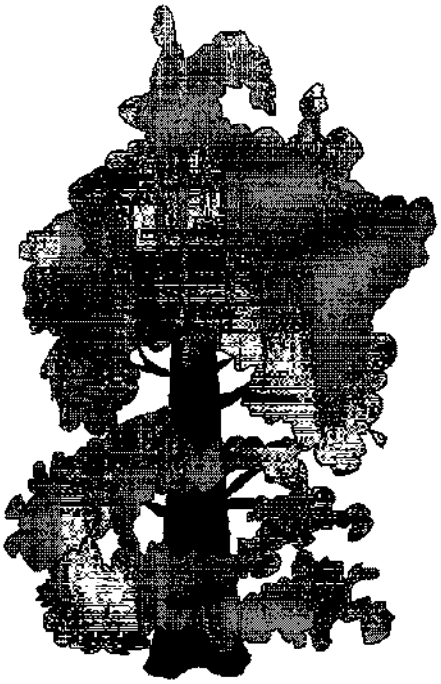


Figure 5

Possible Strategies for Levee and Habitat Improvements

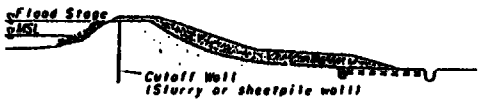
LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 A. Placement of Fill on Levee Crown and Landside Slope in Firm Mineral Soil Foundation Areas	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path.	Firm foundation areas, generally located in outer fringes of Delta and on old stream channels filled with mineral soils.	a. Levee structural stability is improved. b. Levee improvements stay within general footprint of existing levee and drain ditch. c. Relatively easily maintained as a flood control levee. d. Provides small increase in seismic stability.	a. Requires import of mineral soil. b. Represents a significant cost. c. Provides no environmental enhancement. d. Provides no significant increase in seismic stability. e. Addition of fill may result in short-term instability and/or cracking if levee/foundation system is weak.
 B. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation.	Most areas of Delta, but especially applicable in areas where soft foundation material exists.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability.	a. Requires significant import of mineral soil. b. Represents a significant cost. c. Provides no environmental enhancement. d. Provides only slight increase in seismic stability. e. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. f. Seepage system may need to be modified. g. Infringes on inboard farm land or habitat areas.
 C. Placement of Fill on Levee Crown, on Landside Slope, and in Landside Berm in Soft Foundation Areas - Together with Seepage Cutoff Wall (Slurry or Sheetpile Wall	o Increases freeboard and flood protection. o Increases landside slope stability. o Significantly lengthens seepage path. stops concentrated seepage areas. o Placement of berm accounts for soft foundation.	Areas of the Delta where both soft foundation materials and significant, concentrated seepage problems exist.	a. Levee structural stability is improved. b. Provides significant improvement in control of seepage problems in levee. c. Relatively easily maintained as a flood control levee. d. May provide moderate improvement in seismic stability of levee if water levels inboard of cutoff wall are greatly reduced within levee (reduces amount of possible liquefaction).	a. Requires significant import of mineral soil. b. Placement of fill represents a significant cost. c. Construction of cutoff wall represents a major cost. d. Provides no environmental enhancement. e. Levee and foundation may still be unstable during earthquake loading. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Construction of cutoff wall may result in hydraulic fracturing and/or levee cracking if not carried out carefully. h. Lowered ground water inboard of wall may result in differential settlement and cracking. i. Seepage system may need to be modified.

Figure 5 cont.

Possible Strategies for Levee and Habitat Improvements

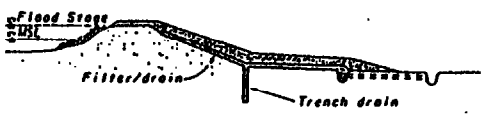
LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 D. Placement of Fill on Levee Crown, on Landside Slope, and in Landside Berm in <u>Soft</u> Foundation Areas - Together with <u>Filter/Drain System</u> on Landside Slope.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path, stabilizes concentrated leaks and prevents piping erosion. o Placement of berm accounts for soft foundation.	Areas of the Delta where both soft foundation materials and significant, concentrated seepage or settlement and cracking problems exist.	a. Levee structural stability is improved. b. Provides significant improvement in control of seepage problems in levee. c. May prevent piping erosion associated with both flood events and moderate earthquake-induced settlement and cracking.	a. Requires significant import of mineral soil. b. Placement of fill represents a significant cost. c. Construction of filter/drain represents additional cost. d. Provides no environmental enhancement. e. Levee and foundation may still be unstable during earthquake loading. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Seepage system may need to be modified. h. Seepage and filter/drain system may need to be maintained. i. Infringes on inboard farm land or habitat areas.
 E. Placement of Fill on Levee Crown, on Landside Slope, and in Landside Berm in <u>Soft</u> Foundation Areas - Together with <u>Filter/Drain System</u> on Landside Slope and Toe Drain	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path, stabilizes concentrated leaks and prevents piping erosion through both levee and foundation. o Placement of berm accounts for soft foundation.	Areas of the Delta where both soft foundation materials and significant, concentrated seepage or settlement and cracking problems exist. Particularly suited where piping erosion problems exist within levee foundation.	a. Levee structural stability is improved. b. Provides significant improvement in control of seepage problems in levee <u>and foundation</u>. c. May prevent piping erosion associated with both flood events and moderate earth quake-induced settlement and cracking.	a. Requires significant import of mineral soil. b. Placement of fill represents a significant cost. c. Construction of filter/drain on both slope and in trench represents additional cost. d. Provides no environmental enhancement. e. Levee and foundation may still be unstable during earthquake loading. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Construction of drain trench may cause levee distress or seepage problems if not carried out carefully. h. Seepage system may need to be modified. i. Seepage and filter/drain system may need to be maintained. j. Infringes on inboard farm land or habitat areas.

Figure 5 cont.

Possible Strategies for Levee and Habitat Improvements

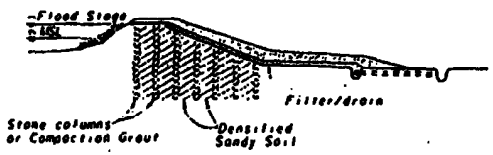
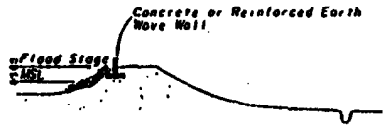
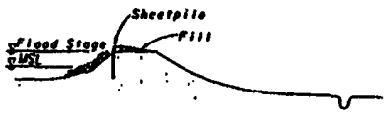
LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 F. Placement of Fill on Levee Crown, on Landside Slope, and in Landside Berm in Soft Foundation Areas - Together with Filter/Drain System on Landside Slope. Densification of Levee and Foundation Soils Using Vibroreplacment (Stone Columns) or Compaction Grouting.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path, stabilizes concentrated leaks and prevents piping erosion through levee. o Placement of berm accounts for soft foundation. o Densification of levee and foundation soils prevents/limits earthquake-induced liquefaction.	Areas of the Delta where both soft foundation materials and liquefiable materials exist within levee and/or levee foundation.	a. Levee structural stability is improved. b. Provides significant improvement in control of seepage problems in levee. c. Densification reduces amount of slumping and cracking which may occur during an earthquake. Filter/drain may prevent piping erosion following an earthquake (and flood events).	a. Requires significant import of mineral soil. b. Placement of fill represents a significant cost. c. Construction of filter/drain represents additional cost. d. Densification represents a major cost. e. Provides no environmental enhancement. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Densification construction may cause levee distress or seepage problems if not carried out carefully. h. Seepage system may need to be modified. i. Seepage and filter/drain system may need to be maintained. j. Infringes on inboard farm land or habitat areas.
 G. Construction of Concrete Wave Wall on Levee Crown	o Provides wave protection during high tides and flood events (Probably only an interim measure).	Areas of the Delta where levee freeboard is of immediate concern.	a. Provides wave protection. b. Relatively inexpensive. c. Can be constructed relatively quickly.	a. Provides no significant improvement in: - overall freeboard. - structural stability. - seepage control. - piping erosion. - seismic stability. b. Provides no environmental enhancement.
 H. Construction of Sheetpile Wave Wall on Levee Crown	o Provides wave protection during high tides and flood events (Probably only an interim measure).	Areas of the Delta where levee freeboard is of immediate concern.	a. Provides wave protection. b. Relatively inexpensive. c. Can be constructed relatively quickly.	a. Provides no significant improvement in: - overall freeboard. - structural stability. - seepage control. - piping erosion. - seismic stability. b. Requires limited import of fill. c. Provides no environmental enhancement. d. Installation of sheetpile wall may result in cracking of levee if not carried out with care.

Figure 5 cont.

Possible Strategies for Levee and Habitat Improvements

LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 I. Maintenance of Vegetation on Existing Levee Slopes	• Provides reasonable on-site growth and regrowth of vegetation while maintaining safety, access, and inspectability of levees.	Most areas in the Delta, but impact on levee stability must be first evaluated on a site by site basis. Waterside vegetation must be integrated with wave protection systems such as riprap to prevent major levee erosion.	a. Limited waterside vegetation provides some riparian and shaded aquatic habitat. b. Limited waterside vegetation provides some wave protection for levee. c. Grass vegetation provides erosion control for surface runoff. d. Preservation of existing trees provides valuable riparian habitat.	a. If Engineer's guidance not followed and vegetation becomes overgrown, there - Vegetation limits access for inspection, maintenance, and flood fighting. - Vegetation encourages burrowing rodents. - Downing of trees during storms causes damage to levees due to fallen root balls pulling out chunks of the levee. - *Tree roots can also eventually provide a* seepage path through levee when they decay. b. Cannot be implemented on Federal levees. c. Because levees require continual maintenance and remediation, some developed habitats need to be covered over with stabilizing berms.
 J. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas. Creation of Waterside Berm at Mean Sea Level to Create Waterside Wetland Habitat.	• Increases freeboard and flood protection. • Increases landside slope stability. • Lengthens seepage path. • Placement of berm accounts for soft foundation. • Provides Waterside Wetland Habitat.	Areas of Delta where soft foundation material exists and where waterside slope is not steep (deep). Cannot be used where channel capacity is severely limited.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides valuable Waterside Wetland Habitat (Waterside fill may limit seepage and improve waterside slope stability).	a. Requires major import of mineral soil. b. Placement of landside fill represents a significant cost. c. Placement of waterside fill represents a significant cost. d. Provides only limited increase in seismic stability. e. Limits channel capacity. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. *Dredging may be needed on waterside.* h. Seepage system may need to be modified.
 K. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas. Creation of Waterside Berm above Mean Sea Level to Create Waterside Riparian Habitat.	• Increases freeboard and flood protection. • Increases landside slope stability. • Lengthens seepage path. • Placement of berm accounts for soft foundation. • Provides Waterside Riparian Habitat.	Areas of Delta where soft foundation material exists, and where waterside slope is not steep (deep). Cannot be used where channel capacity us severely limited.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides valuable Waterside Riparian Habitat (Waterside fill may limit seepage and improve waterside slope stability).	a. Requires major import of mineral soil. b. Placement of landside fill represents a significant cost. c. Placement of waterside fill represents a significant cost. d. Provides only limited increase in seismic stability. e. Limits channel capacity. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Dredging may be needed on waterside. h. Seepage system may need to be modified.

Figure 5 cont.

Possible Strategies for Levee and Habitat Improvements

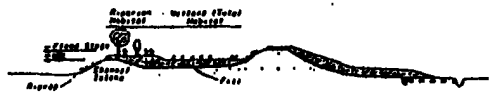
LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 L. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas. Placement of Fill between Channel Island and Levee to Create Waterside Wetland and Riparian Habitat.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation. o Provides Waterside Riparian and Wetland Habitat.	Areas of Delta where soft foundation material exists, and where channel islands and channel between island levee is not too deep. Cannot be used where channel capacity is severely limited.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides valuable Waterside Riparian and Wetland Habitat (Waterside fill may limit seepage and improve waterside slope stability).	a. Requires major import of mineral soil. b. Placement of landside fill represents a significant cost. c. Placement of waterside fill represents a significant cost. d. Provides only limited increase in seismic stability. e. Limits channel capacity. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Dredging may be needed on waterside. h. Seepage system may need to be modified. i. Channel island requires protection.
 M. Placement of Fill on Levee Crown and Landside Slope. Together with Landside Berm in Soft Foundation Areas. Placement of Sand Beach on Waterside Slope to Create Recreation Area.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation. o Provides Recreation Area.	Areas of Delta where soft foundation material exists, and where waterside slope is not too steep (deep). Cannot be used where channel capacity is severely limited.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides valuable Waterside Recreation Area. (Waterside fill may limit seepage and improve waterside slope stability.)	a. Requires major import of mineral soil. b. Placement of landside fill represents a significant cost. c. Placement of waterside sandy fill represents a significant cost. d. Provides only limited increase in seismic stability. e. Limits channel capacity. f. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. g. Dredging may be needed on waterside. h. Seepage system may need to be modified. i. Beach area requires maintenance.
 N. Partial Setback of Levee to Create Waterside Riparian Habitat, Placement of Fill on Levee Crown and Landside Slope. Slope, Together with Landside Berm in Soft Foundation Areas.	o Increases freeboard and flood protection. o Increases overall slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation. o Provides Waterside Riparian Habitat.	All areas of Delta, but especially applicable in areas where soft foundation material exists.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Lengthens seepage path.	a. Requires significant import of mineral soil. b. Fill placement and cost associated with levee setback greater than simply raising levee crown and adding berm. c. Provides only limited increase in seismic stability. d. Addition of fill likely to result in short-term instability and/or cracking if staged-construction is not used. e. Seepage system may need to be modified. f. Infringes on inboard farm land or habitat areas.

Figure 5 cont.

Possible Strategies for Levee and Habitat Improvements

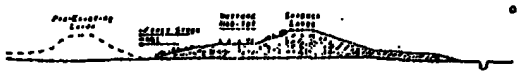
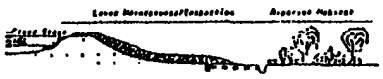
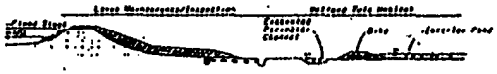
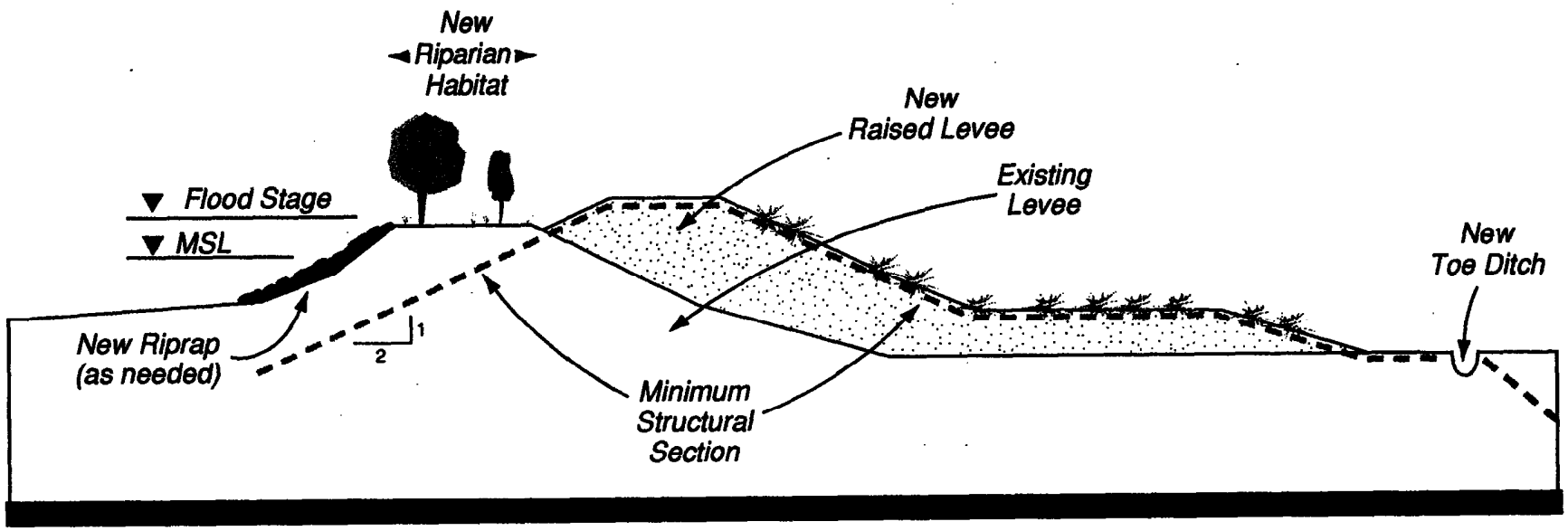
LEVEE IMPROVEMENT EXAMPLES	PURPOSE	APPLICABLE AREAS	POSITIVES	NEGATIVES
 O. Complete Setback of Levee to Improve Channel Capacity, Improve Levee Structural Stability and Provide Waterside Wetland Habitat.	o Increases channel capacity. o Improves levee stability. o Provides Waterside Wetland Habitat.	Many areas of Delta, but possibly not in areas where very thick layers of soft foundation material may make creation of new setback levees infeasible.	a. Increases channel capacity and improves flood control. b. New levee would be an engineered fill and would not liquefy during seismic events. c. Provides Waterside Wetland Habitat.	a. Requires major import of mineral soil. b. Fill placement and cost associated with levee setback greater than simply raising levee crown and adding berm. c. Foundation liquefaction could still cause failure during future earthquake. d. New levee fill likely to result in short-term instability and/or cracking if staged-construction is not used. This could temporarily make new levee less reliable than existing levee. e. Significantly infringes on inboard farm land or habitat areas.
 P. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas. Creation of Landside Riparian Habitat.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation. o Provides Landside Riparian Habitat.	All areas of Delta, but especially applicable in areas where soft foundation material exists.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides Landside Riparian Habitat. e. Reduces subsidence near levee by not tilling land in habitat area.	a. Requires significant import of mineral soil. b. Represents a significant cost. c. Provides only slight increase in seismic stability. d. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. e. Seepage system may need to be modified. f. Significantly infringes on inboard farm land and requires some land to be taken out of agricultural production.
 Q. Placement of Fill on Levee Crown and Landside Slope, Together with Landside Berm in Soft Foundation Areas. Creation of Inboard Ponds and Waterfilled Perimeter Ditches for Landside Wetland Habitat.	o Increases freeboard and flood protection. o Increases landside slope stability. o Lengthens seepage path. o Placement of berm accounts for soft foundation. o Provides Landside Wetland Habitat.	All areas of Delta, but especially applicable in areas where soft foundation material exists and significant inland subsidence is occurring.	a. Levee structural stability is improved. b. Relatively easily maintained as a flood control levee. c. Provides limited increase in seismic stability. d. Provides Landside Wetland Habitat. e. Reduces subsidence near levee by keeping organic soils saturated.	a. Requires significant import of mineral soil. b. Represents a significant cost. c. Provides only slight increase in seismic stability. d. Addition of fill may result in short-term instability and/or cracking if staged-construction is not used. e. Seepage system may need to be modified. f. Significantly infringes on inboard farm land and requires some land to be taken out of agricultural production. g. Inland pond and dike systems require maintenance.

Figure 6a

Selected Strategy for Levee and Habitat Improvements



Raised Levee with New Riparian Habitat

not to scale

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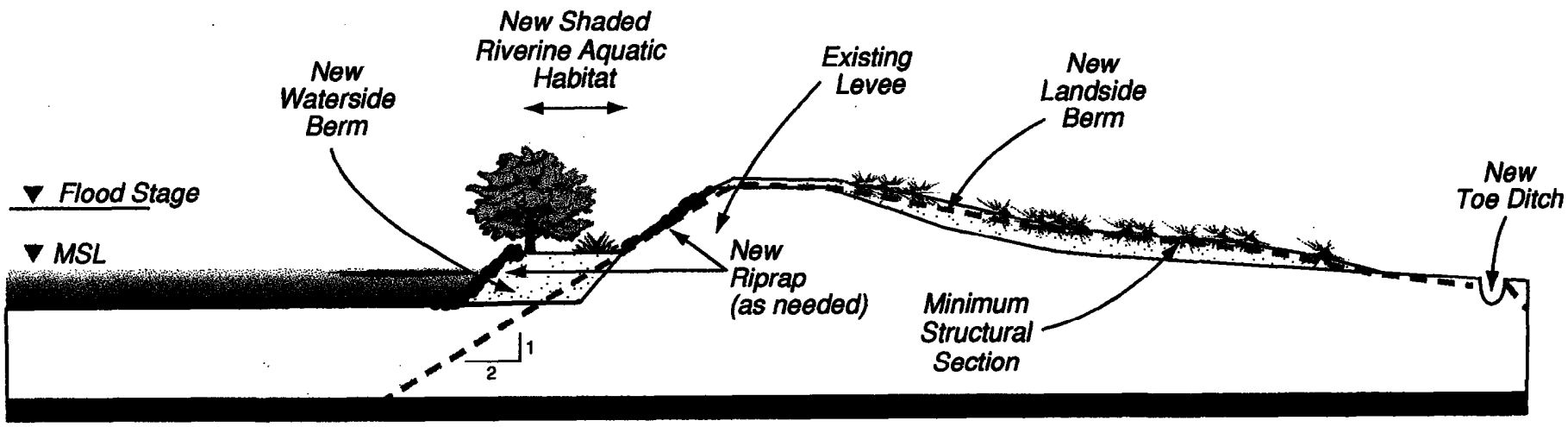
Figure 6b

Selected Strategy for Levee and Habitat Improvements



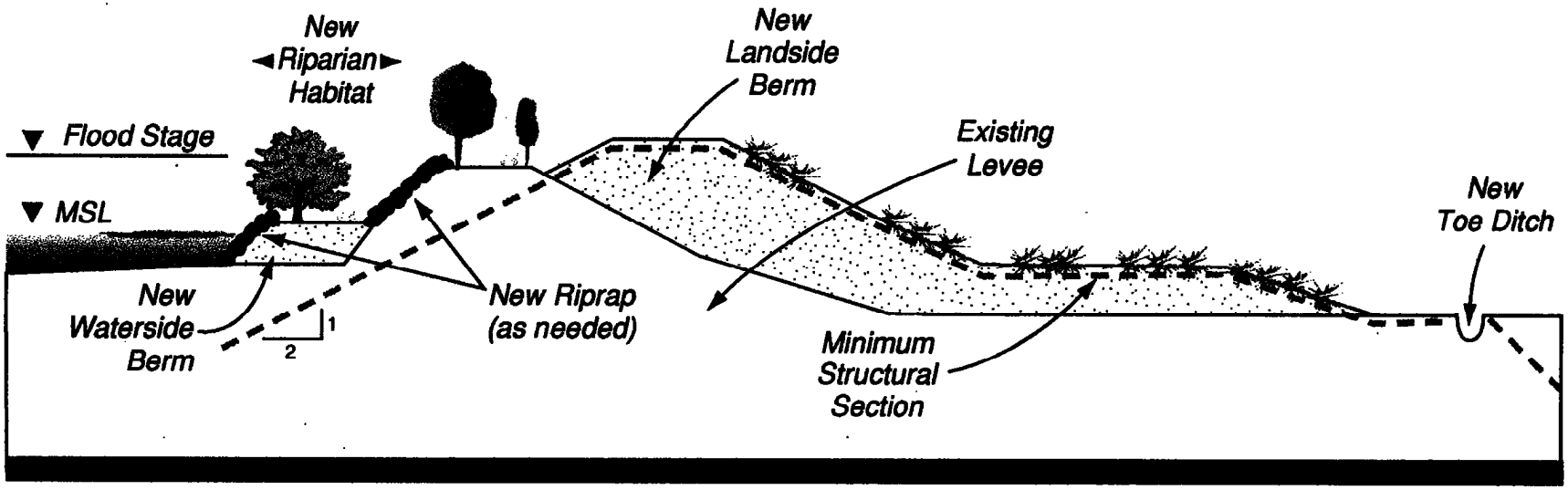
Levee Enlargement, Waterside Berm with New (SRA) Habitat

not to scale

CALFED BAY-DELTA PROGRAM

Figure 6c

Selected Strategy for Levee and Habitat Improvements



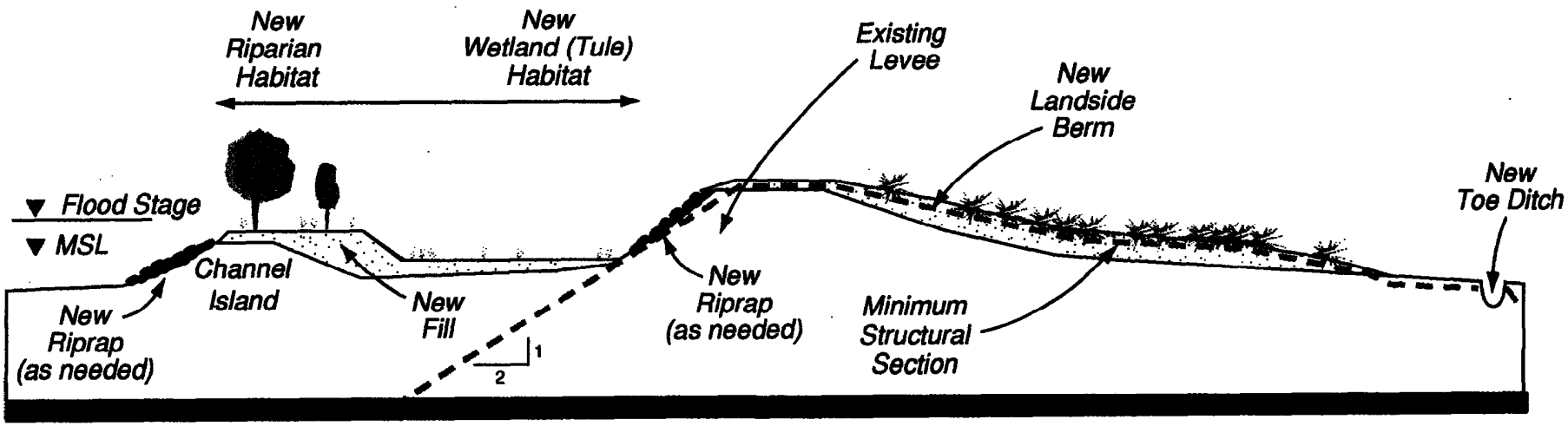
Raised Levee with New Riparian Wetland Habitat

not to scale

CALFED BAY-DELTA PROGRAM

Figure 6d

Selected Strategy for Levee and Habitat Improvements



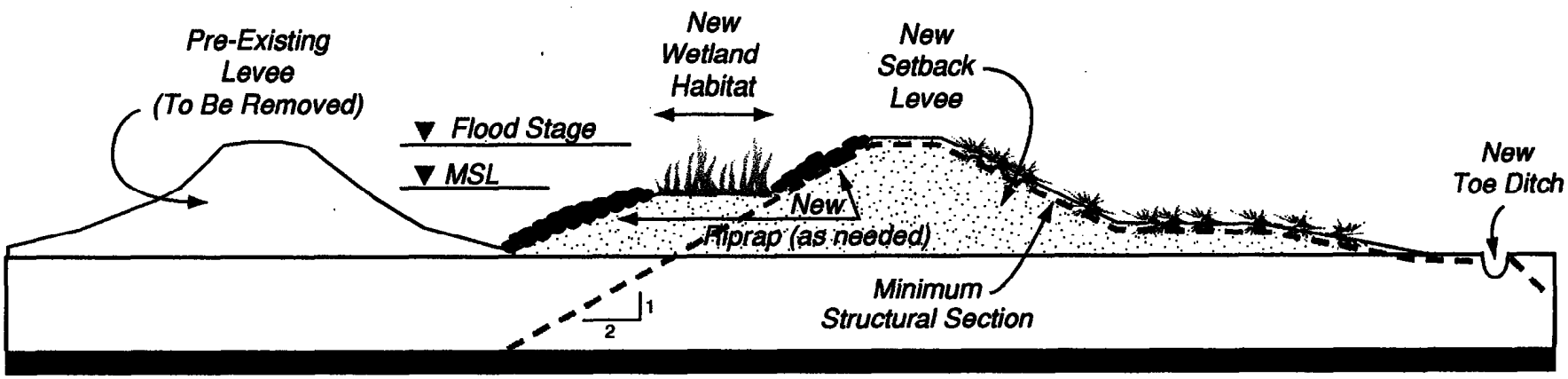
Levee Enlargement, Waterside Berm with New Riparian Habitat

not to scale

CALFED BAY-DELTA PROGRAM

Figure 6e

Selected Strategy for Levee and Habitat Improvements



Setback Levee with Habitat Improvements

not to scale

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TABLES

Table 1. Chronological Summary of Events Important to the Delta

Year	Activity
The following reclamation, water management, and legislative activities greatly influenced and shaped the current Delta system of waterways and islands:	
1849	Settlers began arriving in the Delta to farm its rich soils. The majority of the Delta was marsh land prior to subsequent reclamation and conversion to agricultural lands.
1850	Congress passed the Federal Swamp and Overflow Act, which provided for the title of wetlands to be transferred from the federal government to the states.
1861	The California Legislature authorized the State Reclamation District Act. As a result of state and federal legislation, swamp and overflow land was sold and reclaimed for agricultural use by construction of levees. The Delta was transformed from a large tidal marsh to a system of improved channels and levees by the early 1900s.
1880	By now most of the Delta has been reclaimed.
1884	Discharge of hydraulic mining debris into California rivers declared illegal.
1902	Congress passed the Reclamation Act for development of irrigated lands in the western United States.
1911	The Reclamation Board was created by the California Legislature.
1933	Congress authorized the Central Valley Water Project (CVP).
	The Stockton Deep Water Ship Channel, which extends from the confluence of the Sacramento and San Joaquin Rivers to the City of Stockton, was completed.
1940	The Contra Costa Canal, which exports water from the south Delta to the Bay Area, was completed. This was the first unit of the CVP that used existing channels to convey water through the Delta for export.
1944	Shasta Dam and Reservoir, a key feature of the CVP used to capture and store water, was completed. This project provided additional water to Delta channels during low-flow periods.
1951	The Delta-Mendota Canal, which exports water from the Delta via the Tracy Pumping Plant to the San-Joaquin Valley, was completed. This unit of the CVP increases exports from the Delta.
	The Delta Cross Channel, which aids transfer of water from the Sacramento River across the Delta to the Tracy Pumping Plant, was completed.
1959	The Delta Protection Act was enacted by the California Legislature to protect, conserve, develop, control, and use the waters of the Delta for the public good.
1960	Voters approved the State Water Resources Development Bond Act (also known as the Burns-Porter Act) to help finance the initial facilities of the State Water Project (SWP). These facilities included master levees, control structures, channel improvements, and appurtenant facilities in the Delta that are used for water conservation, water supply in the Delta, transferring water across the Delta, and flood and salinity control.
	The Sacramento River Flood Control Project, authorized by Congress, was completed by the U.S. Army Corps of Engineers. This project incorporated and improved certain Delta levees to provide improved flood control for a portion of the Delta. These levees are commonly referred to as "project" levees.

Table 1. Chronological Summary of Events Important to the Delta (Continued)

Year	Activity
1963	The Sacramento Deep Water Ship Channel, which extends from the confluence of the Sacramento and San Joaquin Rivers, was completed.
1967	Oroville Dam and Reservoir, which provides increased channel flows during low-flow periods, was completed. This is a key feature of the SWP and includes the Feather River Fish Hatchery to replace spawning areas lost as a result of the dam.
	The first stage of the Harvey O. Banks Delta Pumping Plant, another unit of the SWP, was completed along with the John E. Skinner Fish Facility. Diversions began from the Delta to the California and South Bay Aqueducts of the SWP.
	Construction of Clifton Court Forebay located in the south Delta began. This unit of the SWP facilitates export of water from the Delta.
1971	The State Water Resources Control Board adopted Delta Water Rights Decision 1379, establishing Delta water quality standards to be met by the CVP and SWP.
1973	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. The Delta Levee Maintenance Subvention Program (Senate Bill [SB] 541) was enacted to provide state funding and technical assistance for maintenance and rehabilitation of non-project Delta levees.
1976	The California Legislature adopted a conceptual plan for improvement of Delta levees (the Nejedly-Mobley Delta Levees Act). The plan for improvement of the Delta levees, as set forth in California Department of Water Resources (DWR) Bulletin No. 192, dated May 1975, was approved as the conceptual plan to guide the formulation of projects in order to preserve the integrity of the Delta levee system.
1986	Congress passed the DWR and U.S. Bureau of Reclamation historic accord, the CVP-SWP Coordinated Operation Agreement.
	The California Supreme Court confirmed the State Water Resources Control Board's broad authority and discretion over water rights and water quality issues in the Bay/Delta system, including jurisdiction over the federal CVP.
1988	Barker Slough Pumping Plant, which provides water from the northwest Delta for the North Bay aqueduct, was completed.
	Suisun Marsh salinity control gates, which aid in controlling water quality in the marsh for protection of waterfowl, were completed.
	SB 34, the Delta Flood Protection Act of 1988, was enacted, creating the Special Flood Control Project Program for eight islands in the western Delta and the towns of Thorton and Walnut Grove. This act amended the Delta Levee Maintenance Subventions Program and established a special account in the California Water Fund for appropriation by the Legislature for mitigation activities.
1991	Environmental Mitigation and Protection Requirements (SB 1065 and Assembly Bill [AB] 360) were enacted, amending the Delta Flood Protection Act of 1988. Sections were added to the California Water Code to establish coordination between the Resources Agency, DWR, the Reclamation Board, and the Department of Fish and Game to ensure that flood protection activities resulted in no net loss of riparian, wildlife, or fishery habitat.

Table 1. Chronological Summary of Events Important to the Delta (Continued)

Year	Activity
1992	The Delta Protection Act of 1992 established the Delta Protection Commission. The Commission has developed a regional, comprehensive long-term resources management plan for the Delta to protect, maintain, and, where possible, enhance and restore the overall quality of the Delta environment. The act acknowledges that agricultural land in the Delta is of significant value, including its function of providing open space and habitat for waterfowl using the Pacific Flyway. All local general plans for areas in a designated Primary zone and within the boundaries of the Delta are required to be consistent with the Delta Protection Commission regional plan.
	Congress passed the Central Valley Project Improvement Act (Public Law [PL] 102-575).
1994	State and federal agencies and representatives signed the Bay-Delta Accord.
1995	The CALFED Bay-Delta Program was initiated.
1996	Proposition 204, the Safe, Clean, Reliable Water Supply Act was approved by the voters to fund a variety of Delta improvements and local programs that were designed to address California water needs, including Delta levee system improvements.

Table 3. Delta Levee Inventory

No.	Reclamation District	Island/Reclamation District	Total Levee Miles [a]	Total Project Levee Miles [b]	Total Non-Project Levee Miles [c]	Total Non-Project Levee Miles up to PL 84-99 Standard	Total Flooded/ Other Levee Miles [d]	Total Eligible Levee Miles [e]
1	556	Andrus, Upper; RD 556	11.7	11.2	0.5	0	0	0.5
2	2028	Bacon; RD 2028	14.3	0	14.3	0	0	14.3
3		Bear Creek	2.5	2.5	0	0	0	0
4		Bethany	5.2	0	5.2	0	5.2	0
5		Bethel Island MID	11.5	0	11.5	0	0	11.5
6	2042	Bishop; RD 2042	7.8	0	7.8	7.8	0	0
7		Bishop East	0.6	0	0.6	0.6	0	0
8	2121	Bixler; RD 2121	6.2	0	6.2	6.2	0	0
9	404	Boggs Dist; RD 404	5.3	4.1	1.2	1.2	0	0
10		Borrow Pond Area	2	0	2	0	2	0
11	756	Bouldin; RD 756	18	0	18	0	0	18
12	2033	Brack; RD 2033	10.8	0	10.8	0	0	10.8
13		Browns Island (T)	0	0	0	0	0	0
14	2059	Bradford; RD 2059	7.4	0	7.4	7.4	0	0
15	2067/317/407	Bran.-Andrus LMD	29.4	19.3	10.1	0	0	10.1
16	800	Byron; RD 800	19.3	0	19.3	19.3	0	0
17	2098	Cache Haas; RD 2098	12.1	12.1	0	0	0	0
18	2086	Canal Ranch; RD 2086	9.6	0	9.6	0	0	9.6
19		Chipps Island	2.6	0	2.6	0	2.6	0
20		Clifton Court (F)	9.2	0	9.2	0	9.2	0
21		Collinsville	1.1	0	1.1	0	1.1	0
22	2117	Coney; RD 2117	5.4	0	5.4	0	0	5.4
23	2111	Deadhorse; RD 2111	2.6	0	2.6	0	0	2.6
24		Delta Mendota	2.1	0	2.1	0	2.1	0
25		Decker	4.1	0	4.1	0	4.1	0
26		Drexler	4	0	4	0	0	4
27	536/2084	Egbert; RDs 536 and 2084	10.6	10.6	0	0	0	0
28	813	Ehrheart; RD 813	4.7	0	4.7	0	4.7	0
29	2029	Empire; RD 2029	10.5	0	10.5	0	0	10.5

Table 3. Delta Levee Inventory (Continued)

No.	Reclamation District	Island/Reclamation District	Total Levee Miles [a]	Total Project Levee Miles [b]	Total Non-Project Levee Miles [c]	Total Non-Project Levee Miles up to PL 84-99 Standard	Total Flooded/ Other Levee Miles [d]	Total Eligible Levee Miles [e]
30	773	Fabian; RD 773	18.8	0	18.8	0	0	18.8
31	2113	Fay; RD 2113	1.6	0	1.6	0	0	1.6
32		Frank, Little (F)	3.5	0	3.5	0	3.5	0
33	1002	Glanville; RD 1002	13	0	13	0	0	13
34	765	Glide; RD 765	1.7	1.7	0	0	0	0
35	3	Grand; RD 3	28.8	28.8	0	0	0	0
36	2126	Harbor Cove (Atlas); RD 2126	1.9	0	1.9	0	0	1.9
37	1609	Harveys; RD 1609	12.4	0	12.4	0	12.4	0
38	2060	Hastings; RD 2060	16	16	0	0	0	0
39	2025	Holland; RD 2025	11	0	11	0	0	11
40	999	Holland Land; RD 999	33.4	33.4	0	0	0	0
41	2116	Holt Station; RD 2116	0.4	0	0.4	0.4	0	0
42	799	Hotchkiss; RD 799	6.3	0	6.3	0	0	6.3
43	830	Jersey; RD 830	15.6	0	15.6	0	0	15.6
44	2038	Jones, Lower; RD 2038	9	0	9	0	0	9
45	2039	Jones, Upper; RD 2039	9.3	0	9.3	0	0	9.3
46	2085	Kasson; RD 2085	6.2	6.2	0	0	0	0
47		Kimball Island	1.9	0	1.9	0	1.9	0
48	2044	King; RD 2044	9.1	0	9.1	0	0	9.1
49	369	Libby McNeil; RD 369	1.9	0.8	1.1	0	0	1.1
50	2093	Liberty; RD 2093	14.5	0	14.5	0	14.5	0
51	307	Lisbon; RD 307	6.6	6.6	0	0	0	0
52	2118	Little Mandeville (F); RD 2118	4.5	0	4.5	0	4.5	0
53		Los Medanos	5.6	0	5.6	0	5.6	0
54		Maintenance Area 9	19.6	19.6	0	0	0	0
55	2027	Mandeville; RD 2027	14.3	0	14.3	0	0	14.3
56	2110	McCormack-Williamson; RD 2110	8.8	0	8.8	0	8.8	0
57	2075	McMullin; RD 2075	7.5	7.5	0	0	0	0
58	2030	McDonald; RD 2030	13.7	0	13.7	0	0	13.7

Table 3. Delta Levee Inventory (Continued)

No.	Reclamation District	Island/Reclamation District	Total Levee Miles [a]	Total Project Levee Miles [b]	Total Non-Project Levee Miles [c]	Total Non-Project Levee Miles up to PL 84-99 Standard	Total Flooded/ Other Levee Miles [d]	Total Eligible Levee Miles [e]
59	2041	Medford; RD 2041	5.9	0	5.9	0	0	5.9
60	150	Merritt; RD 150	18.1	18.1	0	0	0	0
61	2021	Mildred (F); RD 2021*	7.3	0	7.3	0	7.3	0
62		Montezuma Flats	1.9	0	1.9	0	0	0
63		Montezuma Island	0.4	0	0.4	0	0.4	0
64	2107	Mossdale 2; RD 2107	4.2	4.2	0	0	0	0
65	1007	Naglee Burke; RD 1007	8.3	0	8.3	0	0	8.3
66	348	New Hope; RD 348	18.6	0	18.6	0	0	18.6
67		Oakley	6.7	0	6.7	0	6.7	0
68	2024	Orwood; RD 2024	6.3	0	6.3	0	0	6.3
69	2036	Palm; RD 2036	7.5	0	7.5	0	0	7.5
70	2095	Paradise; RD 2095	4.9	4.9	0	0	0	0
71	2058	Pescadero; RD 2058	9.2	6.7	2.5	0	0	2.5
72	2104	Peters; RD 2104	8.4	8.4	0	0	0	0
73	551	Pierson; RD 551	14	6.8	7.2	7.2	0	0
74	1667	Prospect; RD 1667 (F)	10	2.9	7.1	0	7.1	0
75	2090	Quimby; RD 2090	7	0	7	0	0	7
76	755	Randall; RD 755	1.9	1.9	0	0	0	0
77	2037	Rindge; RD 2037	15.8	0	15.8	0	0	15.8
78	2114	Rio Blanco; RD 2114	4.2	0	4.2	0	0	4.2
79	2064	River Junction; RD 2064	11.9	11.9	0	0	0	0
80	684	Roberts, Lower; RD 684	16	0	16	0	0	16
81	524	Roberts, Middle; RD 524	12.7	6.1	6.6	0	0	6.6
82	544	Roberts, Upper; RD 544	15	10.6	4.4	0	0	4.4
83		Rough and Ready*	5.5	0	5.5	0	5.5	0
84	501	Ryer; RD 501	20.6	20.6	0	0	0	0
85		Sacramento Deepwater	26	0	26	0	26	0
86	2074	Sargent Barnhart; RD 2074	6	1.5	4.5	4.5	0	0
87	341	Sherman; RD 341	18.5	9.7	8.8	0	0	8.8

Table 3. Delta Levee Inventory (Continued)

No.	Reclamation District	Island/Reclamation District	Total Levee Miles [a]	Total Project Levee Miles [b]	Total Non-Project Levee Miles [c]	Total Non-Project Levee Miles up to PL 84-99 Standard	Total Flooded/ Other Levee Miles [d]	Total Eligible Levee Miles [e]
88		Sherman West (F)	5.5	0	5.5	0	5.5	0
89	2115	Shima; RD 2115	6.6	0	6.6	0	0	6.6
90		Shin Kee	3.6	0	3.6	0	0	3.6
91		SJCFCD Five Mile Slough	1.4	0	1.4	1.4	0	0
92		SJCFCD Fourteen Mile Slough	2	0	2	2	0	0
93		SJCFCD Mosher Slough	4.1	0	4.1	4.1	0	0
94	17	San Joaquin River; RD 17	16.2	16.2	0	0	0	0
95	1614	Smith Tract; RD 1614	2.8	0	2.8	2.8	0	0
96	1608	Lincoln Village West	4.3	0	4.3	4.3	0	0
97		Spinner Island	0.8	0	0.8	0	0.8	0
98	2089	Stark; RD 2089	3.5	2.8	0.7	0.7	0	0
99	38	Staten; RD 38	25.4	0	25.4	0	0	25.4
100	2062	Stewart; RD 2062	12.3	12.3	0	0	0	0
101	349	Sutter; RD 349	12.5	12.5	0	0	0	0
102	548	Terminous; RD 548	21	0	21	0	0	21
103	2108	Tinsley; RD 2108	0	0	0	0	0	0
104	1601	Twitchell; RD 1601	12	2.5	9.5	0	0	9.5
105	563	Tyler; RD 563	22.9	12.2	10.7	0	0	10.7
106	1	Union, East; RD 1	14	1	13	0	0	13
107	2	Union, West; RD 2	16.2	0	16.2	0	0	16.2
108	1607	Van Sickle; RD 1607	3.8	0	3.8	0	3.8	0
109	2065	Veale; RD 2065	5.1	0	5.1	0	0	5.1
110	2023	Venice; RD 2023	12.3	0	12.3	0	0	12.3
111	2040	Victoria; RD 2040	15.1	0	15.1	0	0	15.1
112	554	Walnut Grove; RD 554	4.9	1	3.9	3.9	0	0
113	2094	Walthall; RD 2094	3.3	3.3	0	0	0	0
114	2026	Webb; RD 2026	12.9	0	12.9	0	0	12.9
115	828	Weber; RD 828	1.7	0	1.7	1.7	0	0
116		West Island	3	0	3	0	3	0

Table 3. Delta Levee Inventory (Continued)

No.	Reclamation District	Island/Reclamation District	Total Levee Miles [a]	Total Project Levee Miles [b]	Total Non-Project Levee Miles [c]	Total Non-Project Levee Miles up to PL 84-99 Standard	Total Flooded/ Other Levee Miles [d]	Total Eligible Levee Miles [e]
117	900	West Sacramento; RD 900	13.6	13.6	0	0	0	0
118	2096	Wetherbee; RD 2096	0.2	0.2	0	0	0	0
119	2122	Winter; RD 2122	4.8	0	4.8	0	0	4.8
120	2072	Woodward; RD 2072	8.8	0	8.8	0	0	8.8
121	2119	Wright-Elmwood; RD 2119	7.1	0	7.1	0	0	7.1
122	2068	Yolano; RD 2068	8.7	8.7	0	0	0	0
123		Yolo Bypass Unit 4	3.6	3.6	0	0	0	0
		Total Miles	**1,116**	**384.6**	**731.7**	**75.5**	**148.3**	**506.0**

NOTES:

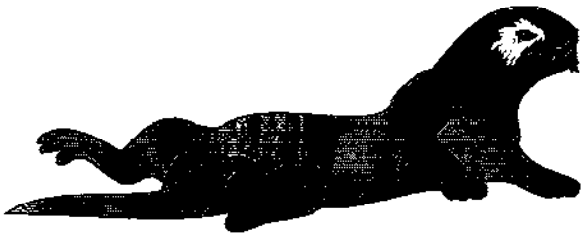
From Corps' 1993 System Final Report - Lower Sacramento.
Includes Corps' estimate for project levee repairs.
Discrepancies in the Delta levee inventory and the cost estimate are being investigated.

[a] Total Levee Miles - Length of levees in the legal Delta.
[b] Total Project Levee Miles - Length of federal project levees.
[c] Total Non-Project Levee Miles - Non-project levees included in the Subventions Program. Includes Direct Agreement levees.
[d] Total Flooded Levees - Islands or tracts that are permanently flooded or tidal and the levees are not being maintained. Other Levees - Non-Project levees maintained and operated by either a private entity or the Corps, U.S. Bureau of Reclamation, Navy, or DWR.
[e] Total Eligible Levee Miles - Non-project levees that are not up to PL 84-99 standards and are not flooded or maintained by a private or federal entity.

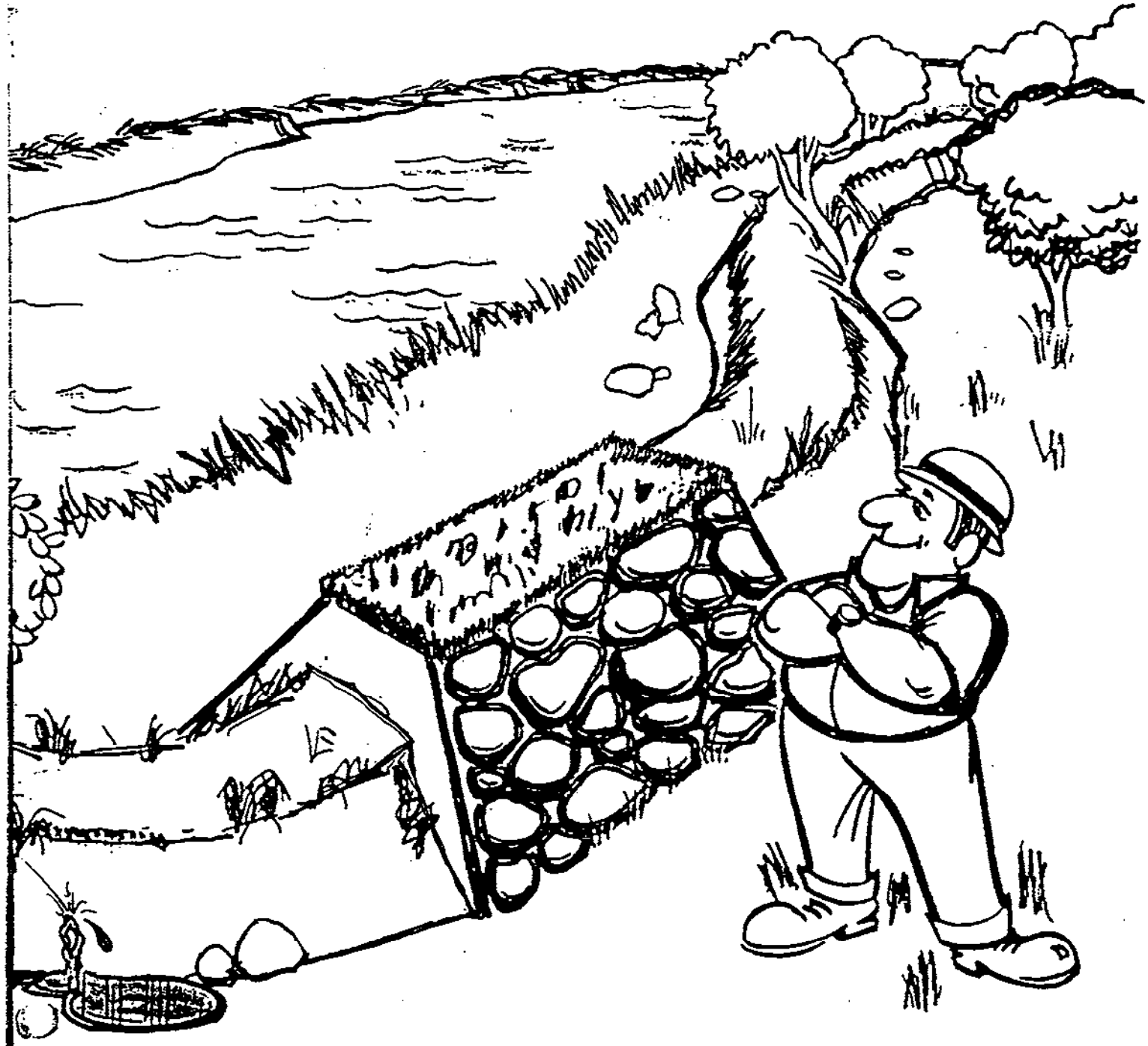
APPENDICES

APPENDIX A

PL 84-99 DELTA SPECIFIC STANDARD AND PL 84-99 OVERVIEW



GUIDELINES FOR REHABILITATION OF NON-FEDERAL LEVEES-IN THE SACRAMENTO-SAN JOAQUIN LEGAL DELTA



DEPARTMENT OF THE ARMY
U.S. Army Corps of Engineers
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

24 MAR 1988

CECW-OE-D

MEMORANDUM FOR: Commander, South Pacific Division

SUBJECT: Non-Federal Levee Rehabilitation in the Sacramento-San Joaquin Legal Delta under the Provisions of PL 84-99, as amended

1. Reference: Memorandum with enclosures, CESPD-CO-E, 30 November 1987, sab.

2. The proposed eligibility guidelines are approved subject to the following conditions:

a. The PL 84-99 rating guide dated 2 December 1987, which superseded the 30 June 1987 version, will be used in the final eligibility guidelines.

b. General dewatering of inundated tracts as a result of levee failure will not be considered as eligible work under Corps rehabilitation project as it is rightfully a non-federal responsibility. Costs associated with dewatering the immediate construction area for the purpose of levee embankment repair is eligible for consideration.

3. Implementation of the new guidelines must always focus on our common objective to ensure consistent application of the emergency authority to all eligible applicants where the Federal interest and flood protection are of paramount concern. This position must be clearly transmitted to all interested parties.

FOR THE COMMANDER:

JOHN P. ELMORE
Chief, Operations and Readiness Division
Directorate of Civil Works

DEPARTMENT OF THE ARMY
SOUTH PACIFIC DIVISION, CORPS OF ENGINEERS
630 Sansome Street Room 720
San Francisco, California 94111-2206

REPLY TO
ATTENTION OF:
CESPD-CO-E

24 Sept 1987

MEMORANDUM FOR: Commander, HQUSACE, ATTN: DAEN-CWO-EO, 20 Mass. Ave, N.W. Wash D.C., 20314-1000

SUBJECT: Non-Federal Levee Rehabilitation in the Sacramento-San Joaquin Legal Delta under the Provisions of PL 84-99, as amended.

1. The Corps position on rehabilitation of non-Federal levees within the Sacramento-San Joaquin Delta was defined in a February 1980 PL 84-99 policy statement by Commander, HQUSACE, Lieutenant General John W. Morris. General Morris stated that since non-Federal Delta levees were built for tidal and not flood control they could not be rehabilitated under PL 84-99 authority. Director of Civil Works Major General John F. Wall reviewed this policy in May of 1984 and added that if local interests upgraded these tidal levees to meet appropriate flood control standards they may be considered for rehabilitation assistance. General Wall also stated that SPD may have to develop Delta exclusive standards for any levee upgrade by locals.

2. Based on the above policy guidance Sacramento District has developed Delta exclusive standards (Encl 3) for non-Federal levees to qualify for rehabilitation under PL-84-99. I concur with the District's proposal with the following stipulations:

a. It is agreed to view FEMA's short-term hazard mitigation plan for the Delta (valid through 1991) as the interim Federal guideline for Delta levees. These guidelines would apply to eligibility for Federal assistance under PL 93-288 only.

b. The long-term solution to eligibility to Corps emergency assistance in the Delta will be based on eligibility guidelines for rehabilitation under PL 84-99 as coordinated between the State and Corps. This is consistent with FEMA's expectations.

c. The Corps accepts the established State standards for level of protection and freeboard in the Delta (State long-term subvention program as expressed in State Pub 192.82.) However, geotech standards must also be addressed to establish eligibility for Corps rehabilitation assistance. The geotech/stability screening process developed by SPK will be proposed to the State for their consideration. An option must be included for levee sponsors to do their own analysis to reclaima if desired.

d. SPK's proposed definition of a flood event in the Delta appears reasonable for eligibility purposes, provided it is understood that the Division Commander retains the purogative to judge individual events based on specific H&H data.

3. This document is forwarded for your review and comment. A formal presentation on the proposal will be given to your staff if so requested.

4. References:

a. MSG, DAEN-CWO-E, 271415 Feb 80, Subject: PL 84-99 Authority. (Encl 1 - Morris Policy on Delta)

b. First Endorsement, DAEN-CWO-EO, 1 May 84, Subject: Sacramento San Joaquin Delta, California. (Encl 2 - Wall Policy on Delta)

/S/

Enclosures (3)

PATRICK J. KELLY
Brigadier General, U.S. Army
Commanding

CESPD-CO-E (CECW-OE-D/24 Mar 88) 1st End B. Edmisten/dah/556-3108
SUBJECT: Non-Federal Levee Rehabilitation in the Sacramento-San Joaquin Legal Delta under the Provisions of PL 84-99, as amended

DA, South Pacific Division, Corps of Engineers, 630 Sansome Street, Room 720, San Francisco, CA 94111-2206 13 April 1988

FOR: Sacramento District Emergency Management (CESPK-EM)

The proposed eligibility guidelines are approved subject to conditions stated in basic memorandum and those conditions listed in paragraph 2 of CESPD-CO-E Memorandum of 30 November 1987, same subject.

FOR THE COMMANDER:

DAVID L. FULTON, Chief
Construction-Operations Division

CESPK-EM (500) 4 September 1987

MEMORANDUM FOR: Commander, South Pacific Division

SUBJECT: Non-Federal Levee Rehabilitation in the Sacramento-San Joaquin Legal Delta under the Provisions of PL 84-99, as amended

1. Reference:

a. Letter, SPKEM, 1 May 1987.

b. Joint SPD/SPK Meeting, 2 September 1987.

c. DRAFT - Guidelines for Rehabilitation of non-Federal Levees in the Sacramento-San Joaquin Legal Delta, CA, 3 September 1987 (encl 1).

2. Purpose.

a. The purpose of this letter is to change the recommendations submitted by Reference 1.a. The changes are to those items discussed at the joint meeting (Reference 1.b.).

b. This letter also requests your approval to implement the subject guidelines.

3. General.

a. The Chief of Engineers and the South Pacific Division Engineer tasked the Sacramento District Engineer to develop Delta-exclusive standards for non-Federal levee upgrade, by local interests, to appropriate flood control standards that will result in their being eligible for consideration for repair under PL 84-99, as amended. The Delta-exclusive standards supplement the National Guidelines (33 CFR203) issued 16 July 1986.

b. The recommended guidelines are Delta-specific and they are not intended to establish design standards for the 537 miles of non-Federal levees in the Sacramento-San Joaquin legal Delta, but to provide uniform procedures to be used by the Corps of Engineers in determining eligibility under PL 84-99, as amended. These Delta-specific guidelines supplement the National Guidelines.

c. The National Guidelines provide a maintenance inspection rating guide that is meant to be used for all non-Federal levees. That document plus the supplemental guidelines (recommended herein) and all existing PL 84-99 criteria will be used to qualify the non-Federal levees in the Sacramento-San Joaquin Delta for rehabilitation assistance.

4. Recommendations - Supplemental to the National Guidelines.

a. Non-Federal Levee Guidelines for structures in the Legal Delta to be considered flood control structures eligible to qualify for post-flood rehabilitation under PL 84-99, as amended, are as follows:

(1) 1.5 feet of freeboard above the 100-year flood stage for all islands/tracts.

(2) The 100-year flood stages are those stages developed by the Sacramento District for FEMA that are being used in their Flood Hazard Mitigation Plan, Sacramento-San Joaquin Delta, Disaster Declaration FEMA-758-DR-CA, 1986.

(3) The levee will have a 16-foot crown width with an all-weather patrol road.

(4) The minimum water side slope of the levee will be 1V:2H.

(5) The minimum land side slope of the levee will vary with the levee height and depth of peat (see encl 1). The levee stability charts were computed using an idealized levee section with 5 zones of materials and using a safety factor of 1.25. Public agencies whose levees do not fit into these guidelines may submit data/information prepared by an engineer registered in the fields of geotechnical, soils or civil that demonstrates their levees meet or exceed a 1.25 factor of safety.

(6) A levee toe drain will be located 30 feet landward from the landside levee toe.

b. The California State Water Code Section 12200 (dated 1959) has defined the boundary of the Delta and it is

recommended that the Corps of Engineers adopt this boundary of the Delta for the purposes of administering the provisions of PL 84-99, as amended.

c. When any one of the following conditions is met, a determination will be made by the Sacramento District Engineer and concurred in by the South Pacific Division Engineer, for post-flood rehabilitation of non-Federal levees in the legal Delta.

(1) Antioch tidal gauge equals or exceeds 6.0 feet (1929 National Geodetic Vertical Datum) NGVD (about 25-year frequency), plus the combined flow in the Sacramento River and Yolo Bypass equals or exceeds 320,000 cfs (about 10-year frequency flow) at the latitude of the city of Sacramento, or

(2) Antioch tidal gauge equals or exceeds 6.0 feet NGVD (about 25-year frequency), plus the flows in the San Joaquin River at Vernalis equals or exceeds 28,000 cfs (about 10-year frequency rain flood), and the stage on the Mokelumne River at New Hope Landing equals or exceeds 11 feet NGVD (about 10-year frequency stage), or

(3) Antioch tidal gauge equals or exceeds 6.0 feet NGVD (about a 25-year frequency), plus the flow of any other river/stream into the legal Delta exceeds a 10-year frequency.

5. Subsequent to your approval to implement the subject Delta-specific guidelines, we have arranged to meet informally with FEMA, State OES, State DWR and State Reclamation Board officials to solicit their views. The meeting will be held at the Sacramento District office, Room No. 6543, on 30 September 1987 at 1300 hours.

Encl

WAYNE J. SCHOLL
COL, CE
Commanding

DG
GARRETT/pk/
2539
JLC
CZARNASTY
SCHOLL

CF (w/encl):
CESPD-CO-E (6)
CESPK-ED
CESPK-PD
CESPK-CO
CESPK-EM (4)

cc:
Exec RF
EMD RF

GUIDELINES FOR REHABILITATION OF NON-FEDERAL LEVEES IN THE SACRAMENTO-SAN JOAQUIN LEGAL DELTA, CA

1. In 1980, the Corps of Engineers stopped all rehabilitation assistance to non-Federal levees in Sacramento-San Joaquin Legal Delta under PL 84-99 until such time that the non-Federal levees could be considered flood-control levees that provide a dependable adequate degree of protection. Subsequently, the Corps of Engineers developed National Guidelines that were finalized and published in the Federal Register Vol. 48, No. 246, dated July 16, 1986. Those guidelines are supplemented by additional guidelines, contained in this document, that are specific to the Delta. The boundaries of the legal Delta are defined in the State of California Water Code Section 12200 dated 1959. All non-Federal levees in the legal Delta will be evaluated for eligibility for rehabilitation under the provisions of PL 84-99, as amended, when they meet the guidance provided herein.

2. Summary of changes to PL 84-99, as amended. These changes prescribe a set of minimum guidelines that non-Federal flood control projects must meet to be eligible for

consideration for rehabilitation under the provisions of PL 84-99. These guidelines address both maintenance and engineering criteria and revise the existing cost-sharing formula for non-Federal projects. The changes also include a requirement that all applications for rehabilitation of non-Federal projects have a public agency sponsor. The new cost-sharing requirements, effective immediately, establish an 80% Federal-20% non-Federal distribution of the construction cost of the rehabilitation of non-Federal flood control projects. Evaluations for eligibility, investigation of flood damages, engineering and rehabilitation design costs are borne by the Corps of Engineers.

3. The National Guidance for the technical and maintenance evaluation of non-Federal flood control facilities is attached as Appendix A.

4. The Delta-specific guidelines are supplemental to the National Guidelines and are as follows:

a. 1.5 feet of freeboard above the 100-year flood stage for all islands/tracts.

b. The 100-year flood stages are shown on Appendix B. These are the same 100-year flood stages used for the Flood Hazard Mitigation Plan, Sacramento-San Joaquin Delta, Disaster Declaration FEMA-758-DR-CA, 1986.

c. The levee will have a 16-foot crown width with an all-weather patrol road.

d. The minimum water side slope of the levee will be 1V:2H.

e. The minimum land side slope of the levee will vary with the levee height and depth of peat (see Appendix D). The levee stability charts were computed using an idealized levee section with 5 zones of materials and using a safety factor of 1.25. Public agencies whose levees do not fit into these guidelines may submit data/information prepared by a registered engineer (geotechnical, soils, civil) that demonstrates their levees meet or exceed a 1.25 factor of safety.

f. A levee toe drain will be located 30 feet landward from the landside levee toe.

5. Public agencies may request an evaluation of their non-Federal levee system by providing the following information to U.S. Army Corps of Engineers, ATTN: Emergency Management Division, 650 Capitol Mall, Sacramento, CA 95814-4794.

a. Name of Island/Tract, point of contact, telephone number and address.

b. Furnish centerline profile and cross-sections of the levee at a minimum of 1,000 feet intervals.

c. If applicable, certification data of a 1.25 factor of safety.

6. When any one of the following conditions is met, a determination will be made by the Sacramento District Engineer and concurred in by the South Pacific Division Engineer for post-flood rehabilitation of non-Federal levees in the legal Delta.

a. Antioch tidal gauge equals or exceeds 6.0 feet (1929 National Geodetic Vertical Datum) NGVD (about 25-year frequency), plus the combined flow in the Sacramento River and Yolo Bypass equals or exceeds 320,000 cfs (about 10-year frequency flow) at the latitude of the city of Sacramento or

b. Antioch tidal gauge equals or exceeds 6.0 feet NGVD (about 25-year frequency), plus the flows in the San Joaquin River at Vernalis equals or exceeds 28,000 cfs (about 10-year frequency rain flood), and the stage on the Mokelumne River at New Hope Landing equals or exceeds 11 feet NGVD (about 10-year frequency stage), or

c. Antioch tidal gauge equals or exceeds 6.0 feet NGVD (about a 25-year frequency), plus the flow of any river/stream into the legal Delta exceeds a 10-year frequency.

Atchs

APPENDICES

Appendix	Description
A	Levee Rating Guide
B	Map of 100-year Flood Stages in the Delta
C	Peat Thickness Map
D	Minimum Landside Levee Configuration

Rating codes:

A- Acceptable Performance Level
M- Minimally Acceptable Performance Level
U- Unacceptable Performance Level

ITEM	RATING GUIDE		
1.	**Level of Protection**	A-	The designed section is for an exceedance frequency greater than 10% chance (10 yr.) with minimum freeboard of 2 feet.
		M-	The designed section is for an exceedance frequency between 20% to 10% chance (5-10 yr) with minimum freeboard of 1 foot.
		U-	The designed section is less than the minimum required for an M rating.
2.	**Erosion Control**	A-	Erosion protection in active areas is capable of handling the designed flow velocity for the level of protection for the entire FCW.
		M-	Erosion protection is capable of handling the designed flow velocity for the level of protection for 75% or more of the FCW.
		U-	Erosion protection measures protects less than 75% of the FCW; or if erosion protection was not provided and there is evidence indicating a need for erosion protection.
3.	**Embankment**	A-	Fill material for embankment is suitable to prevent slides and seepage for the existing side slopes. Fill material is uniform and adequately compacted through the entire FCW.
		M-	Material is adequate and suitable to prevent major slides and capable of handling localized seepage for the existing side slopes. Fill material is uniform and adequately compacted in 75% or more of the FCW.
		U-	Material is unsuitable and likely to cause numerous slides and allow excessive uncontrolled seepage. Fill material is not uniform, or there is no compaction and evidence indicates a need for compaction.
4.	**Foundation**	A-	Foundation materials will not cause piping, sand boils, seepage, or settlements which reduce the level of protection.
		M-	Foundation materials may show signs of excessive seepage, minor sand boils, and localized settlements.
		U-	Foundation materials are unsuitable and likely to cause excessive uncontrolled seepage, sand boils, and piping.

Figure E-2. Engineering Guide

5.	Structures	A- Structures are capable of performing their design functions and show no signs of failure.
		M- Structures are performing their design functions but show signs of overtopping and bypassing flows.
		U- Structures are not performing their design functions or show signs of structural failure.

Figure E-2. Engineering Guide (Cont'd)

E-5. Maintenance Compliance Guide. This guide (Figure E-3) is used to assign a rating for maintenance compliance during the Initial Eligibility Inspection and the Continuing Eligibility Inspection. The evaluation should reflect the level of maintenance required to insure the intended degree of flood protection and actions required by the owner/sponsor for a FCW to remain eligible for the rehabilitation program under PL 84-99.

Rating codes:

A- Acceptable Performance Level
M- Minimally Acceptable Performance Level
U- Unacceptable Performance Level

ITEM	RATING GUIDE		
1.	Depressions	A-	Minimal depressions or potholes; proper drainage.
		M-	Some depressions that will not pond water.
		U-	Depressions 6" vertical or greater which endangers the integrity of the levee.
2.	Erosion	A-	No erosion observed.
		M-	LEVEES: Erosion of levee crown or slopes that will not interrupt inspection or maintenance access. OTHER: Erosion gullies less than 6 inches deep or deviation of 1 foot from designed grade or section.
		U-	LEVEE: Erosion of levee crown or slopes that has interrupted inspection or maintenance access. OTHER: Erosion gullies greater than 6 inches or deviation of 1 foot or more from designed grade or section.
3.	Slope Stability	A-	No slides present, or erosion of slopes more than 4" deep.
		M-	Minor superficial sliding that with deferred repair does not pose an immediate threat to FCW integrity. No displacement or bulges.
		U-	Evidence of deep seated sliding (2 ft. vertical or greater) requiring repairs to re-establish FCW integrity.
4.	Cracking	A-	No cracks in transverse or longitudinal direction observed in the FCW.
		M-	Longitudinal cracks are no longer than the levee height. No displacement and bulging. No transverse cracks observed.
		U-	Longitudinal cracks are greater than levee height with some bulging observed. Transverse cracks are evident.

Figure E-3. Maintenance Compliance Guide

5.	**Animal Burrows**	A-	Continuous animal burrow control program that eliminates any active burrowing in a short period of time.
		M-	Animal burrows present that will not result in seepage or slope stability problems.
		U-	Animal burrows present that would result in possible seepage or slope stability problems.
6.	**Unwanted Levee Growth**	A-	No large brush or trees exist in the FCW. Grass cover well maintained. CHANNELS: Channel capacity for designed flows is not affected.
		M-	Minimal tree (2" diameter or smaller) and brush cover present that will not threaten FCW integrity. (NOTE: Trees that have been cut and removed from levees should have their roots excavated and the cavity filled and compacted with impervious material). CHANNELS: Channel capacity for designed flows is not adversely affected.
		U-	Tree, weed and brush cover exists in the FCW requiring removal to re-establish or ascertain FCW integrity. (NOTE: If significant growth on levees exists, prohibiting rating of other levee inspection items, then the inspection should be ended until this item is corrected.) CHANNEL: Channel obstructions have impaired the floodway capacity and hydraulic effectiveness.
7.	**Encroachments**	A-	No trash, debris, excavations, structures, or other obstructions present.
		M-	Trash, debris, excavations, structures, or other obstructions present or inappropriate activities occurring that will not inhibit operations and maintenance performance.
		U-	Trash, debris, excavations, structures or other obstructions present or inappropriate activities that would inhibit operations and maintenance performance.
8.	**Riprap/Revetment**	A-	Existing protection works which is properly maintained and undamaged.
		M-	No scouring activity that could undercut banks, erode embankments, or restrict desired channel flow.
		U-	Meandering and/or scour activity that is undercutting banks, eroding embankments (such as levees), or impairs channel flows by causing turbulence, meandering or shoaling.

Figure E-3. Maintenance Compliance Guide (Cont'd)

9.	**Stability of Concrete Structures**	A-	Tilting, sliding or settling of structures, that has been secured which preserves the integrity or performance.
		M-	Uncorrected sliding or settlement of structures of a magnitude that doesn't affect performance.
		U-	Tilting or settlement of structures that has resulted with a threat to the structure's integrity and performance.
10.	Concrete Surfaces	A-	Negligible spalling or scaling. No cracks present that are not controlled by reinforcing steel or that cause integrity deterioration or result in inadequate structure performance.
		M-	Spalling, scaling and cracking present but immediate integrity or performance of structure not threatened.
		U-	Surface deterioration or deep, controlled cracks present that result in an unreliable structure.
11.	**Structural Foundations**	A-	No scouring or undermining near the structures.
		M-	Scouring near the footing of the structure but not close enough to impact structure stability during the next flood event.
		U-	Scouring or undermining at the foundation which has impacted structure integrity.
12.	**Culverts**	A-	[a] No breaks, holes, cracks in the culvert that would result in any significant water leakage. No surface distress that could result in permanent damage. [b] Negligible debris or silt blocking culvert section. None or minimal debris or sediment present which has negligible effect on operations of the culvert.
		M-	[a] Culvert integrity not threatened by spalls, scales or surface rusting. Cracks are present but resulting leakage is not impacting the structure. [b] Debris or sediment present, which is proposed to be removed prior to the next flood event, that minimally affects the operations of the culvert.
		U-	[a] Culvert has deterioration such as surface distress and/or has significant leakage in quantity or degree to threaten integrity. [b] Accumulated debris or settlement which has not been annually removed and severely affects the operations of the culvert.

Figure E-3. Maintenance Compliance Guide (Cont'd)

13.	Gates	A-	Gates open easily and close to a tight seal. Materials do not have permanent corrosion damage and appear to have historically been maintained adequately.
		M-	Gates operate but leak when closed, however, leakage quantity is not a threat to performance. All appurtenances of the facility are in satisfactory condition.
		U-	Gates leak significantly when closed or don't operate. Gates and appurtenances have damages which threaten integrity and/or appear not to have been maintained adequately.
14.	Closure Structures	A-	Closure structure in good repair. Placing equipment readily available at all times.
		U-	Closure structure in poor condition. Parts missing. Placing equipment may not be available within normal warning time.
15.	Pumps and Motors	A-	All pumps and motors are operational. Preventive maintenance is occurring and system is periodically subject to performance testing.
		M-	All pumps are operational and minor discrepancies are such that pumps could be expected to perform through the next projected period of usage.
		U-	Pumps are not operational, or noted discrepancies have not been corrected.
16.	Power	A-	Adequate, reliable, and enough capacity to meet demands.
		U-	Power source not considered reliable to sustain operations during flood condition.
17.	Pump Control System	A-	Operational and maintained free of damage, corrosion or other debris.
		M-	Operational with minor discrepancies.
		U-	Not operational, or uncorrected noted discrepancies.
18.	Metallic items	A-	All metal parts in a plant/building protected from permanent damage from corrosion. Trash racks free from damage/debris and are capable of being cleared, if required, during operation. Gates operable.
		M-	Corrosion on metal parts appears maintainable. Trash racks free from damage and minimum debris present, and capable of being cleared before next flood event or during operation. Gates operable.
		U-	Metal parts need replacement. Trash racks damaged, have accumulated debris that have not been cleared annually or cannot be cleared during operation.

Figure E-3. Maintenance Compliance Guide (Cont'd)

19.	Sumps	A-	Clear of debris and obstructions, and mechanisms are in place to maintain this condition during operation.
		M-	Clear of large debris and minor obstructions present and mechanisms are in place to deter further accumulation during operation.
		U-	Large debris or major obstructions present in sump or no mechanism exists to prevent debris accumulation during operation.

Figure E-3. Maintenance Compliance Guide (Cont'd)

Figure I-2

MINIMUM ELIGIBILITY INSPECTION DATA

1. SPONSOR/OWNER INFORMATION

Name of Applicant/Requestor
Levee Location, River, stream, river mile and bank
City, County, State
Name, Address, Phone, point of contact.
POC phone of both Levee Owner and Sponsor.

2. INTRODUCTION

Should list authority for inspection (e.g., PL 84-99), purpose and scope of the inspection.

32. PROJECT INFORMATION

a. Identification:

Project ID number
River Basin and levee or drainage district
Previous repair history such as costs, dates and by whom
River or Creek bank and mile.

b. Classification:

Project purpose (flood control, land reclamation, etc.)
Type levee (primary, secondary, setback, etc.)
Complete/incomplete/operational/ abandoned, etc.

c. Economic Protection Provided:

Total area protected
Land usage and Percent
Cropping pattern
Value of property protected
Facilities protected
Historic flood damages, cite year and amount
Frequency of event.

d. Design Data:

Height: top width
Riverward and landward side slopes
Estimated level of protection (percentage)
Overtopping elevation
Gage data if available
Type of levee construction material
Erosion protection
Interior Drainage

4. FIELD INSPECTION DATA (Based on Rating Guide)

Identify inspection team
Summary of results of observations

5. EVALUATION

a. Structural and Geotechnical:

General Description of levee embankment features
Foundation condition
Stability and Seepage

b. Hydrology and Hydraulics:

Level of protection
Erosion Protection

c. Comments on Operation and Maintenance:

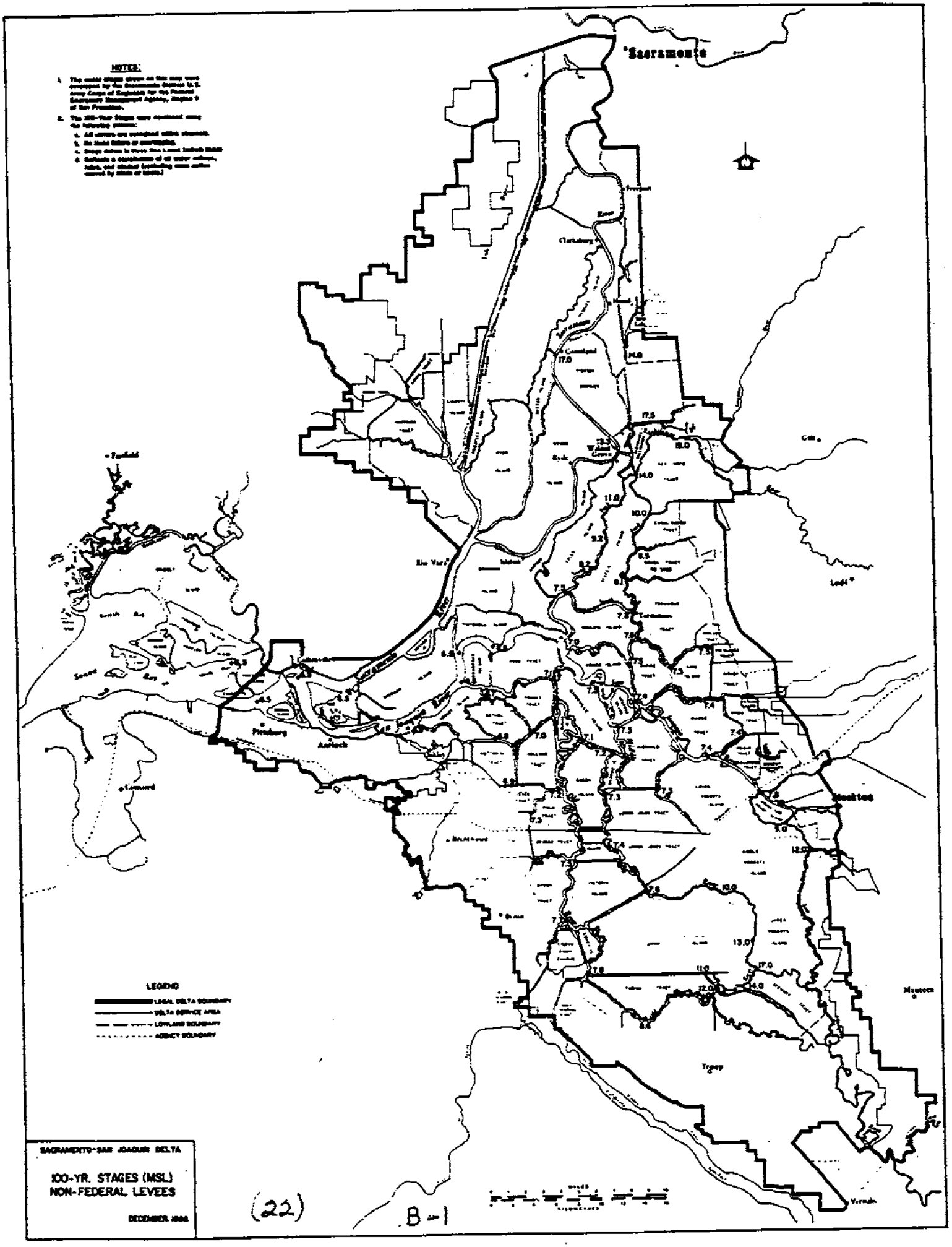
6. RECOMMENDATIONS

7. LIST OF ATTACHMENTS:

8. SIGNATURES:

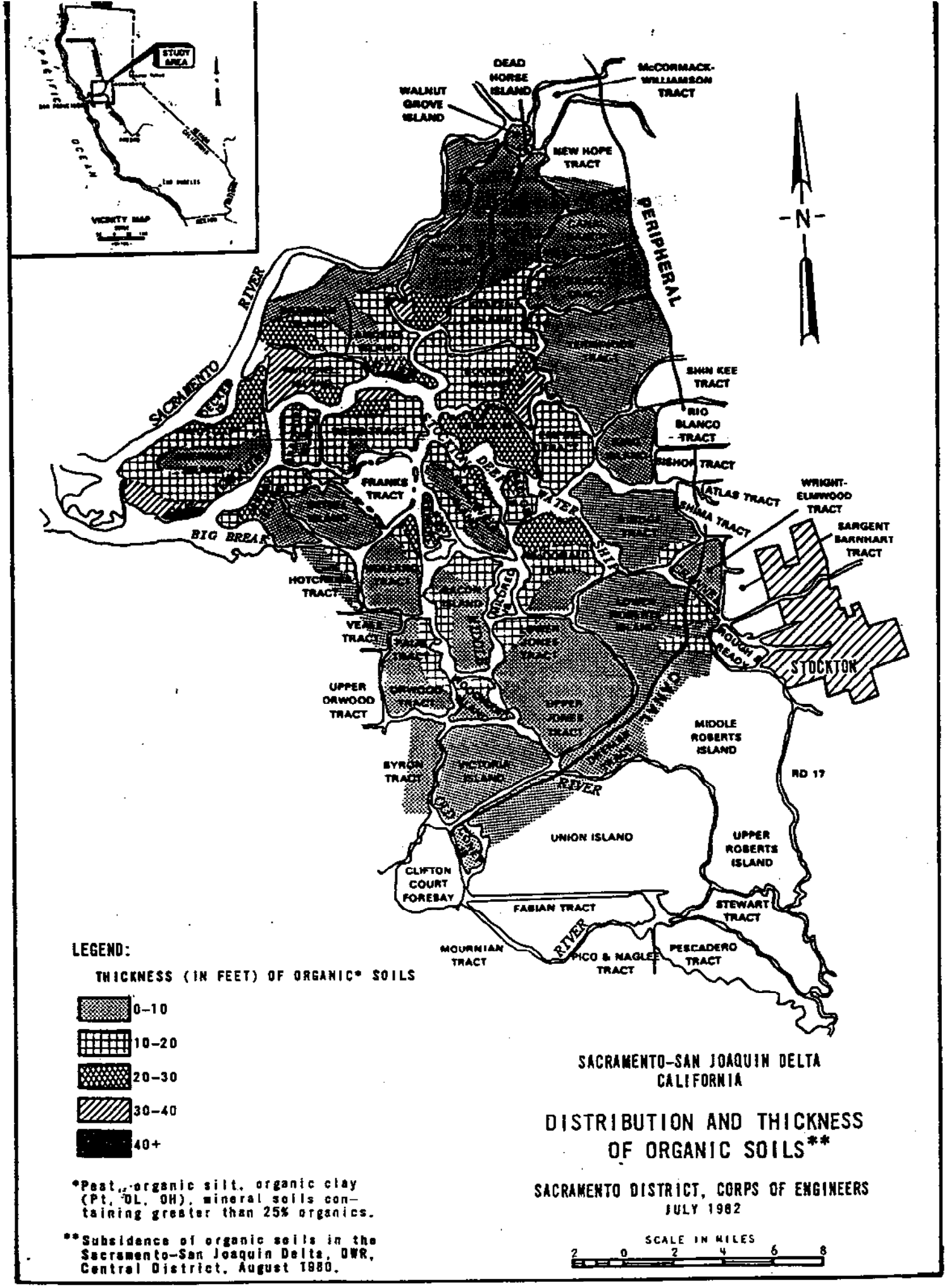
Report should be signed by a representative of each discipline.

9. Each division/district shall develop a standard form (approved as required by local Information Management element) for use in documenting these inspections.


NOTES:
Sacramento
Freeport
Clarksburg
Rio Vista
Pittsburg
Antioch
Concord
Stockton
Lodi
Mauteca
Tracy
Vernalis
LEGEND
LEGAL DELTA BOUNDARY
DELTA SERVICE AREA
LOWLAND BOUNDARY
AGENCY BOUNDARY
SACRAMENTO-SAN JOAQUIN DELTA
100-YR. STAGES (MSL)
NON-FEDERAL LEVEES
DECEMBER 1986

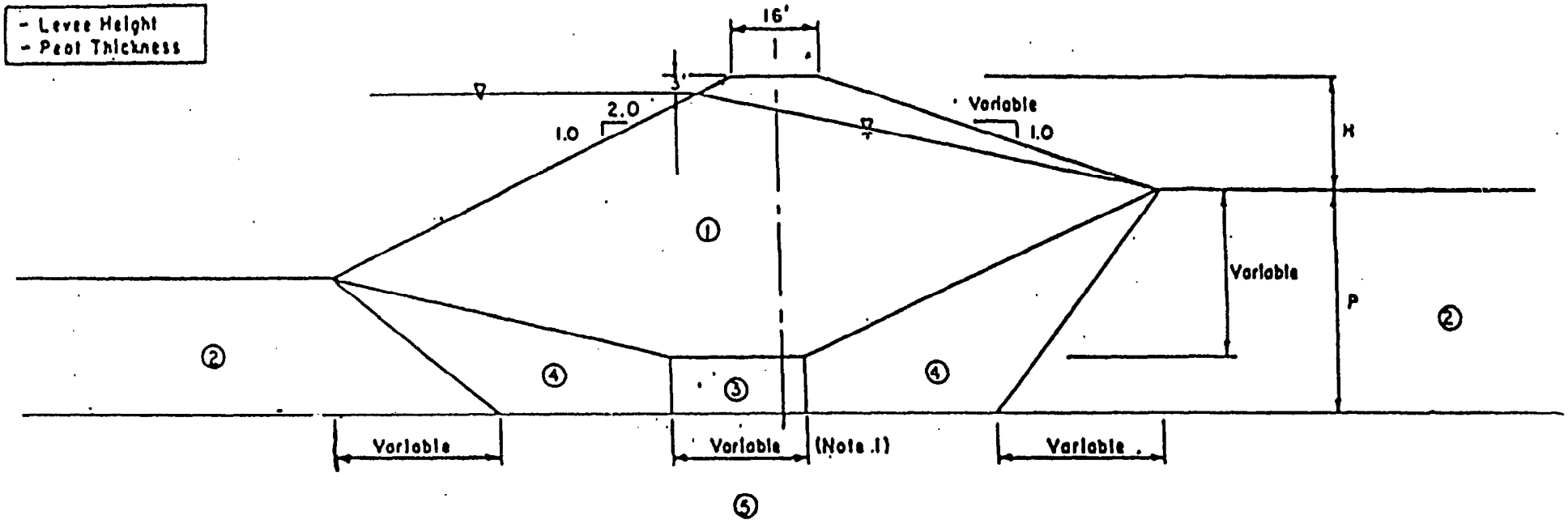
(22)

B-1


STUDY AREA
VICINITY MAP
PACIFIC OCEAN
DEAD HORSE ISLAND
WALNUT GROVE ISLAND
McCORMACK-WILLIAMSON TRACT
NEW HOPE TRACT
PERIPHERAL
N
SACRAMENTO RIVER
SHIN KEE TRACT
RIO BLANCO TRACT
BISHOP TRACT
ATLAS TRACT
SHIMA TRACT
WRIGHT-ELMWOOD TRACT
SARGENT BARNHART TRACT
FRANKS TRACT
BIG BREAK
HOTCHKISS TRACT
VEALE TRACT
UPPER ORWOOD TRACT
ORWOOD TRACT
UPPER JONES TRACT
STOCKTON
MIDDLE ROBERTS ISLAND
RD 17
BYRON TRACT
VICTORIA ISLAND
RIVER
UNION ISLAND
UPPER ROBERTS ISLAND
CLIFTON COURT FOREBAY
FABIAN TRACT
STEWART TRACT
MOURNIAN TRACT
PICO & NAGLEE TRACT
PESCADERO TRACT
LEGEND:
THICKNESS (IN FEET) OF ORGANIC* SOILS
0-10
10-20
20-30
30-40
40+
*Peat, organic silt, organic clay (Pt, OL, OH), mineral soils containing greater than 25% organics.
**Subsidence of organic soils in the Sacramento-San Joaquin Delta, DWR, Central District, August 1980.
SACRAMENTO-SAN JOAQUIN DELTA
CALIFORNIA
DISTRIBUTION AND THICKNESS OF ORGANIC SOILS**
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
JULY 1982
SCALE IN MILES
2 0 2 4 6 8

LEGEND

- Levee Height
- Peat Thickness



Zone	Material	Moist Wt (PCF)	Sat Wt (PCF)	Strength c (PCF)	Strength d (Deg)
1	Levee Fill - Clay, Sand Peat, Silt	115	120	0	33
2	Foundation - Unconsolidated Peat & Clayey Peat	77	77	100	18°
3	Foundation - Consolidated Peats & Clayey Peats	85	85	200	27
4	Foundation - Partially Consolidated Peats & Clayey Peats	85	85	150	25
5	Foudation - Clayey Sand, Firm Sand & Silty Sand	127	135	0	35

NOTES:

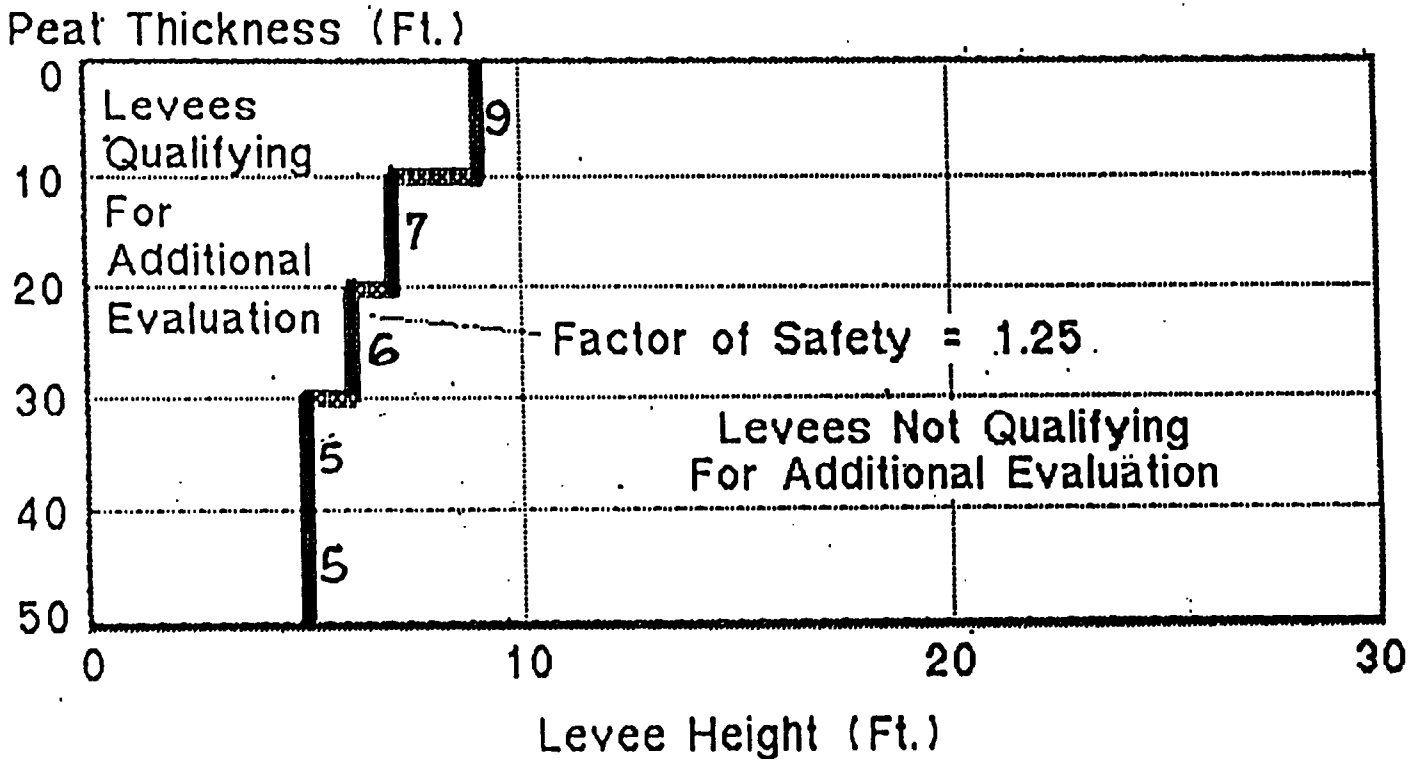
1. Dimensions noted as variable, change as a function of levee height and peat depth.
2. References a & d.
3. No distinction is made between peat, organic silt, organic clay, and mineral soil containing greater than 25% organics.

Minimum Levee Geometry
Sacramento - San Joaquin Delta

GENERALIZED LEVEE SECTION & DESIGN PARAMETERS

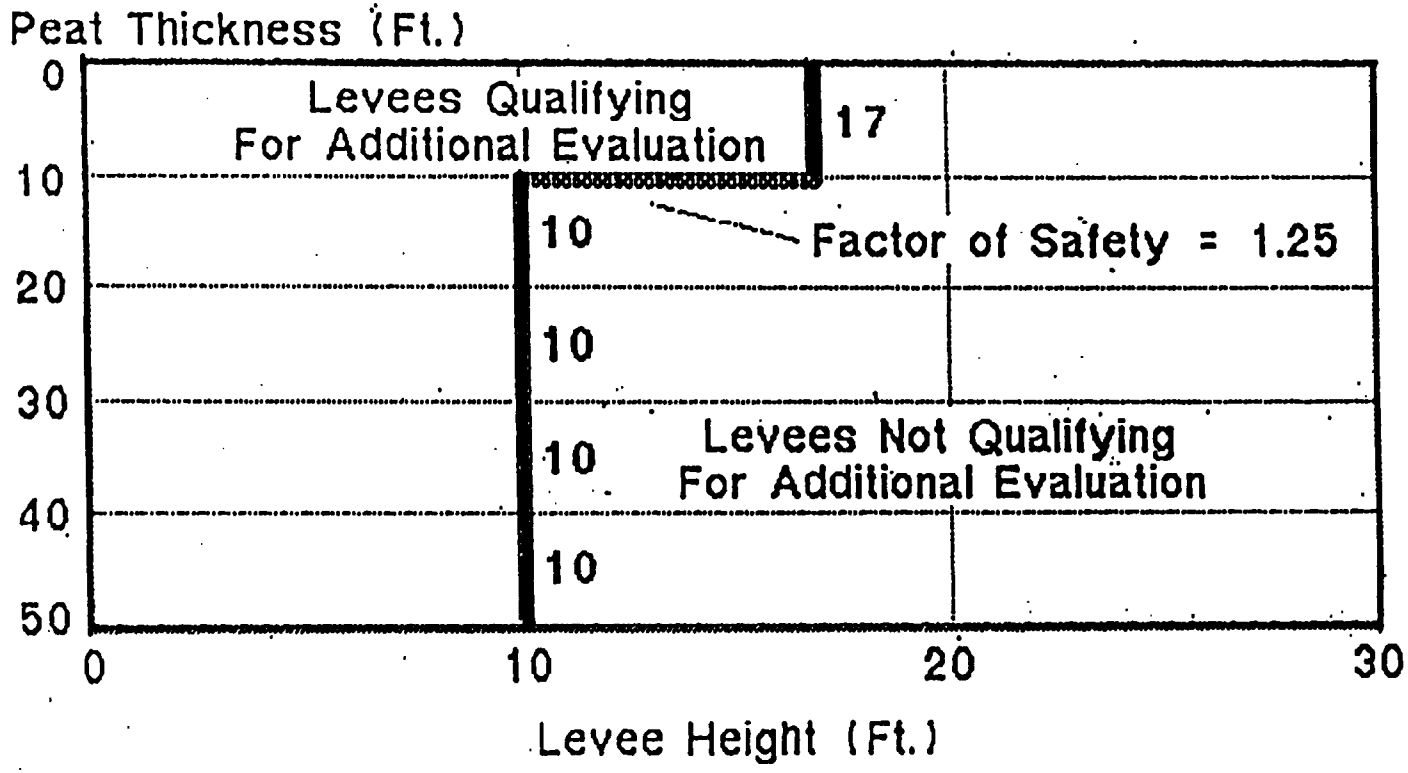
Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 2(H) LANDSIDE SLOPE



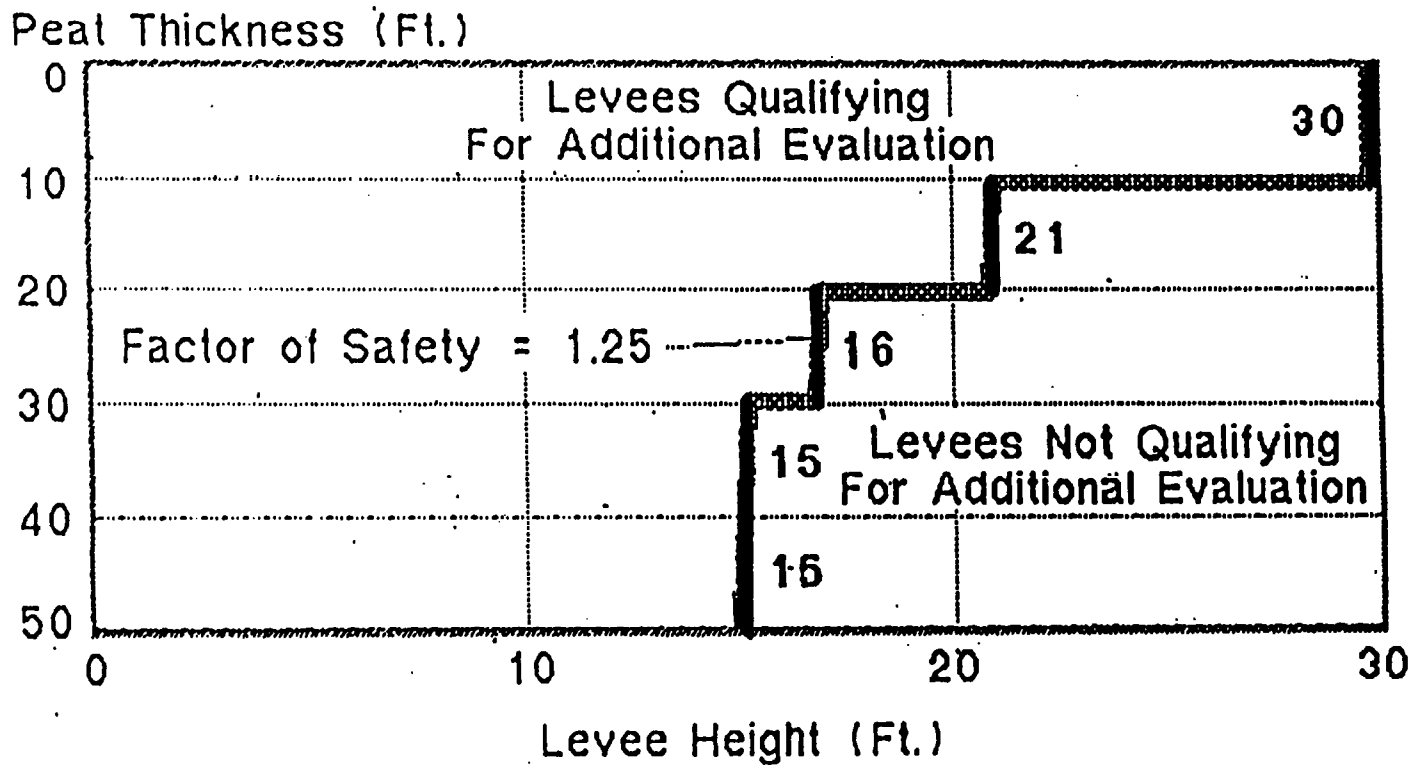
Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 3(H) LANDSIDE SLOPE



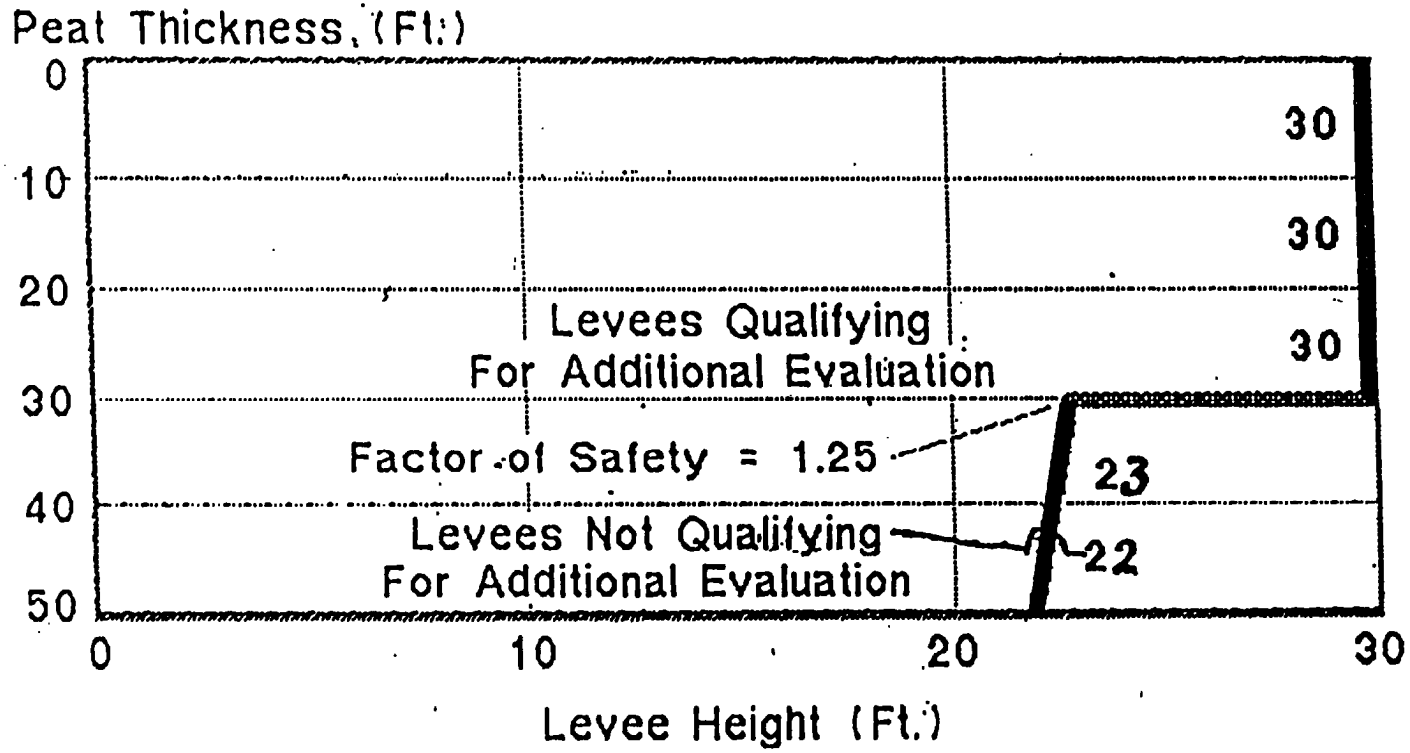
Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 4(H) LANDSIDE SLOPE



Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 5(H) LANDSLIDE SLOPE



US ARMY CORPS OF ENGINEERS

DISASTER ASSISTANCE OVERVIEW

The US Army Corps of Engineers is a major Army command with a broad set of missions and capabilities. One of its missions is to provide assistance, within its authorities, when natural disasters or other emergencies occur.

Emergency preparedness and response is primarily a state and local responsibility. However, in instances when the nature of the disaster exceeds the capabilities of state and local interests, the Corps of Engineers may provide help to save human life, prevent immediate human suffering, or mitigate property damage.

The authority for the Corps of Engineers to provide such assistance is Public Law (PL) 84-99. Under this law, the Corps of Engineers is authorized to provide assistance under the following six programs:

1. Disaster Preparedness
2. Advance Measures
3. Emergency Operations
4. Rehabilitation and Inspection of Flood Control Works
5. Emergency Water
6. Hazard Mitigation

Each program is described in greater detail in the subsequent paragraphs.

1. Disaster Preparedness. State and local governments are responsible for natural disaster emergency preparedness, including training and stockpiling of flood fight supplies. The role of the US Army Corps of Engineers is to supplement maximum efforts of the state and local authorities during a natural disaster emergency. The Corps of Engineers provides the following assistance to the state and local communities:

a. Provides personnel to assist communities with public information programs for awareness and knowledge of natural disaster hazards.

b. When requested by state and local officials, the Corps will participate in natural disaster emergency seminars or exercises.

c. Provide technical assistance for development of emergency plans at the state and local level.

d. Inspection of flood control works constructed or repaired by the Corps of Engineers, and advisement to local sponsors of needed maintenance.

e. Upon request, inspection of non-federal flood control works. This is covered more thoroughly under Rehabilitation of Flood Control Works.

2. Advance Measures. Advance measures consist of actvities performed prior to a flood event, including flood fighting actions, to protect against loss of life and damages to urban and/or public facilities. The threat must be of a nature that if no action is not immediately taken, damages will be incurred. The following criteria must be met for Corps assistance:

a. An imminent threat of unusual flooding must exist to justify assistance. The threat must be established by either the National Weather Service (NWS) forecast or by Corps determination of unusual flooding from adverse conditions.

b. Assistance will be in support of state and local on going or planned efforts. All activities will be coordinated with the State Office of Emergency Operations or equivalent. Local and state interests must commit available resources.

c. A written request is required from the state governor or designated representative.

d. Requested assistance must be technically feasible and have a economically justifiable cost benefit ratio.

e. Assistance will be temporary in nature, designed to effectively deal with the specific threat, and capable of construction in time to prevent projected damages.

f. These projects must have a Public Sponsor.

g. Assistance is terminated when the imminent flood threat ends.

h. Assistance may be in the form of Technical or Direct assistance.

i. Technical assistance consists of technical review, advice, and/or recommendations to state and local agencies before, during and/or after a flood event. The following are examples of technical assistance support:

- Provide personnel to inspect existing flood control works to identify potential problems and solutions, to evaluate conditions to determine additional flood control protection requirements, and to recommend the most expedient construction methods.

- Provide hydraulic, hydrologic, and/or geotechnical analysis.

- Provide information, readily available at Corps districts, to local entities for use in the preparation of local

evacuation and/or contingency flood plans.

j. Direct assistance provided by the Corps to supplement state and local resources may include:

- Flood fight materials such as sandbags, plastic sheeting, lumber, stone, pumps etc.

- Corps equipment if available

- Emergency contracting

k. The types of emergency work the Corps can provide are:

- Emergency work on Federal and Non-Federal Flood Control Works by strengthening or temporary raising to prevent structural failure or overtopping.

- Construction of temporary flood control levees to protect life and improved property.

- Removal of channel obstructions to allow the passing of predicted flood flows. Obstructions may be snags/logs or debris jams, or sand and gravel bars restricting hydraulic capacity.

- Relieve the threat of dam failures by dewatering, controlled breaching, or strengthing.

3. Emergency Operations. The Corps of Engineers may provide emergency assistance for flood and post flood response to save lives and protect improved property, such as public facilities/services and residential/commercial developments. This assistance will supplement state and local efforts. State and local entities must commit all available resources, i.e., manpower, supplies, equipment, funds, etc. Assistance to individual homeowners, businesses (to include agricultural property) is not permitted.

a. Corps assistance during flood fight operations will be of a temporary nature to meet the immediate threat and is not intended to provide permanent solutions to flood problems.

b. Emergency assistance must be requested by the state governor or his/her designated representative for flood and post flood response.

c. The Corps flood fight assistance may be in the form of technical or direct assistance.

- Technical Assistance for any disaster consists of providing review and recommendations in support of state and local efforts. Examples of technical assistance are:

(1) Providing experienced personnel at the

disaster site to give guidance on flood fight techniques and emergency construction methods.

(2) Providing personnel to inspect existing flood protection projects and/or structurally threatened dams to identify problem areas and recommended corrective measures.

(3) Providng hydraulic or hydrologic analysis, geotechnical evaluations, topography and stream data, maps, and historic flood or storm information.

- Direct Assistance may include but is not limited to the following:

(1) Purchase of flood fight materials to support on-going state and local efforts. These materials include sandbags, sand, plastic sheeting, lumber, etc. Government supplies may be furnished only if local resources are exhausted or will be exhausted. Unused materials will be returned, replaced in kind, or reimbursement made to the Corps of Engineers.

(2) Assist in search and rescue operations. The Corps may use its resources in such operations.

(3) Corps may direct flood fight operations upon request of an appropriate state or local official. However, legal responsibility remains with the requesting official.

(4) Emergency contracting will be available to hire equipment and operators. Emergency work includes construction of temporary levees, the emergency repair, strengthening, or temporary raising of levees or other flood control works, or removal of stream obstructions.

d. Flood response assistance will end when the flood waters recede to bankfull conditions.

e. The authority for the Corps of Engineers to perform post flood response was enacted by the US Congress under Section 917 of the Water Resources Act of 1986. The intent of this authority is to allow Corps assistance prior to a Presidential Declaration made under authority of the Stafford Act. Corps assistance will be limited to major floods/coastal storms resulting in life threatening situations. Response is limited to lifesaving actions and protection of public facilities/services and residential/commercial developments. Assistance to individual homeowners and businesses (to include agricultural property) is not permitted.

- A written request from the governor to the appropriate district commander will be provided concurrently with or immediately after the governor's request to FEMA for a Preliminary Damage Assessment (PDA).

- This request must indicate that recovery work is

beyond the capability of the state, identify specific damage locations, and detail specific requirements for Corps of Engineers assistance.

- Corps assistance is limited to a maximum of 10 days from the receipt date of the governor's request for assistance.

- No work, including contract work, shall be performed after the 10 day period expires. Post response assistance may be technical or direct assistance. Direct assistance activities include:

(1) Clearance of debris necessary to reopen critical transportation routes.

(2) Restoration of critical transportation routes or public ervices or facilities.

(3) Other assistance required to prevent loss of life or public property as determined by the division or district commander.

4. Rehabilitation and Inspection Program (RIP). The RIP is the Corps of Engineers program that implements the provisions of Public Law 84-99 regarding inspection and rehabilitation of Non-Federal flood control works and the rehabilitation of Federal flood control works. Rehabilitation assistance is limited to eligible Non-Federal and Federally authorized flood control projects. The Non-Federal Flood Control Works Rehabilitation Program is described on pages 7 thru 10 and Exhibit A and B. Structures that are not eligible for assistance are:

a. Structures built for channel alignment, navigation, recreation, fish and wildlife, land reclamation, drainage, or to protect against land erosion are not flood control works.

b. Bank protection works, river control structures, or other non-flood control projects constructed by the Corps.

c. Structures damaged by non-flood disasters such as earthquakes or volvanic eruptions are not authorized assistance. If a potential flood threat exists due to damage caused by a non-flood disaster, Corps of Engineers Headquarters may grant exceptions on a case by case basis to allow rehabilitation.

d. Those flood control works constructed, operated and maintained by the Corps or other Federal agencies are not eligible for inclusion into the RIP and not eligible for rehabilitation assistance. Those flood control works constructed, modified, or repaired with financial assistance from other Federal agencies (e.g., Bureau of Reclamation, Natural Resources Conservation Service) are not eligible for assistance, unless exceptions are granted by Corps of Engineers Headquarters.

e. The project Public Sponsor must furnish items of

cooperation and assurance prior to any construction work:

(1) Provide without cost to the United States all lands, easements, barrow lands, and rights-of-way necessary.

(2) Hold and save the United States free from damages due to the work, exclusive of damages due to negligence of the United States or its contractor.

(3) Maintain and operate, in a manner satisfactory to the Chief of Engineers, the entire project after completion.

5. Emergency Water Assistance. The Corps may provide potable water to any community confronted with water supply problems associated with a contaminated water source or drought conditions. The supply problems must present a substantial threat to the public health and welfare of the inhabitants in the area. The intent of the assistance is to meet minimum public health, safety, and welfare requirements. This assistance will supplement state and local relief efforts to supply water for public health and welfare.

a. Written request required from the state governor or authorized representative.

b. Contamination, whether deliberate, accidental, or natural will be be established by one or more of the following:

(1) Maximum established contaminant levels pursuant to the Safe Drinking Water Act are exceeded.

(2) Water supply identified as source of illness by state or Federal public health official.

(3) Emergency situation has either resulted in contaminants entering the source or has made equipment inoperable to remove the contaminants.

c. Assistance provided for transportation of bulk water by certified vehicle, small diameter pipeline, purchase of bottled water, or installation of temporary filtration units. Must be cost effective and meet the need. Also, construction of wells by competitive bid contract.

d. Assistance provided for 30 days. Extensions granted with adequate justification and explanation.

e. A drought distressed area is one that the Assistant Secretary of the Army determines to have an inadequate supply which is causing, or is likely to cause, substantial threat to public health and welfare of the area including threat of damage or loss of property.

6. Hazard Mitigation. The Corps of Engineers supports and is a member of the FEMA Hazard Mitigation Team.

PUBLIC LAW 84-99 AS AMENDED
Non-Federal Flood Control Works Rehabilitation Program

A. General Policy

The Corps of Engineers has authority, under PL 84-99, to repair flood control projects which are damaged by flood. Flood control projects constructed by non-Federal interests may be eligible for this disaster recovery assistance provided that certain criteria for eligibility and local cooperation are met. For example, a project constructed by non-Federal interests must meet established Corps quidelines to establish its structural integrity for flood control purposes. The policy is consistent with policy and procedures established by other Federal agencies for disaster assistance. The policy will help insure that the intent of Executive Order 11988 is met.

B. Policy Background

In July 1986, the Corps of Engineers revised and standardized the PL84-99 levee rehabilitation program for structures not originally constructed by a Federal agency. The program revisions were intended to provide uniformity throughout the Corps in establishing requirements for state and local participation associated with rehabilitation assistance. The revisions culminated in focusing on development of uniform eligibility quidelines and requirements for public sponsorship and local cooperation, to include cost sharing. The revisions will provide for greater participation by concerned state and local agencies in the Corps non-Federal flood control project rehabilitation program. Also, project sponsors are given the same eligibility requirements nationwide, for promoting local attention on disaster preparedness and promoting improved levee design and maintenance, and encourage sound floodplain management practices.

C. Policy Coordination Between Corps and NCRS

In 1986, the Corps and Soil Conservation Service (NCRS) signed a Memorandum of Agreement which outlined how the two agencies would delineate responsibility for repair of levees. The agencies agreed in general principle that the delineation would be based upon the area of geoghraphical contributing drainage. The Corps would be responsible for repairing levees with drainage areas of 400 square miles or greater with the NCRS responsible drainage areas less than 400 square miles. Corps policy for the repair of levees in the Corps geographic areas requires that levee sponsors be active participants in the Corps PL84-99 non-Federal levee rehabilitation program at the time of the disaster event to be considered eligible for rehabilitation assistance. Sponsors or private owners that have not applied for

the Corps program and are in the NCRS's area of responsibility should seek assistance under NCRS's Emergency Watershed Program.

D. Corps PL84-99 Non-Federal FCW Rehabilitation Program

1. To become eligible for assistance, several steps must be taken. One very important step the levee owner must take is to acquire public sponsorship for the flood control structure. The public sponsor will request the Initial Levee Eligibility Inspection on behalf of the levee owner. The sponsor will sign the Project Cooperation Agreement with the Federal Government in the event rehabilitation work will be authorized on the levee. A public sponsor must be a financially, viable identity capable of fulfilling operations and maintenance requirements and ensuring proper stewardship of the Federal investment. The sponsor must be one of the following:

* state chartered organization such as a levee board, reclamation board, flood control district, etc.
* a legal subdivision of a state or a county government
* a local unit of government
* a qualified Indian tribe or tribal organization

2. Another step in the eligibility process is the eligibility inspection. This inspection will be conducted by the Corps to assess the integrity and reliability of your flood control works. The eligibility inspection will consist of:

* structural and geotechnical analysis
* hydrologic and hydraulic evaluation
* operation and maintenance determinations

The eligibility inspection will be conducted using a rating quide which provides the inspector with a consistent and accurate system of inspection. An inspection checklist, based upon the quidelines, will be filled out at the conclusion of the field inspection. A copy of this checklist will be provided to the sponsor on site for his records and a copy retained in the Corps files. At the conclusion of the eligibility determination process, the sponsor and owner will receive written notification of the overall condition of the levee. The levee will be rated as one of the following:

* Acceptable - no work required
* Minimally Acceptable - deficient conditions exist which should be improved
* Unacceptable - the levee is ineligible for rehabilitation assistance under PL84-99 unless corrective action is taken and the levee is reinspected before any request for assistance is accepted.

If an unacceptable rating is given, a recommendation for corrective action will be made by the Corps of Engineers. If the levee sponsor does not comply with the recommendation and the levee **is not** upgraded to at least the Minimally Acceptable level, the Corps **will** not perform repair work in the event of damage resulting from a flood. The sponsor should complete the recommended upgrade work as soon as possible. If the levee is upgraded to at least the Minimum Acceptable level, the sponsor **must** notify the Corps that the corrective work has been completed. The levee will be reinspected and reinstated in the program as an active levee. An Unacceptable rated levee is carried as an inactive levee until corrective work is accomplished.

The Corps will conduct Continuing Eligibility Inspections utilizing the Maintenance Compliance Guide for all flood control works that are in an "active" eligibility status. These subsequent inspections will be for the purpose of detecting significant changes to the levee from the Initial Inspection which impact the integrity of the levee. A rating in accordance with the rating guidelines will be given for each inspection and will be performed at least once every two years. If the levee receives an unacceptable rating on these inspection, the levee will be put in an "inactive" status until the corrective work is accomplished and the sponsor requests the Corps to perform a re inspection.

E. <u>Criteria for Corps Assistance</u>

The following criteria must be met for the Corps to repair Federal and non-Federal flood control works.

* The Corps will repair federal levees and flood control works at 100% cost to the federal government. A federal levee or federal flood control works is authorized, constructed by the Corps, and operated and maintained by a local sponsor.
* Requests for Corps assistance in repairing non federal flood control works must:
    * Be in an "active" status under the PL84-99 FCW rehabilitation program.
    * Be from the public sponsor.
    * Be economically justified (have a favorable cost benefit ratio of at least 1:1).
    * Be cost shared 80% federal and 20% public sponsor.
    * Provide required level of flood protection.
    * Adhere to environmental laws, policies and regulations.
    * Meet the rehabilitation engineering and maintenance guidelines prior to the flood event.
    * Restore flood control Works (FCW) to original pre-flood conditions.

Attached Exhibit A contains the Eligibility Rating Guidelines, Policy Summary, and the Project Cooperation Agreement. The rating guidelines **are not** intended as an absolute standard, nor

are they intended to establish design standards for non-Federal flood control works. The guidelines are used to establish uniform procedures in assigning rating codes to the flood control works.

F. Sacramento-San Joaquin Delta Specific Guidelines

1. In 1987, the Corps implemented additional eligibility guidelines specifically for the legal delta, as defined by the California State Water Code Section 12200, dated 1959. The Delta-exclusive quidelines supplement the National Guidelines described in paragraphs D and E.

2. The minimum quidelines that must be met for the flood control works to be eligible for PL84-99 rehabilitation consideration are as follows:

* 1.5 feet of levee freeboard above the 100 year flood stage for all islands/tracts. These are the same 100 year flood stages used for the Flood Hazard Mitigation Plan, Sacramento-San Joaquin Delta, Disaster Declaration FEMA-758-DR-CA, 1986.
* The levee will have a 16 foot crown width with an all weather patrol road.
* A levee toe drain will be located 30 feet landward from the land side levee toe.
* The minimum water side slope of the levee will be 1V:2H.
* The minimum land side slope of the levee will vary with the levee height and the depth of peat. The levee stability charts in attached Exhibit B were computed using an idealized levee section with 5 zones of materials and using a safety factor of 1.25. Public sponsors whose levees do not fit into these quidelines may submit data/information prepared by a registered engineer (geotechnical, soils, civil) that demonstrates their levees meet or exceed a 1.25 factor of safety. A delta peat thickness map is included in Exhibit B.

3. Public sponsors may request an evaluation of their non-Federal flood control works system by providing the following information to U.S. Army Corps of Engineers, ATTN: Construction-Operations Division, Readiness Branch, 1325 J Street, Sacramento, CA 95814-2922. The telephone number is (916) 557-6911 or 557-6913.

Rating codes:

A- Acceptable Performance Level
M- Minimally Acceptable Performance Level
U- Unacceptable Performance Level

ITEM	RATING GUIDE		
1.	**Level of Protection**	A-	The designed section is for an exceedance frequency greater than 10% chance (10 yr.) with minimum freeboard of 2 feet.
		M-	The designed section is for an exceedance frequency between 20% to 10% chance (5-10 yr) with minimum freeboard of 1 foot.
		U-	The designed section is less than the minimum required for an M rating.
2.	**Erosion Control**	A-	Erosion protection in active areas is capable of handling the designed flow velocity for the level of protection for the entire FCW.
		M-	Erosion protection is capable of handling the designed flow velocity for the level of protection for 75% or more of the FCW.
		U-	Erosion protection measures protects less than 75% of the FCW; or if erosion protection was not provided and there is evidence indicating a need for erosion protection.
3.	**Embankment**	A-	Fill material for embankment is suitable to prevent slides and seepage for the existing side slopes. Fill material is uniform and adequately compacted through the entire FCW.
		M-	Material is adequate and suitable to prevent major slides and capable of handling localized seepage for the existing side slopes. Fill material is uniform and adequately compacted in 75% or more of the FCW.
		U-	Material is unsuitable and likely to cause numerous slides and allow excessive uncontrolled seepage. Fill material is not uniform, or there is no compaction and evidence indicates a need for compaction.
4.	**Foundation**	A-	Foundation materials will not cause piping, sand boils, seepage, or settlements which reduce the level of protection.
		M-	Foundation materials may show signs of excessive seepage, minor sand boils, and localized settlements.
		U-	Foundation materials are unsuitable and likely to cause excessive uncontrolled seepage, sand boils, and piping.

Figure E-2. Engineering Guide

5.	Structures	A-	Structures are capable of performing their design functions and show no signs of failure.
		M-	Structures are performing their design functions but show signs of overtopping and bypassing flows.
		U-	Structures are not performing their design functions or show signs of structural failure.

Figure E-2. Engineering Guide (Cont'd)

TABLE E-2
Cross Section Template Data

Levee Material	Maximum Riverward Side-Slope	Maximum Landward Side-Slope	Maximum Height	Top Width
Clay	1V on 2 1/2H	1V on 2 1/2H	12 Feet	10 Ft
Sand	1V on 3H	1V on 4H	15 Feet	10 Ft

Table E-2 used as a quide for the evaluation of slope stability.

E-5. Maintenance Compliance Guide. This guide (Figure E-3) is used to assign a rating for maintenance compliance during the Initial Eligibility Inspection and the Continuing Eligibility Inspection. The evaluation should reflect the level of maintenance required to insure the intended degree of flood protection and actions required by the [redacted]/sponsor for a FCW to remain eligible for the rehabilitation program under PL 84-99.

Rating codes:

A- Acceptable Performance Level
M- Minimally Acceptable Performance Level
U- Unacceptable Performance Level

ITEM	RATING GUIDE		
1.	**Depressions**	A-	Minimal depressions or potholes; proper drainage.
		M-	Some depressions that will not pond water.
		U-	Depressions 6" vertical or greater which endangers the integrity of the levee.
2.	**Erosion**	A-	No erosion observed.
		M-	LEVEES: Erosion of levee crown or slopes that will not interrupt inspection or maintenance access. OTHER: Erosion gullies less than 6 inches deep or deviation of 1 foot from designed grade or section.
		U-	LEVEE: Erosion of levee crown or slopes that has interrupted inspection or maintenance access. OTHER: Erosion gullies greater than 6 inches or deviation of 1 foot or more from designed grade or section.
3.	**Slope Stability**	A-	No slides present, or erosion of slopes more than 4" deep.
		M-	Minor superficial sliding that with deferred repair does not pose an immediate threat to FCW integrity. No displacement or bulges.
		U-	Evidence of deep seated sliding (2 ft. vertical or greater) requiring repairs to re-establish FCW integrity.
4.	**Cracking**	A-	No cracks in transverse or longitudinal direction observed in the FCW.
		M-	Longitudinal cracks are no longer than the levee height. No displacement and bulging. No transverse cracks observed.
		U-	Longitudinal cracks are greater than levee height with some bulging observed. Transverse cracks are evident.

Figure E-3. Maintenance Compliance Guide

5.	**Animal Burrows**	A-	Continuous animal burrow control program that eliminates any active burrowing in a short period of time.
		M-	Animal burrows present that will not result in seepage or slope stability problems.
		U-	Animal burrows present that would result in possible seepage or slope stability problems.
6.	**Unwanted Levee Growth**	A-	No large brush or trees exist in the FCW. Grass cover well maintained. CHANNELS: Channel capacity for designed flows is not affected.
		M-	Minimal tree (2" diameter or smaller) and brush cover present that will not threaten FCW integrity. (NOTE: Trees that have been cut and removed from levees should have their roots excavated and the cavity filled and compacted with impervious material). CHANNELS: Channel capacity for designed flows is not adversely affected.
		U-	Tree, weed and brush cover exists in the FCW requiring removal to re-establish or ascertain FCW integrity. (NOTE: If significant growth on levees exists, prohibiting rating of other levee inspection items, then the inspection should be ended until this item is corrected.) CHANNEL: Channel obstructions have impaired the floodway capacity and hydraulic effectiveness.
7.	**Encroachments**	A-	No trash, debris, excavations, structures, or other obstructions present.
		M-	Trash, debris, excavations, structures, or other obstructions present or inappropriate activities occurring that will not inhibit operations and maintenance performance.
		U-	Trash, debris, excavations, structures or other obstructions present or inappropriate activities that would inhibit operations and maintenance performance.
8.	**Riprap/Revetment**	A-	Existing protection works which is properly maintained and undamaged.
		M-	No scouring activity that could undercut banks, erode embankments, or restrict desired channel flow.
		U-	Meandering and/or scour activity that is undercutting banks, eroding embankments (such as levees), or impairs channel flows by causing turbulence, meandering or shoaling.

Figure E-3. Maintenance Compliance Guide (Cont'd)

9.	**Stability of Concrete Structures**	A-	Tilting, sliding or settling of structures, that has been secured which preserves the integrity or performance.
		M-	Uncorrected sliding or settlement of structures of a magnitude that doesn't affect performance.
		U-	Tilting or settlement of structures that has resulted with a threat to the structure's integrity and performance.
10.	Concrete Surfaces	A-	Negligible spalling or scaling. No cracks present that are not controlled by reinforcing steel or that cause integrity deterioration or result in inadequate structure performance.
		M-	Spalling, scaling and cracking present but immediate integrity or performance of structure not threatened.
		U-	Surface deterioration or deep, controlled cracks present that result in an unreliable structure.
11.	**Structural Foundations**	A-	No scouring or undermining near the structures.
		M-	Scouring near the footing of the structure but not close enough to impact structure stability during the next flood event.
		U-	Scouring or undermining at the foundation which has impacted structure integrity.
12.	**Culverts**	A-	[a] No breaks, holes, cracks in the culvert that would result in any significant water leakage. No surface distress that could result in permanent damage. [b] Negligible debris or silt blocking culvert section. None or minimal debris or sediment present which has negligible effect on operations of the culvert.
		M-	[a] Culvert integrity not threatened by spalls, scales or surface rusting. Cracks are present but resulting leakage is not impacting the structure. [b] Debris or sediment present, which is proposed to be removed prior to the next flood event, that minimally affects the operations of the culvert.
		U-	[a] Culvert has deterioration such as surface distress and/or has significant leakage in quantity or degree to threaten integrity. [b] Accumulated debris or settlement which has not been annually removed and severely affects the operations of the culvert.

Figure E-3. Maintenance Compliance Guide (Cont'd)

13.	Gates	A-	Gates open easily and close to a tight seal. Materials do not have permanent corrosion damage and appear to have historically been maintained adequately.
		M-	Gates operate but leak when closed, however, leakage quantity is not a threat to performance. All appurtenances of the facility are in satisfactory condition.
		U-	Gates leak significantly when closed or don't operate. Gates and appurtenances have damages which threaten integrity and/or appear not to have been maintained adequately.
14.	Closure Structures	A-	Closure structure in good repair. Placing equipment readily available at all times.
		U-	Closure structure in poor condition. Parts missing. Placing equipment may not be available within normal warning time.
15.	Pumps and Motors	A-	All pumps and motors are operational. Preventive maintenance is occurring and system is periodically subject to performance testing.
		M-	All pumps are operational and minor discrepancies are such that pumps could be expected to perform through the next projected period of usage.
		U-	Pumps are not operational, or noted discrepancies have not been corrected.
16.	Power	A-	Adequate, reliable, and enough capacity to meet demands.
		U-	Power source not considered reliable to sustain operations during flood condition.
17.	Pump Control System	A-	Operational and maintained free of damage, corrosion or other debris.
		M-	Operational with minor discrepancies.
		U-	Not operational, or uncorrected noted discrepancies.
18.	Metallic Items	A-	All metal parts in a plant/building protected from permanent damage from corrosion. Trash racks free from damage/debris and are capable of being cleared, if required, during operation. Gates operable.
		M-	Corrosion on metal parts appears maintainable. Trash racks free from damage and minimum debris present, and capable of being cleared before next flood event or during operation. Gates operable.
		U-	Metal parts need replacement. Trash racks damaged, have accumulated debris that have not been cleared annually or cannot be cleared during operation.

Figure E-3. Maintenance Compliance Guide (Cont'd)

19.	Sumps	A-	Clear of debris and obstructions, and mechanisms are in place to maintain this condition during operation.
		M-	Clear of large debris and minor obstructions present and mechanisms are in place to deter further accumulation during operation.
		U-	Large debris or major obstructions present in sump or no mechanism exists to prevent debris accumulation during operation.

Figure E-3. Maintenance Compliance Guide (Cont'd)

PUMP STATION MAINTENANCE INSPECTION GUIDE

RATED ITEM	A	M	U	EVALUATION
SECTION I				*FOR USE DURING INITIAL ELIGIBILITY INSPECTION ONLY*
1. Pump Station Size				Pump station has adequate capacity (considering pumping capacity, ponding areas, etc.) to handle expected inflow volumes. (A or U.)
SECTION II				*FOR USE DURING ALL PUMP STATION INSPECTIONS*
2. O&M Manual				O&M Manual is present and adequately covers all pertinent areas. (A or U.)
3. Operating Log				Pump Station Operating Log is present and being used. (A or U.)
4. Annual Inspection				Annual Inspection is being performed by the local sponsor. (A or U.)
5. Plant Building				A Plant building is in good structural condition. No apparent major cracks in concrete, no subsidence, roof is not leaking, etc. Intake louvers clean, clear of debris. Exhaust fans operational and maintained. Safe working environment. M Spalling and cracking are present, or minimal subsidence is evident, or roof leaks, or other conditions are present that need repair but do not threaten the structural integrity or stability of the building. U Any condition that does not meet at least Minimum Acceptable standards.
6. Pumps				A All pumps are operational. Preventive maintenance and lubrication are being performed. System is periodically subjected to performance testing. No evidence of unusual sounds, cavitation, or vibration. M All pumps are operational and deficiencies/minor discrepancies are such that pumps could be expected to perform through the next expected period of usage. U One or more primary pumps are not operational, or noted discrepancies have not been corrected.
7. Motors, Engines, and Gear Reducers				A All items are operational. Preventive maintenance and lubrication being performed. System is periodically subjected to performance testing. Instrumentation, alarms, and auto shutdowns operational. M All systems are operational and deficiencies/minor discrepancies are such that pumps could be expected to perform through the next expected period of usage. U One or more primary motors are not operational, or noted discrepancies have not been corrected.
8. Trash Rakes				A Drive chain, bearings, gear reducers, and other components are in good operating condition and properly maintained. M Drive chain, bearings, gear reducers, and other components are capable of performing as designed through the next flood event. U Proper operation would be inhibited during the next flood event.
9. Other Metallic Items				A All metal parts in plant/building are protected from permanent damage by corrosion. Equipment anchors show no rust or deterioration. M Corrosion on metallic parts (except equipment anchors) appears maintainable. U Any condition that does not meet at least Minimum Acceptable standards.
10 Insulation Megger Testing				A Results of megger test show that insulation meets manufacturer's or industry standard. Test not more than 24 months old. M Results of megger test show that insulation resistance is lower than manufacturer's or industry standard, but can be corrected with proper application of heat. U Insulation resistance is low enough to cause the equipment to not be able to meet its design standard of operation.
11 Backup Power				A Adequate, reliable, and enough capacity to meet demands. Required backup generators are on hand and deemed reliable. Backup units are properly sized, operational, periodically exercised, and maintained in accordance with operating manual. U Power source not considered reliable to sustain operations during flood condition.

ENCL 2

PUMP STATION MAINTENANCE INSPECTION GUIDE

RATED ITEM	A	M	U	EVALUATION
12 Pump Control System				A Operational and maintained free of damage, corrosion, or other debris. M Operational with minor discrepancies. U Not operational, or uncorrected discrepancies noted from previous inspections.
13 Sumps				A Clear of debris and obstructions. Mechanisms are in place to maintain this condition during operations. M Clear of large debris, minor obstructions present. Mechanisms are in place to deter any further accumulation during operation. Sump will function as intended. U Large debris or major obstructions present, or no mechanism exists to prevent debris acoumulation during operation.
14 Intake/Discharge Gates.				Functional. Electric operators maintained. (A or U.)
15 Cranes				Operational. Inspected and load tested in accordance with OSHA requirements. (A or U.)
16 Telephone Communications				Telephone communication is available in the pump station. Alternatively, two-way radio, cellular telephone, or similar device is available, or, access to a telephone is within a reasonable driving distance. (A or U.)
17 Safety				No exhaust leaks in building. Fuel storage/distribution meets state/local requirement. Fire extinguishers on hand, of sufficient quantity, and properly charged. Safety hardware installed. Required safety items (e.g., aural protectors) used. (A or U.)
18 Remarks.				Continued on separate sheet: Yes ____ No ____

GENERAL INSTRUCTIONS

1. All items on this guide must be addressed and a rating given.
2. The lowest single rating given will determine the overall rating for the pump station.
3. A non-Federal pump station located behind a Federal levee will be treated as a separate FCW, and will not be incorporated into the Federal levee project.
4. Additional areas for inspection will be incorporated by the inspector into this guide if the layout or physical characteristics of the pump station warrant this. Appropriate entries will be made in the REMARKS block.
5. Rating Codes:
   - A - Acceptable
   - M - Minimally Acceptable
   - U - Unacceptable

SPECIFIC INSTRUCTIONS

SECTION I. Pump station must have primary purpose of flood control, not interior drainage. District will determine, based on appropriate study, if adequate capacity exists. Lack of adequate capacity mandates a determination of Unacceptable.

AGREEMENT BETWEEN
THE UNITED STATES OF AMERICA
and

_____

FOR REHABILITATION OF FLOOD CONTROL WORKS
or
FEDERALLY AUTHORIZED HURRICANE OR SHORE PROTECTIVE STRUCTURES

THIS AGREEMENT, entered into this _____ day of _____, 19_____, by and between THE UNITED STATES OF AMERICA (hereinafter called the "Government") represented by Commander, U.S. Army Corps of Engineers, _____, executing this agreement, and _____ _____, (hereinafter called the "Sponsor");

WITNESSETH THAT:

WHEREAS, Public Law 99, 84th Congress, approved 28 June 1955, authorized the Chief of Engineers in the repair or restoration of any flood control works threatened or destroyed by recent floods, including the strengthening, raising, extending, or other modification thereof as may be necessary at the discretion of the Chief of Engineers for the adequate functioning of the work for flood control; in the repair and restoration of any federally authorized hurricane and shore protective structures damaged or destroyed by wind, wave, or water action of other than an ordinary nature when in the discretion of the Chief of Engineers such repairs and restoration are warranted for the adequate functioning of the structure; and

WHEREAS, the Sponsor has requested in writing, assistance in the repair or restoration of the flood control work or federally authorized hurricane or shore protective structure damaged as described by the written request for assistance, and the Sponsor qualifies for assistance in accordance with the established policies of the U.S. Army Corps of Engineers.

NOW, THEREFORE, the parties agree as follows:

1. The Government will perform the work described in its scope of work which is made part of this agreement.

2. The Sponsor agrees, that in consideration of the Government providing assistance, to fulfill the requirement of non-Federal cooperation required by the U.S. Army Corps of Engineers regulations, to wit:

a. Provide without cost to the Government all lands, easements and rights-of-ways necessary for the repair and restoration of the flood control works, and for the use of borrow area and/or spoil areas. This provision will also include the access to and from the flood control works or structures, the borrow sites, and spoil areas.

b. Hold and save the Government free from damages due to the repair or restoration work, except damages due to the fault or negligence of the Government or its contractors.

Figure C-2. Sample C&P Agreement For Rehabilitation

c. Be familiar with the policies and procedures of the U.S. Army Corps of Engineers Inspection Program, participate in the program's periodic inspection, and maintain without cost to the Government the flood control work in a manner satisfactory to the Government and in accordance with the prescribed regulation of the Inspection Program.

d. Give the Government a right to enter, at reasonable times and in a reasonable manner, upon land which the Sponsor owns or controls, for access to the flood control works or structures for the purpose of inspection.

3. The Sponsor further agrees to: (Add as applicable)

a. Contribute, as the sponsor's cost share, the amount and method of contribution as specified in the attachment Sponsor's Cost Share Estimate and Method of Contribution.

b.

4. This agreements remains in effect indefinitely. Termination of this agreement will be automatic when the Sponsor is removed from the U.S. Army Corps of Engineers Inspection Program due to the Sponsor's non compliance with the policies and procedures of the Inspection Program.

5. ATTACHMENTS:

a. Exhibit A - Written request for assistance from the Sponsor.
b. Exhibit B - Government Scope of Work.
c. Exhibit C - Sponsor Cost Share Estimate and Method of Contribution.

6. IN WITNESS WHEREOF, the parties hereto have executed this agreement of the day and year first above written.

THE UNITED STATES OF AMERICA | SPONSOR

_____ (Signature) _____

_____ (Name) _____

_____ (Title) _____

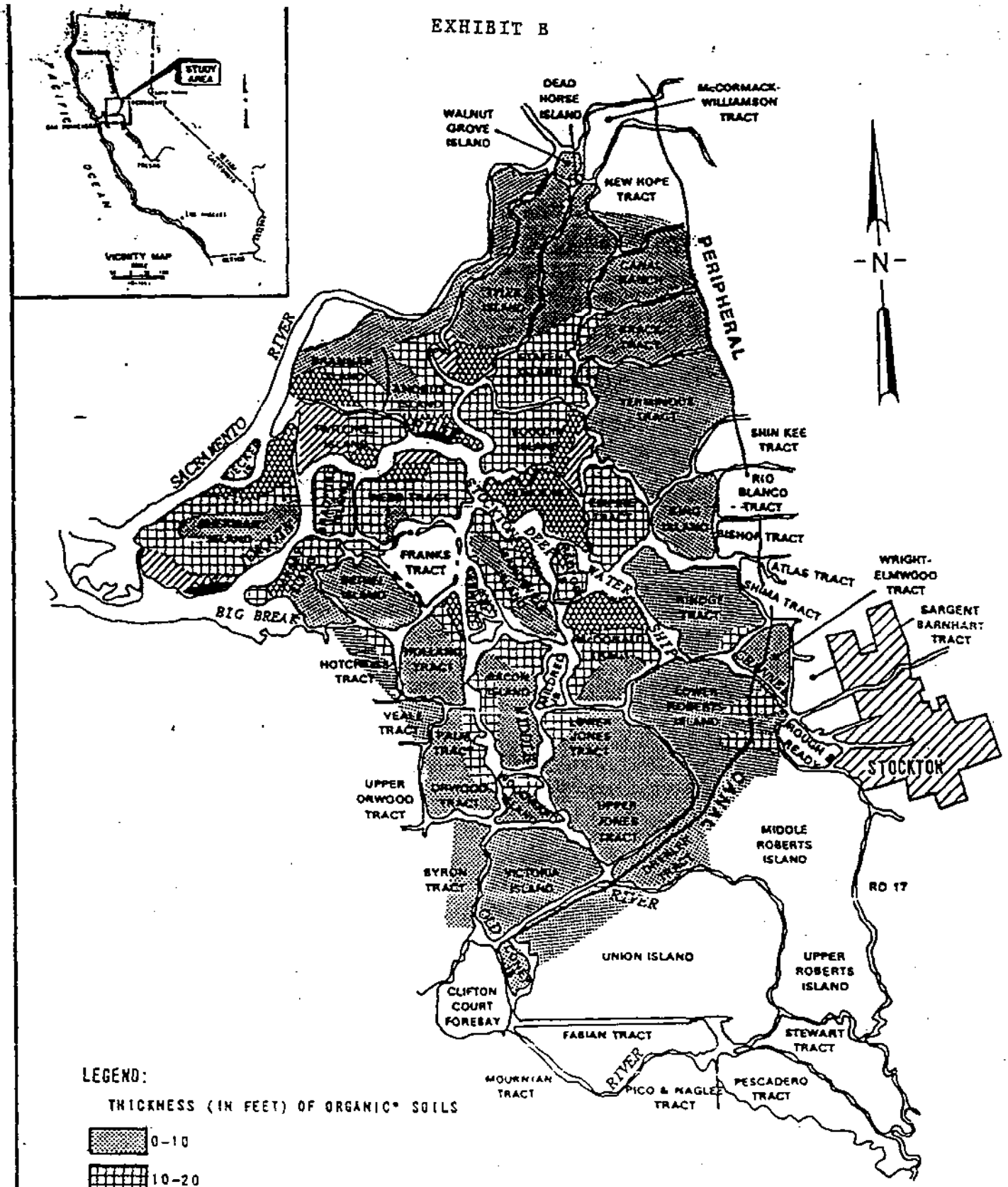
Address:

_____ _____

_____ _____

Figure C-2. Sample C&P Agreement For Rehabilitation (Cont'd)

EXHIBIT B



SACRAMENTO-SAN JOAQUIN DELTA
CALIFORNIA

DISTRIBUTION AND THICKNESS OF ORGANIC SOILS**

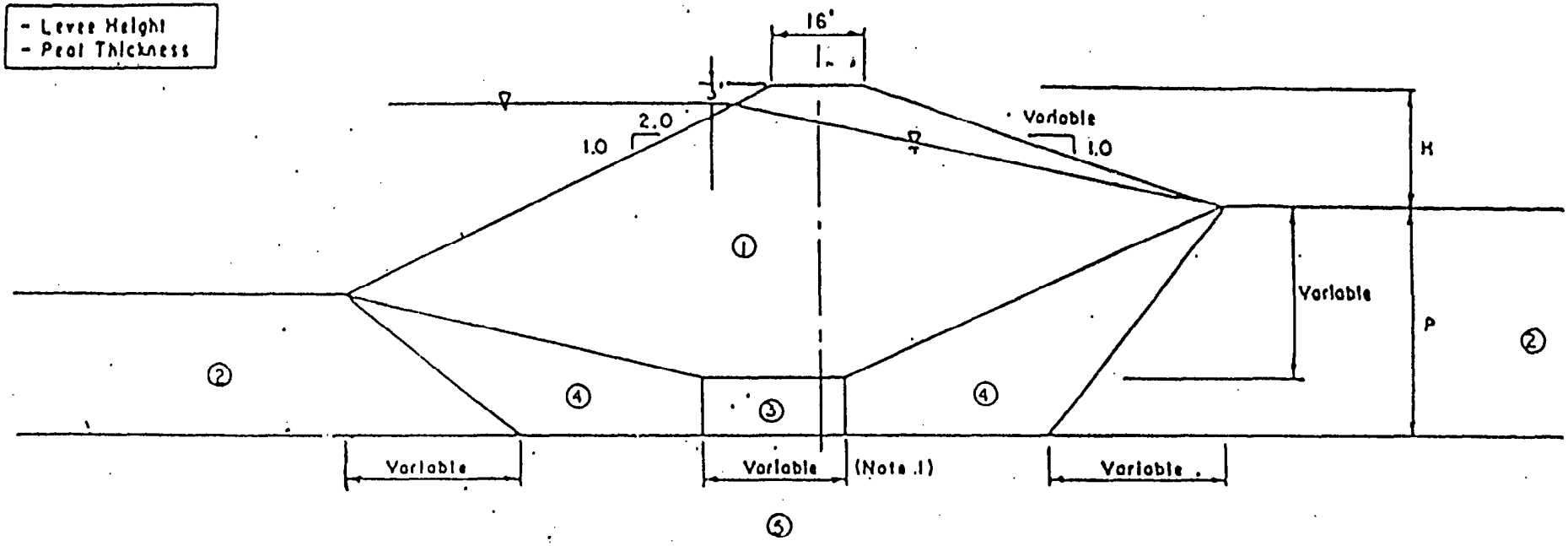
SACRAMENTO DISTRICT, CORPS OF ENGINEERS
JULY 1982

*Peat, organic silt, organic clay (Pt, OL, OH), mineral soils containing greater than 25% organics.

**Subsidence of organic soils in the Sacramento-San Joaquin Delta, DWR, Central District, August 1980.

LEGEND

- Levee Height
- Peat Thickness



Zone	Material	Moist Wt (PCF)	Sat Wt (PCF)	Strength c (PCF)	Strength φ (Deg)
1	Levee Fill - Clay, Sand Peat, Silt	115	120	0	33
2	Foundation - Unconsolidated Peat & Clayey Peat	77	77	100	18
3	Foundation - Consolidated Peats & Clayey Peats	85	85	200	27
4	Foundation - Partially Consolidated Peats & Clayey Peats	85	85	150	25
5	Foudation - Clayey Sand, Firm Sand & Silty Sand	127	135	0	35

NOTES:

1. Dimensions noted as variable, change as a function of levee height and peat depth.
2. References a & d.
3. No distinction is made between peat, organic silt, organic clay, and mineral soil containing greater than 25% organics.

Minimum Levee Geometry
Sacramento - San Joaquin Delta

GENERALIZED LEVEE SECTION
B
DESIGN PARAMETERS

EXHIBIT B

Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 2(H) LANDSIDE SLOPE

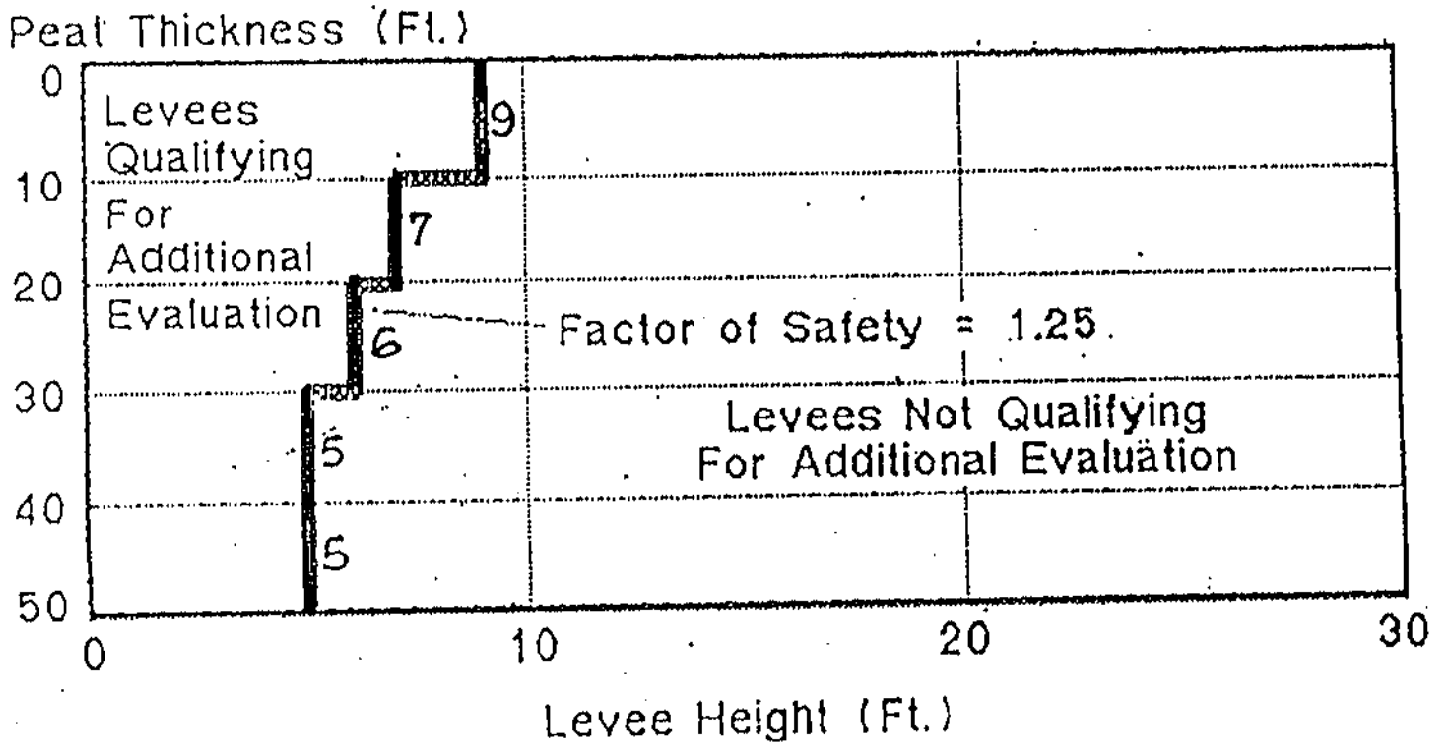
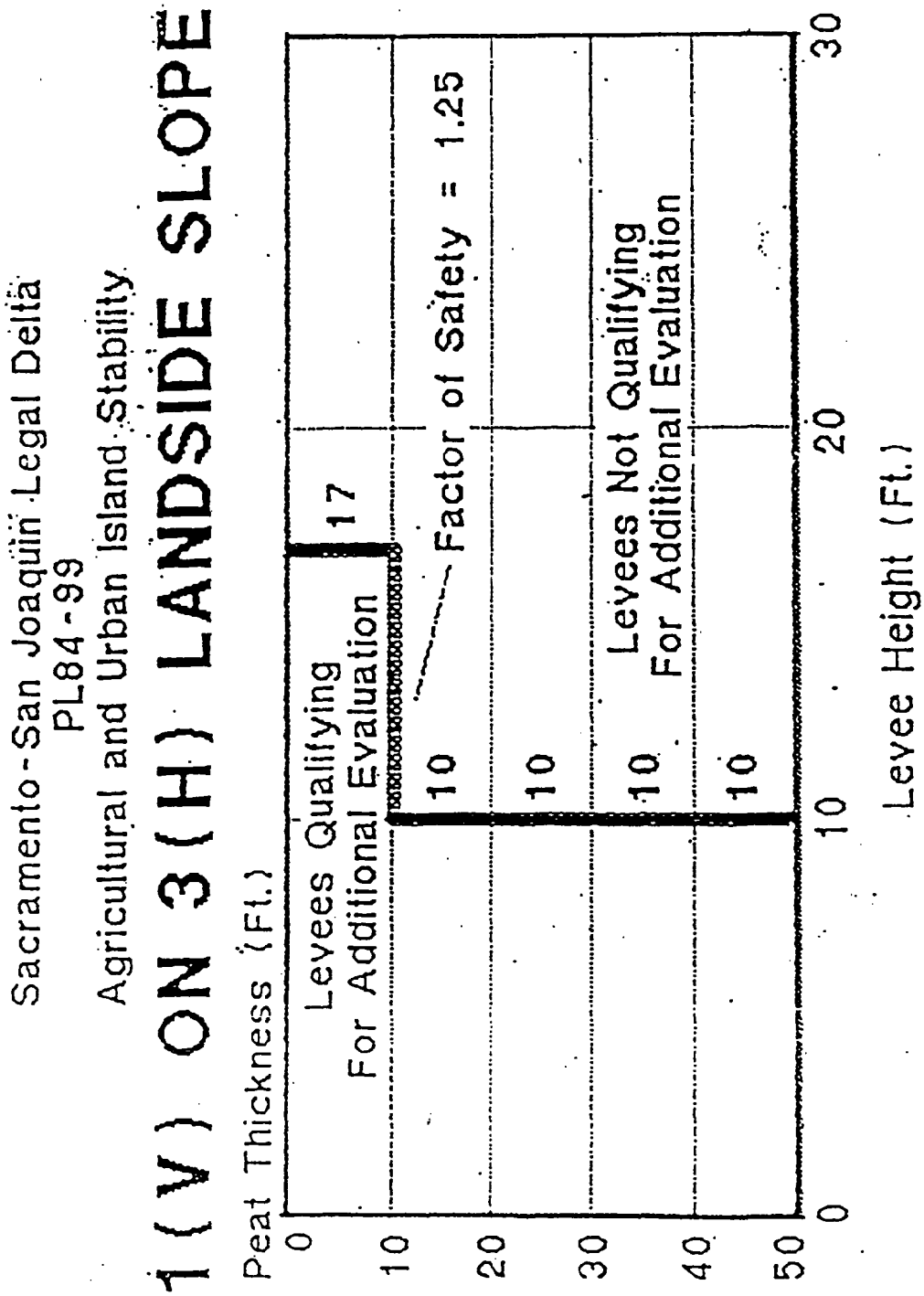
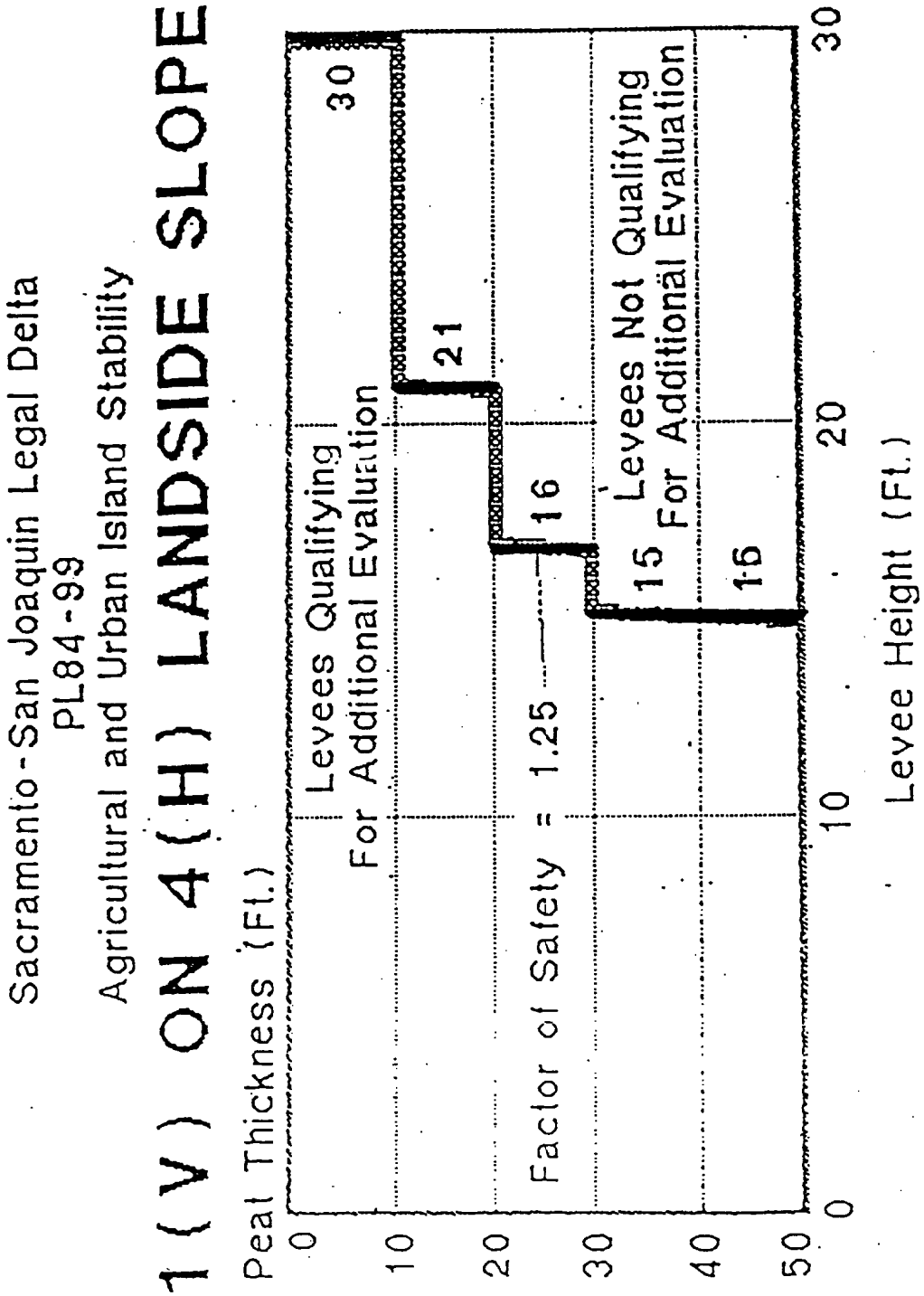


EXHIBIT B


Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability
1(V) ON 3(H) LANDSIDE SLOPE
Peat Thickness (Ft.)
0
10
20
30
40
50
Levees Qualifying
For Additional Evaluation
17
Factor of Safety = 1.25
10
10
10
10
Levees Not Qualifying
For Additional Evaluation
0
10
20
30
Levee Height (Ft.)


Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability
1(V) ON 4(H) LANDSIDE SLOPE
Peat Thickness (Ft.)
0
10
20
30
40
50
Levees Qualifying
For Additional Evaluation
Factor of Safety = 1.25
30
21
16
15
1.6
Levees Not Qualifying
For Additional Evaluation
0
10
20
30
Levee Height (Ft.)

Sacramento-San Joaquin Legal Delta
PL84-99
Agricultural and Urban Island Stability

1(V) ON 5(H) LANDSLIDE SLOPE

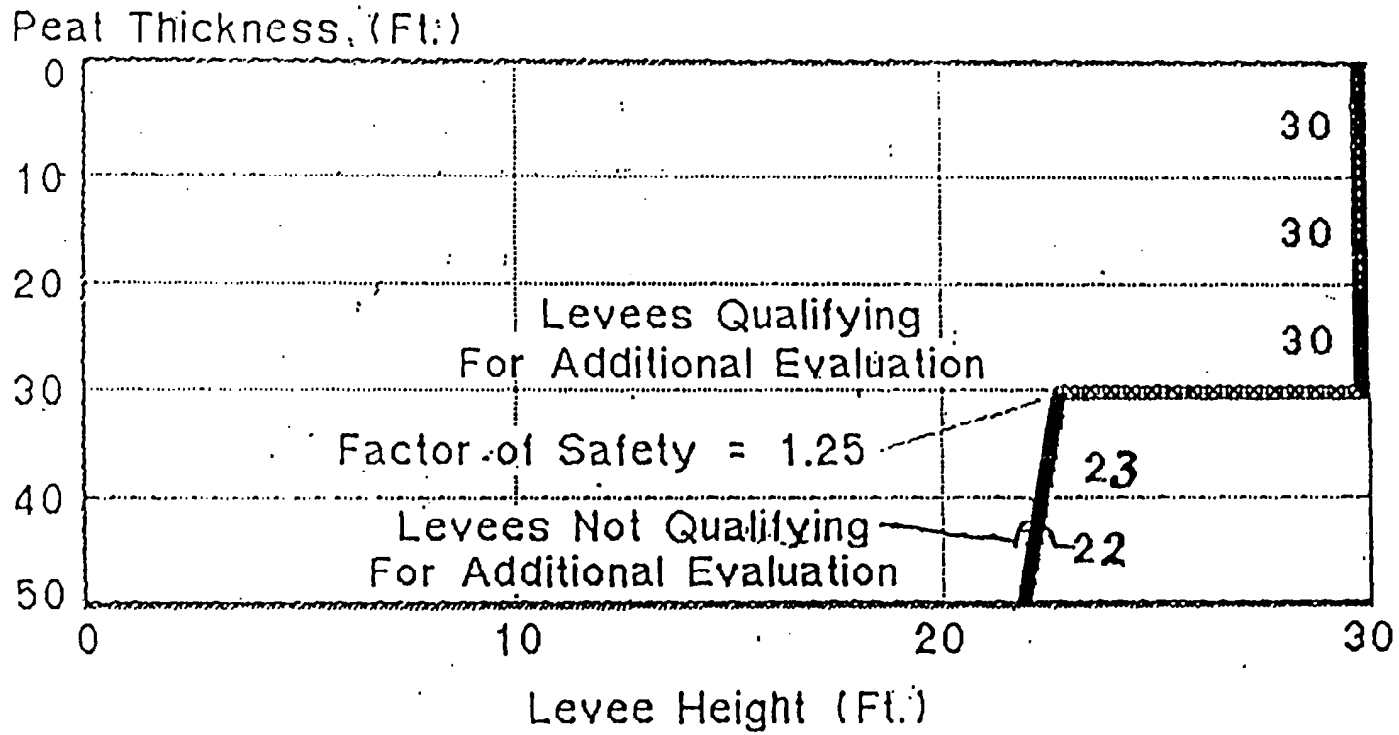


EXHIBIT B

APPENDIX B
PUBLIC LAW 84-99 AS AMENDED

33 U.S.C 701n. Flood Emergency preparation; authorized expenditures

(a)(1) There is authorized an emergency fund to be expended in preparation for emergency response to any natural disaster, in flood fighting and rescue operations, or in the repair or restoration of any flood control work threatened or destroyed by flood, including the strengthening, raising, extending, or other modification thereof as may be necessary in the discretion of the Chief of Engineers for the adequate functioning of the work for flood control; in the emergency protection of federally authorized hurricane or shore protection being threatened when in the discretion of the Chief of Engineers such protection is warranted to protect against imminent and substantial loss to life and property; in the repair and restoration of any federally authorized hurricane or shore protective structures damaged or destroyed by wind, wave, or water action of other than an ordinary nature when in the discretion of the Chief of Engineers such repair and restoration is warranted for the adequate functioning of the structure for hurricane or shore protection. The emergency fund may also be expended for emergency dredging for restoration of authorized project depths for Federal navigable channels and waterways made necessary by flood, drought, earhtquake, or other natural disasters. In any case in which the Chief of Engineers is otherwise performing work under this section in an area for which the Governor of the affected State has requested a determination that an emergency exists or a declaration that a major disaster exists under the Disaster Relief and Emergency Assistance Act of 1974, the Chief of Engineers is further authorized to perform on public and private lands and waters for a period of ten days following the governor's request any emergency work made necessary by such emergency or disaster which is essential for the preservation of life and property, including, but not limited to, channel clearance, emergency shore protection, clearance and removal of debris and wreckage endangering public health and safety, and temporary restoration of essential public facilities and services. The Chief of Engineers, in the exercise of his discretion, is further authorized to provide emergency supplies of clean water, on such terms as he determines to be advisable, to any locality which he finds is confronted with a source of contaminated water causing or likely to cause a substantial threat to the public health and welfare of the inhabitants of the locality. The appropriation of such moneys for the initial establishment of this fund and for its replenishment on an annual basis is authorized: Provided, that pending the appropriation of sums to such emergency fund, the Secretary of the Army may allot, from existing flood control appropriations, such sums as may be necessary for the immediate prosecution of the work herein authorized, such appropriations to be reimbursed from the appropriation herein authorized when made. The Chief of Engineers is authorized, in the prosecution of work in connection with rescue operations, or conducting other flood emergency work, to acquire on a rental basis such motor vehicles, including passenger cars and buses, as in his discretion are deemed necessary.

(2) In preparing a cost and benefit feasibility assessment for any emergency project described in paragraph (1), the Chief of Engineers shall consider the benefits to be gained by such project for the protection of-

"(A) residential establishments;

"(B) commercial establishments, including the protection of inventory; and

"(C) agricultural establishments, including the protection of crops."

"(b)(1) The Secretary, upon a written request for assistance under this paragraph made by any farmer, rancher, or political subdivision within a distressed area, and after determination by the Secretary that (A) as a result of the drought such farmer, rancher, or political subdivision has an inadequate supply of water, (B) an adequate supply of water can be made available to such farmer, rancher, or political subdivision through the construction of a well, and (C) as a result of the drought such well could not be constructed by a private business, the Secretary, subject to paragraph (3) of this subsection, may enter into an agreement with such farmer, rancher, or political subdivision for the construction of such well.

"(2) The Secretary, upon a written request for assistance under this paragraph made by any farmer, rancher, or political subdivision within a distressed area, and after a determination by the Secretary that as a result of the drought such farmer, rancher, or political subdivision has an inadequate supply of water and water cannot be obtained by such farmer, rancher, or political subdivision, the Secretary may transport water to such farmer, rancher, or political subdivision by methods which include, but are not limited to, small-diameter emergency water lines and tank trucks, until such time as the Secretary determines that an adequate supply of water is available to such farmer, rancher, or political subdivision.

"(3)(A) Any agreement entered into by the Secretary pursuant to paragraph (1) of this subsection shall require the farmer, rancher, or political subdivision for whom the well is constructed to pay to the United States the reasonable cost of such construction, with interest, over such number of years, not to exceed thirty, as the Secretary deems appropriate. The rate of interest shall be that rate which the Secretary determines would apply if the amount to be repaid was a loan made pursuant to Section 7(b)(2) of the Small Business Act.

"(B) The Secretary shall not construct any well pursuant to this subsection unless the farmer, rancher, or political subdivision for whom the well is being constructed has obtained, prior to construction, all necessary state and local permits.

"(4) The Federal share for the transportation of water pursuant to paragraph (2) of this subsection shall be 100 per centum.

"(5) For purposes of this subsection-

"(A) the term 'construction' includes construction, reconstruction, or repair;

"(B) the term 'distressed area' means an area which the Secretary determines due to drought conditions has an inadequate water supply which is causing, or is likely to cause, a substantial threat to the health and welfare of the inhabitants of the area including threat of damage or loss of property;

"(C) the term 'political subdivision' means a city, town, borough, county, parish, district, association, or other public body created by or pursuant to state law and having jurisdiction over the water supply of such public body;

"(D) the term 'reasonable cost' means the lesser of (i) the cost to the Secretary of constructing a well pursuant to this subsection exclusive of the cost of transporting equipment used in the construction of wells, or (ii) the cost to a private business of constructing such well;

"(E) the term 'Secretary' means the Secretary of the Army, acting through the Chief of Engineers; and

"(F) the term 'state' means a state, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American samoa, and the Trust Territory of the Pacific Islands."

Historical Note

Codification. The Department of War was designated the Department of the Army, and the title of the Secretary of War was changed to Secretary of the Army by Section 205(a) of Act July 26, 1947, c. 343, Title II, 61 State. 501. Section 205(a) of Act July 26, 1947, was repealed by Section 53 of Act August 10, 1956, c. 1041. 70A Stat. 641. Section 1 of Act August 10, 1956, enacted "Title 10, Armed Forces", which in Sections 3011-3013 continued the military Department of the Army under the administrative supervision of a Secretary of the Army.

1990 - Section 302 of the Water Resources Development Act of 1990 (PL 101-640) amends PL 84-99 by striking "flood emergency preparation" and adding "preparation for emergency response to any natural disaster." It also authorizes the use of the emergency fund for emergency dredging for restoration of authorized project depths for Federal navigable channels and waterways made necessary by flood, drought, earthquake, or other natural disaster.

1987 - Section 9 of the Farm Disaster Assistance Act of 1987 (PL 100-45) amends PL 84-99 by requiring the Corps of Engineers to consider benefits to residential establishments, commercial establishments and agricultural establishments in preparing a benefit-cost analysis for any emergency project.

1986 - Section 917 of the Water Resources Development Act of 1986 (PL 99-662) amends PL 84-99 by removing the word "drinking" in each place it appears. It also authorizes the Chief of Engineers performing emergency work in a disaster area to perform emergency work on public and private lands and waters for a period of ten days following a Governor's request for assistance.

1977 - Amendment: PL 95-51 approved 20 June 1977, added subsection (b) giving the Secretary the authority to construct wells and transport water during drought situations.

1974 - Amendment: PL 93-251 deleted the specified amount of the emergency fund, and authorized the emergency provision of clean drinking water to any locality confronted with a contaminated source.

1962 - Amendment: PL 87-874 authorized expenditures from the emergency fund for the protection of federally authorized hurricane or shore protection being threatened when such is warranted to protect against imminent and substantial loss to life and property, and for the repair and restoration of any such federally authorized hurricane or shore protective structure damaged or destroyed by wind or water action of an extraordinary nature when such is warranted for the adequate functioning of the structure for hurricane or shore protection.

1955 - Amendment: Act June 28, 1955, PL 84-99, authorized expenditure for flood emergency preparation and eliminated the requirement of maintenance of flood control works threatened by flood.

1950 - Amendment: Act May 17, 1950, expanded scope of work considered under emergency repairs to flood control structures and increased the appropriation from $2,000,000 to $15,000,000.

1948 - Amendment: Act June 30, 1948, added provisions relating to the strengthening, extending, or modification of flood control work.

1946 - Amendment: Act July 24, 1946, increased authorization from $1,000,000 to $2,000,000.

1941 - Section 5 of the Flood Control Act of August 18, 1941 (PL 77-228) established the authority for the expenditure of not more than $1,000,000 per year for rescue or in the repair or maintenance of any flood-control work threatened or destroyed by flood.

APPENDIX B

COST ESTIMATE BACKUP AND REPORT

NOTE:

Appendix B contains a summary of the Cost Estimate. The complete cost estimate and all the backup data are available under separate cover. The backup data include levee cross-section data in AUTOCAD format. The cross-sections are available on CD. To obtain the complete cost estimate and all the backup data, contact CALFED's Project Manager for the Levee System Integrity Program.

CALFED LEVEE REHABILITATION STUDY

INTRODUCTION

CALFED has chosen the levee standards established for the Delta under Public Law 84-99 (PL-99) as the minimum level of protection for system integrity. This study inventories the levees within the legal Delta not meeting the PL-99 standard and estimates quantities and costs required to rehabilitate these levees.

SCOPE OF STUDY

The study includes three main components: *an inventory of the levees not meeting the PL-99 standard, quantity and cost estimates to meet the standard,* and *an evaluation and estimated cost for the associated land, easements, rights of way, relocations and disposal (LERRD's) required to perform the levee rehabilitation.*

Generally, the levees not meeting the PL-99 standard consist of the non-project levees in the Delta (Figure 1). Unless there was specific knowledge of site conditions, project levees were assumed to meet the PL-99 standard. The inventory attempts to identify a complete listing of levee districts and associated levee miles not meeting the standard. In addition, the inventory identifies levees which meet the geometric standard but experience significant seepage during high water.

Quantity and cost estimates were based on a comparison of the design levee standard geometry as set forth in PL-99, to the existing levee configuration. Data used for these levee rehabilitation cost estimates included actual levee data from 60% of the existing non-project levee districts, representing 69% of the total mileage of substandard levees. The results of the estimates using actual data were then used to extrapolate the same information for islands where actual data was not available (Figure 2).

Finally, the study evaluated an estimated cost for the LERRD's associated with the levee rehabilitation. Generally, the required levee improvements extend from the levee toe landward into existing private property. In addition, the levee improvements impact existing infrastructure which must be evaluated and costs estimated for work to move or replace the infrastructure. Components of this infrastructure include pumps and siphons, utility lines and

poles, seepage and irrigation ditches and buildings. The LERRD's also include easement acquisition for the additional levee section. The results of this study are summarized on Table 1.

STUDY DETAILS

The study estimates the quantity and cost required to obtain the PL-99 standards for 55 islands or levee districts totaling 521.2 miles of levee. Improvement costs, based on fill and roadway estimates, were used to project other costs associated with levee projects such as engineering, environmental and regulatory. Described below are details regarding the components of the cost estimates.

Fill Quantity Estimates

The basis for establishing fill quantity required to meet the PL-99 standards is establishment of the standard levee section for a particular levee in the Delta. PL-99 simplifies its standard by requiring freeboard of 1.5' above the 100-year flood elevation, a 16' wide crown, a 2 (horizontal)-to-1 (vertical) waterside slope and a variable landside slope based on the levee height and estimated depth of organic material in the foundation. This varying landside slope ranges between 3:1 to 5:1 (Figure 3). Organic material depths were taken from the Department of Water Resources' map entitled, "Organic Isopach Map", October 18, 1976. Flood elevations were from the Corps of Engineers' report entitled, "Sacramento/San Joaquin Delta California Special Study Documentation Report", dated March 1993. Levee heights were computed from actual levee survey data.

Fifty-five of the Delta islands were found to not meet the PL-99 standards. Actual survey data from 32 of these islands was used for the cost estimates. These 32 islands represent 352 miles or 68% of the 521.2 miles of levee providing less than PL-99 level of protection. These survey data were obtained directly from the districts. At a minimum, cross sections were taken at 1,000' intervals. Using this data and superimposing the required PL-99 standard yields the "neat" fill requirements at each section. The average end method was then used to estimate the fill along the levee between each cross section.

The "neat" fill estimates were the basis for the Delta levee rehabilitation. The "neat" fill estimates were increased by 100% to account for losses associated with this type of work. Losses amounting to 150% of the "neat" fill requirement were applied where the levee still

appears to be experiencing significant foundation consolidation. Islands where this is occurring include Sherman, Twitchell, Empire, Bouldin, Tyler and Webb Tract. Much of the loss associated with levee rehabilitation on Delta islands is attributable to consolidation of organic material, consolidation of loosely compacted fill and accuracy of this survey data. Estimated fill based on the above factors is shown on Table 1.

The rehabilitated levee section will require replacement of existing access ramps. These ramps require approximately 1,000 cubic yards (cy) of fill material. Where the number of ramps was known, the corresponding additional fill material was added to the cross-section quantity estimates. Where the number of ramps was not known, an average of three ramps per levee mile was used to estimate the fill requirement needed for replacement of access ramps.

Detailed survey cross-sections were not obtained for 23 levee districts. The fill requirements to meet the PL-99 standard were extrapolated based on values estimated using detailed information. Five categories of fill requirement ranging from 5,000 cy to 100,000 cy per mile were used. Based on knowledge of the 23 districts, each was assigned the category which most nearly represented its need for levee material.

Roadway Quantity Estimates

When raising and widening a levee, the gravel roadway is destroyed. Therefore, quantity estimates were made to replace the roadway under the CALFED system integrity program. Gravel was assumed to be 6-inches by 16-feet for the general levee section. For levees which currently support a county road, the roadway was designed as 6-inches by 24-feet of gravel subgrade covered by a 20 foot wide triple chip seal.

Cost Estimates

Based on fill and roadway quantity estimates, cost estimates were calculated using high and low unit prices from actual Delta levee projects. Delta levee work experiences a great variance in cost due to factors such as proximity to borrow material, accessibility of the project, condition of access roads and workload of local contractors. It is anticipated that a program as extensive as the CALFED will generate new markets which don't currently exist, thus keeping the levee costs to a minimum. For the sake of this study, the improvement costs were left to range between low and high.

Additional Costs

Levee improvement includes an array of costs to account for services required to plan and construct a project. Based as a percentage of the subtotal of the fill and roadway cost estimates, the following costs were included:

- Engineering Planning and Design: $10,000 + 5% to $10,000 + 8%
- Geotechnical Analysis: 5% to 8%
- Construction Inspection and Contract Administration: 5% to 8%
- Environmental and Regulatory: 5% to 8%
- CMARP: 1%
- Erosion Protection for Newly Placed Fill: 8%
- Environmental Mitigation: 15%
- Ongoing Repair: 25%
- Overall Contingency to Account for Unforeseen Costs: 20%

Seepage Repair

Although most federally reconstructed project levees in the Delta meet or exceed the PL-99 geometric standard, there are several locations where the sand composition of the levees causes a threat of seepage and piping of material during high water. This seepage could lead to a reduction in the factor of safety, diminishing the level of protection. The bulk of these levees are located along the San Joaquin River Channel upstream of Stockton. Several areas have also been noted along the Sacramento River and Georgian Slough. The total mileage where this type of repair is required was estimated based on accounts during the January 1997 floods. Cost estimates to repair this type of problem were based on costs estimated by the Corps of Engineers to repair levees along the San Joaquin River at Reclamation District No. 17 (Figure 4). It was assumed 33% of a district's levee system, where seepage has been a problem, would have to be repaired. Table 2 summarizes seepage repair estimates.

Lands, Easements, Rights of Way, Relocations and Disposal (LERRD'S)

The third component of the study was to evaluate the cost of LERRD's resulting from the CALFED System Integrity Program. As described above, a rehabilitation as extensive as CALFED's program will impact existing infrastructure. Widening of the levees will encroach

upon existing private property (Figure 5). Therefore, cost estimates were made to acquire easements for the existing land required due to the levee rehabilitation, and to move or replace existing infrastructure. This infrastructure includes irrigation and drainage pipes and pumping plants, power poles, homes and ditches. These estimates were based on recent experience of a similar type project performed on the levees surrounding the Stockton Metropolitan Area (Table 3).

Summary

Based on the above, the total costs of the levee rehabilitation program is estimated to range from $613 million to $1.28 billion. The range is based on the uncertainty regarding location and cost of levee fill material. The breakdown for the costs, as shown on Tables 1-3, is as follows:

	Low	High
PL-99 Improvement Cost	$ 356,970,324	$ 1,023,686,285
Seepage Repair	$ 164,229,790	$ 164,229,790
LERRD's	$ 92,028,000	$ 92,028,000
	$ 613,228,114	$ 1,279,944,075

These costs include acquisition of easements over 3,419 acres for the PL-99 improvement and 1,209 acres for the seepage repair.

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Sacramento-San Joaquin Delta, California

Levee Rehabilitation Study

District Number		Reclamation District	Levee Miles Project	Levee Miles Non-Project	Levee Miles Total	Total Fill Volume (yd³)	Estimated PL-99 Improvement Cost Low	Estimated PL-99 Improvement Cost High
556	1	Andrus Island, Upper	11.2	0.6	11.8	30,000	$517,290	$1,408,450
2126	1	Atlas Tract	0.0	1.9	1.9	57,000	$927,394	$2,631,111
2028		Bacon Island	0.0	14.3	14.3	1,420,443	$20,712,541	$60,697,769
	2	Bear Creek	46.5	0.0	46.5	0	$0	$0
	2	Bethany			0.0	0	$0	$0
		Bethel Island MID	0.0	11.5	11.5	230,634	$4,188,633	$11,473,059
2042	2	Bishop Tract	0.0	5.8	5.8	0	$0	$0
	2	Bishop Tract, East			0.0	0	$0	$0
2121	2	Bixler	0.0	2.3	2.3	0	$0	$0
404	2	Boggs (Moss) Tract	4.0	1.2	5.2	0	$0	$0
	2	Borrow Pond Area			0.0	0	$0	$0
756		Bouldin Island	0.0	18.0	18.0	2,454,122	$33,917,002	$101,465,550
2033		Brack Tract	0.0	10.8	10.8	246,291	$4,162,288	$11,645,933
2059		Bradford Island	0.0	7.4	7.4	797,028	$11,222,624	$33,430,057
317, 407 & 2067		Branman-Andrus LMD	19.3	10.1	29.4	1,260,711	$19,147,841	$54,942,188
	2	Browns Island			0.0	0	$0	$0
800	2	Byron Tract	0.0	9.7	9.7	0	$0	$0
2098	2	Cache Haas	12.1	0.0	12.1	0	$0	$0
2086		Canal Ranch	0.0	7.5	7.5	511,350	$7,374,253	$21,731,317
	2	Chipps Island			0.0	0	$0	$0
	2	Clifton Court			0.0	0	$0	$0
	2	Collinsville			0.0	0	$0	$0
2117		Coney Island	0.0	5.4	5.4	37,477	$1,004,522	$2,428,368
2111	1	Dead Horse Island	0.0	2.6	2.6	13,258	$384,338	$915,177
	2	Decker			0.0	0	$0	$0
	2	Delta-Mendota			0.0	0	$0	$0
	1	Drexler Island	0.0	4.0	4.0	20,000	$614,178	$1,495,435
536	2	Egbert Tract	14.0	0.0	14.0	0	$0	$0
813	2	Ehrheart	2.0	6.0	8.0	0	$0	$0
2029		Empire Tract	0.0	10.5	10.5	1,093,053	$15,737,352	$46,227,173
773	1	Fabian Tract	0.0	18.8	18.8	188,000	$4,541,103	$11,439,905
2113	1	Fay Island	0.0	1.6	1.6	8,026	$240,435	$569,585
1002	1	Glanville Tract	0.0	13.0	13.0	65,099	$2,335,317	$5,292,676
765	2	Glide	1.7	4.0	5.7	0	$0	$0
3	2	Grand Island	29.0	0.0	29.0	0	$0	$0
1609	2	Harveys			0.0	0	$0	$0
2060	2	Hastings Tract	16.0	0.0	16.0	0	$0	$0
999	2	Holland Land	27.0	5.8	32.8	0	$0	$0
2025		Holland Tract	0.0	10.9	10.9	182,612	$3,816,975	$9,912,258
2116	2	Holt Station	0.0	0.4	0.4	0	$0	$0
799	1	Hotchkiss Tract	0.0	6.3	6.3	121,248	$2,371,992	$6,406,959
830	1	Jersey Island	0.0	15.6	15.6	468,000	$7,527,319	$21,485,215
2038		Jones Tract, Lower	0.0	8.8	8.8	173,847	$3,283,897	$8,908,588
2039		Jones Tract, Upper	0.0	9.3	9.3	32,586	$866,491	$2,142,417
2085	2	Kasson	6.2		6.2	0	$0	$0
	2	Kimball Island			0.0	0	$0	$0
2044		King Island	0.0	9.0	9.0	276,103	$4,483,102	$12,688,246
369	1	Libby McNeil	1.0	0.7	1.7	66,000	$981,195	$2,864,665
2093	2	Liberty Island	0.0	20.5	20.5	0	$0	$0
1608	2	Lincoln Village West	0.0	4.0	4.0	0	$0	$0
307	2	Lisbon	7.8	5.2	13.0	0	$0	$0
2084	2	Little Egbert Tract	0.0	7.0	7.0	0	$0	$0
	2	Little Franks Tract			0.0	0	$0	$0
2118	1	Little Mandeville	0.0	4.5	4.5	450,000	$6,348,833	$18,876,664
	2	Los Medanos			0.0	0	$0	$0
	2	Maintenance Area 9	19.6	0.0	19.6	0	$0	$0
2027		Mandeville Island	0.0	14.3	14.3	502,358	$7,789,541	$22,407,366
2110	1	McCormack-Williamson Tract	0.0	8.8	8.8	525,000	$7,696,924	$22,600,613
2030		McDonald Island	0.0	13.7	13.7	98,170	$2,482,325	$6,316,103
2075	2	McMullin	7.4	0.0	7.4	0	$0	$0
2041		Medford Island	0.0	5.9	5.9	453,667	$6,494,287	$19,197,006
150	2	Merritt Island	18.1	0.0	18.1	0	$0	$0
2021	2	Mildred Island	0.0	7.3	7.3	0	$0	$0
	2	Montezuma Flats			0.0	0	$0	$0
	2	Montezuma Island			0.0	0	$0	$0
2107	2	Mossdale 2	4.2	0.0	4.2	0	$0	$0
17	2	Mossdale Tract	14.0	0.0	14.0	0	$0	$0
1007	1	Naglee Burke Tract	0.0	8.3	8.3	83,000	$1,813,377	$4,762,587
348		New Hope Tract	0.0	18.6	18.6	291,322	$4,928,678	$13,860,672

Table 1

Sacramento-San Joaquin Delta, California

Levee Rehabilitation Study

District Number		Reclamation District	Levee Miles Project	Levee Miles Non-Project	Levee Miles Total	Total Fill Volume (yd^3)	Estimated PL-99 Improvement Cost Low	Estimated PL-99 Improvement Cost High
	2	Oakley			0.0	0	$0	$0
2024		Orwood Tract	0.0	10.9	10.9	12,633	$729,834	$1,640,042
2036		Palm Tract	0.0	7.5	7.5	199,301	$3,298,313	$9,338,080
2095	2	Paradise	4.0	0.0	4.0	0	$0	$0
2058	1	Pescadero Tract	6.7	2.2	8.9	43,340	$1,325,842	$3,248,954
2104	2	Peters	7.4	0.0	7.4	0	$0	$0
551	2	Pierson District	8.4	7.0	15.4	0	$0	$0
1667	2	Prospect Island	2.9	7.1	10.0	0	$0	$0
2090		Quimby Island	0.0	7.0	7.0	426,462	$6,244,751	$18,343,567
755	2	Randall	1.9	0.0	1.9	0	$0	$0
2037		Rindge Tract	0.0	15.7	15.7	520,276	$8,310,102	$23,847,863
2114	2	Rio Blanco Tract	0.0	4.0	4.0	0	$0	$0
2064	2	River Junction	11.6	0.0	11.6	0	$0	$0
524	1	Robert Island, Middle	6.1	3.7	9.8	63,447	$1,932,828	$4,741,046
684		Roberts Island, Lower	0.0	16.0	16.0	43,689	$1,824,462	$4,259,136
544	1	Roberts Island, Upper	10.6	4.4	15.0	88,068	$2,678,112	$6,574,274
	2	Rough and Ready Island	0.0	6.7	6.7	0	$0	$0
501	2	Ryer Island	20.6	0.0	20.6	0	$0	$0
	2	Sacramento Deepwater			0.0	0	$0	$0
2074	2	Sargent Barnhart Tract	1.5	2.8	4.3	0	$0	$0
341		Sherman Island	9.7	9.8	19.5	321,559	$5,778,494	$15,639,373
	2	Sherman Island, West			0.0	0	$0	$0
2115		Shima Tract	0.0	6.6	6.6	41,563	$1;142,313	$2,853,331
	1	Shin Kee Tract	0.0	3.9	3.9	360,000	$5,079,744	$15,099,311
	2	SJCFCD Five Mile Slough			0.0	0	$0	$0
	2	SJCFCD Fourteen Mile Slough			0.0	0	$0	$0
	2	SJCFCD Mosher Slough			0.0	0	$0	$0
1614	2	Smith Tract	6.0	2.8	8.8	0	$0	$0
	2	Spinner Island			0.0	0	$0	$0
2089	2	Stark	2.9	0.7	3.6	0	$0	$0
38		Staten Island	0.0	25.4	25.4	921,949	$14,349,298	$41,373,293
2062	2	Stewart Tract	12.3	0.0	12.3	0	$0	$0
349	2	Sutter Island	12.5	0.0	12.5	0	$0	$0
548	1	Terminous Tract	0.0	16.1	16.1	1,262,330	$18,495,932	$54,337,453
2108	2	Tinsley			0.0	0	$0	$0
1601		Twitchell Island	2.5	9.3	11.8	1,291,084	$18,588,176	$54,670,526
563		Tyler Island	12.2	10.7	22.9	2,863,563	$41,800,546	$121,994,769
1		Union Island, East	1.0	13.0	14.0	0	$0	$0
2	1	Union Island, West	0.0	16.2	16.2	80,492	$2,611,017	$6,240,156
1607	1	Van Sickle Island	0.0	3.8	3.8	380,000	$5,357,353	$15,925,323
2065		Veale Tract	0.0	5.7	5.7	21,243	$718,854	$1,721,402
2023	1	Venice Island	0.0	12.3	12.3	123,977	$2,668,367	$7,001,564
2040	1	Victoria Island	0.0	15.1	15.1	150,775	$3,316,281	$8,735,545
554	2	Walnut Grove	1.0	1.2	2.2	0	$0	$0
2094	2	Walthall	3.3	0.0	3.3	0	$0	$0
2026		Webb Tract	0.0	12.8	12.8	606,166	$9,042,328	$26,322,968
828	2	Weber	0.0	1.2	1.2	0	$0	$0
	2	West Island			0.0	0	$0	$0
900	2	West Sacramento	12.0	1.3	13.3	0	$0	$0
2096	2	Wetherbee	0.2	0.0	0.2	0	$0	$0
2122	1	Winter Island	0.0	4.8	4.8	480,000	$6,765,248	$20,115,682
2072		Woodward Island	0.0	8.8	8.8	323,327	$5,042,183	$14,524,929
2119		Wright-Elmwood Tract	0.0	6.8	6.8	82,516	$1,957,902	$4,914,584
2068	2	Yolano	8.7	0.0	8.7	0	$0	$0
	2	Yolo Bypass Unit 4	3.6	0.0	3.6	0	$0	$0
			430.6	635.2	1065.8	22,864,165	$356,970,324	$1,023,686,285

1 Extrapolated Values

2 Project Levee, Meets or Exceeds PL84-99 or Non-Levee

	Districts	Levee Miles Project	Levee Miles Non-Project
Detailed Quantity Estimates	32	44.7	352.0
Extrapolated Values	23	35.6	169.2
Project Levee, Meets or Exceeds PL84-99 or Non-Levee	69	350.3	114.0
	124	430.6	635.2

Sacramento - San Joaquin Delta, California

Levee Rehabilitation Study

Seepage Control

Reclamation District No.	Name of Island/Tract	Mobilization/Demo (cost est.)	Berm Drain Rock (cost est.)	Berm Material (cost est.)	Geotextile (cost est.)	Total (cost est.)
317, 407 & 2067	Brannan-Andrus Island	$150,000	$21,318,528	$2,173,248	$3,622,080	$27,263,856
3	Grand Island	$150,000	$21,028,480	$2,143,680	$3,572,800	$26,894,960
2025	Holland Tract	$150,000	$7,903,808	$805,728	$1,342,880	$10,202,416
2075	McMullin Ranch	$150,000	$5,365,888	$547,008	$911,680	$6,974,576
2107	Mossdale 2	$150,000	$3,045,504	$310,464	$517,440	$4,023,408
17	Mossdale Tract	$150,000	$10,151,680	$1,034,880	$1,724,800	$13,061,360
2095	Paradise	$150,000	$2,900,480	$295,680	$492,800	$3,838,960
2058	Pescadero Tract	$150,000	$6,453,568	$657,888	$1,096,480	$8,357,936
2064	River Junction	$150,000	$8,411,392	$857,472	$1,429,120	$10,847,984
684	Roberts Island, Lower	$150,000	$11,601,920	$1,182,720	$1,971,200	$14,905,840
524	Roberts Island, Middle	$150,000	$7,106,176	$724,416	$1,207,360	$9,187,952
544	Roberts Island, Upper	$150,000	$10,876,800	$1,108,800	$1,848,000	$13,983,600
2062	Stewart Tract	$150,000	$8,918,976	$909,216	$1,515,360	$11,493,552
2094	Walthall	$150,000	$2,392,896	$243,936	$406,560	$3,193,392
					SEEPAGE CONTROL GRAND TOTAL:	**$164,229,790**

Table 2

Sacramento - San Joaquin Delta, California

Lands, Easements, Right of Ways, Relocations & Disposals (LERRDS)

Reclamation District No.	Name of Island/Tract	Negotiation (cost est.)	Land (cost est.)	Toe Drain (cost est.)	Siphons (cost est.)	Power Poles (cost est.)	Land (seepage) (cost est.)	Total LERRDS (cost est.)
556	Andrus Island, Upper	$15,000	$8,000	$5,000	$15,000	$100,000	$0	$143,000
2126	Atlas Tract	$90,000	$32,000	$20,000	$60,000	$100,000	$0	$302,000
2028	Bacon Island	$405,000	$396,000	$151,000	$975,000	$100,000	$0	$2,027,000
	Bethel Island MID	$10,230,000	$10,259,000	$122,000	$345,000	$100,000	$0	$21,056,000
756	Bouldin Island	$105,000	$435,000	$190,000	$795,000	$125,000	$0	$1,650,000
2033	Brack Tract	$225,000	$224,000	$122,000	$300,000	$100,000	$0	$971,000
2059	Bradford Island	$915,000	$212,000	$78,000	$120,000	$100,000	$0	$1,425,000
317, 407 & 2067	Brannan-Andrus LMD	$3,330,000	$219,000	$136,000	$390,000	$100,000	$136,000	$4,175,000
2086	Canal Ranch	$105,000	$257,000	$102,000	$315,000	$100,000	$0	$879,000
2117	Coney Island	$30,000	$92,000	$57,000	$75,000	$100,000	$0	$354,000
2111	Dead Horse Island	$60,000	$51,000	$28,000	$105,000	$100,000	$0	$344,000
	Drexler Island	$90,000	$68,000	$42,000	$120,000	$100,000	$0	$420,000
2029	Empire Tract	$255,000	$275,000	$111,000	$705,000	$100,000	$0	$1,446,000
773	Fabian Tract	$435,000	$319,000	$199,000	$570,000	$130,000	$0	$1,653,000
2113	Fay Island	$45,000	$31,000	$17,000	$45,000	$100,000	$0	$238,000
1002	Glanville Tract	$255,000	$253,000	$137,000	$30,000	$100,000	$0	$775,000
3	Grand Island	$2,175,000	$0	$0	$870,000	$100,000	$1,406,000	$3,145,000
2025	Holland Tract	$435,000	$223,000	$116,000	$360,000	$100,000	$103,000	$1,234,000
799	Hotchkiss Tract	$375,000	$2,310,000	$94,000	$570,000	$100,000	$0	$3,449,000
830	Jersey Island	$315,000	$265,000	$165,000	$465,000	$105,000	$0	$1,315,000
2038	Jones Tract, Lower	$180,000	$162,000	$95,000	$330,000	$100,000	$0	$867,000
2039	Jones Tract, Upper	$120,000	$85,000	$53,000	$255,000	$100,000	$0	$613,000
2044	King Island	$180,000	$207,000	$96,000	$615,000	$100,000	$0	$1,198,000
369	Libby McNeil	$15,000	$19,000	$12,000	$30,000	$100,000	$0	$176,000
2118	Little Mandeville	$15,000	$76,000	$48,000	$90,000	$100,000	$0	$329,000
2027	Mandeville Island	$105,000	$275,000	$150,000	$300,000	$100,000	$0	$930,000
2110	McCormack-Williamson Tract	$660,000	$427,000	$93,000	$264,000	$100,000	$0	$1,544,000
2030	McDonald Island	$150,000	$247,000	$145,000	$450,000	$100,000	$0	$1,092,000
2075	McMullin Ranch	$555,000	$0	$0	$222,000	$100,000	$359,000	$877,000
2041	Medford Island	$60,000	$120,000	$62,000	$150,000	$100,000	$0	$492,000
2107	Mossdale 2	$315,000	$0	$0	$126,000	$100,000	$204,000	$541,000
17	Mossdale Tract	$1,050,000	$0	$0	$420,000	$100,000	$679,000	$1,570,000
1007	Naglee Burke	$180,000	$141,000	$88,000	$255,000	$100,000	$0	$764,000
348	New Hope Tract	$645,000	$316,000	$197,000	$555,000	$130,000	$0	$1,843,000
2024	Orwood Tract	$225,000	$108,000	$67,000	$195,000	$100,000	$0	$695,000
2036	Palm Tract	$30,000	$134,000	$83,000	$240,000	$100,000	$0	$587,000
2095	Paradise	$300,000	$0	$0	$120,000	$100,000	$194,000	$520,000
2058	Pescadero Tract	$180,000	$147,000	$92,000	$150,000	$100,000	$91,000	$669,000
2090	Quimby Island	$30,000	$135,000	$74,000	$90,000	$100,000	$0	$429,000
2037	Rindge Tract	$240,000	$329,000	$167,000	$1,005,000	$110,000	$0	$1,851,000
2064	River Junction	$870,000	$0	$0	$348,000	$100,000	$562,000	$1,318,000
684	Roberts Island, Lower	$780,000	$251,000	$156,000	$795,000	$100,000	$155,000	$2,082,000
524	Roberts Island, Middle	$255,000	$215,000	$134,000	$255,000	$100,000	$133,000	$959,000
544	Roberts Island, Upper	$360,000	$299,000	$186,000	$360,000	$120,000	$185,000	$1,325,000
341	Sherman Island	$1,440,000	$329,000	$205,000	$585,000	$135,000	$0	$2,694,000
2115	Shima Tract	$60,000	$111,000	$69,000	$120,000	$100,000	$0	$460,000
	Shin Kee Tract	$15,000	$61,000	$38,000	$105,000	$100,000	$0	$319,000
38	Staten Island	$15,000	$554,000	$268,000	$765,000	$180,000	$0	$1,782,000
2062	Stewart Tract	$930,000	$0	$0	$369,000	$100,000	$596,000	$1,399,000
548	Terminous Tract	$630,000	$343,000	$170,000	$615,000	$110,000	$0	$1,868,000
1601	Twitchell Island	$345,000	$254,000	$126,000	$345,000	$100,000	$0	$1,170,000
563	Tyler Island	$705,000	$542,000	$246,000	$915,000	$165,000	$0	$2,573,000
1	Union Island, East	$300,000	$255,000	$159,000	$300,000	$100,000	$0	$1,114,000

Table 3

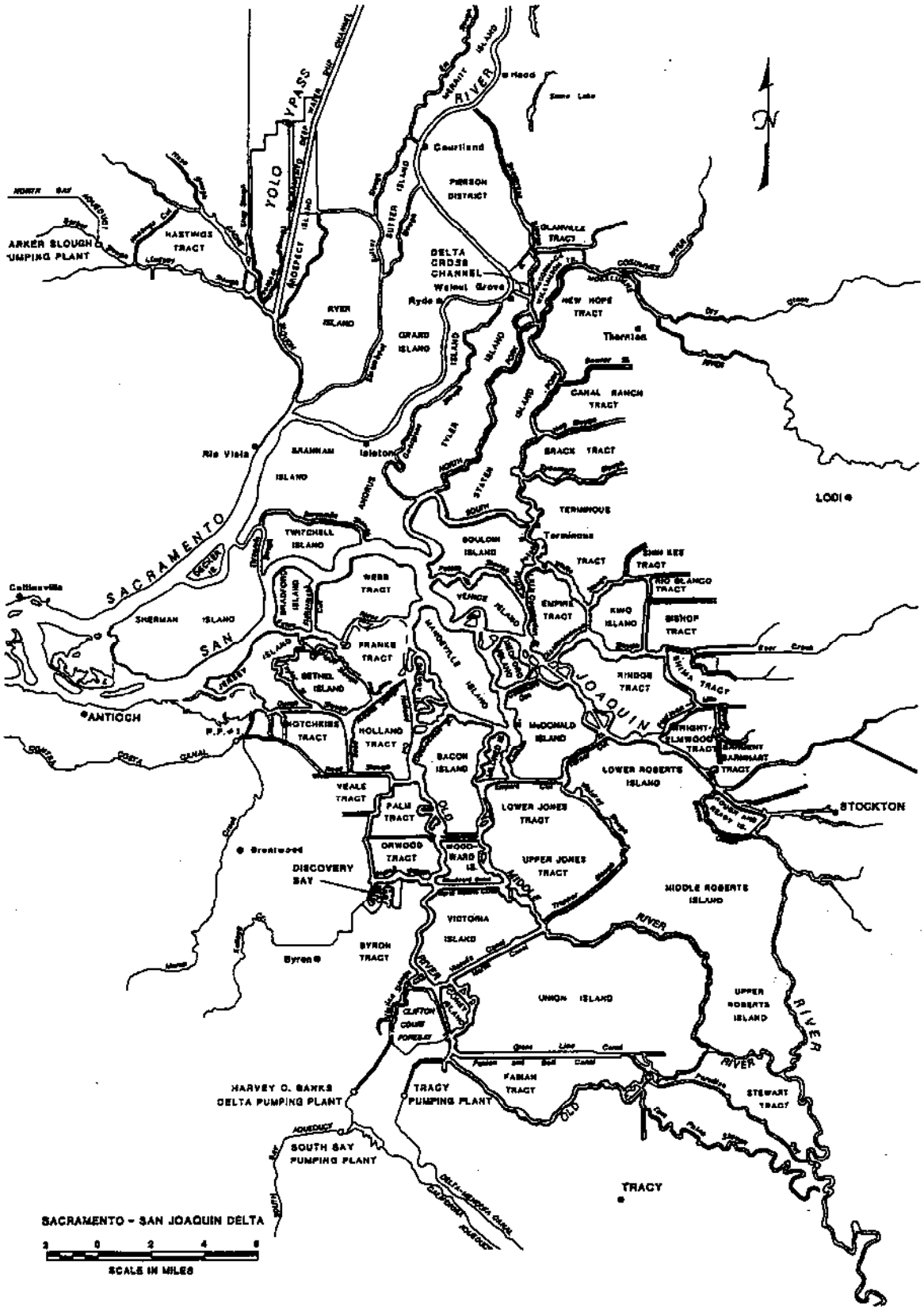
Sacramento - San Joaquin Delta, California

Lands, Easements, Right of Ways, Relocations & Disposals (LERRDS)

Reclamation District No.	Name of Island/Tract	Negotiation (cost est.)	Land (cost est.)	Toe Drain (cost est.)	Siphons (cost est.)	Power Poles (cost est.)	Land (seepage) (cost est.)	Total LERRDS (cost est.)
2	[1] Union Island, West	$375,000	$273,000	$170,000	$885,000	$110,000	$0	$1,813,000
1607	Van Sickle Island	$90,000	$64,000	$40,000	$120,000	$100,000	$0	$414,000
2065	Veale Tract	$45,000	$86,000	$53,000	$150,000	$100,000	$0	$434,000
2023	[1] Venice Island	$90,000	$240,000	$131,000	$375,000	$100,000	$0	$936,000
2040	[1] Victoria Island	$120,000	$292,000	$159,000	$495,000	$100,000	$0	$1,166,000
2094	[1] Walthall	$255,000	$56,000	$35,000	$99,000	$100,000	$35,000	$545,000
2026	Webb Tract	$270,000	$269,000	$136,000	$330,000	$100,000	$0	$1,105,000
2122	[1] Winter Island	$15,000	$81,000	$51,000	$150,000	$100,000	$0	$397,000
2072	Woodward Island	$90,000	$163,000	$94,000	$330,000	$100,000	$0	$777,000
2119	Wright-Elmwood Tract	$165,000	$120,000	$75,000	$330,000	$100,000	$0	$790,000
							LERRDS GRAND TOTAL:	**$92,028,000**

[1] Extrapolated: When no specific data was available, the data was derived from adjoining islands/tracts with similar conditions.

CALFED Levee Rehabilitation Study

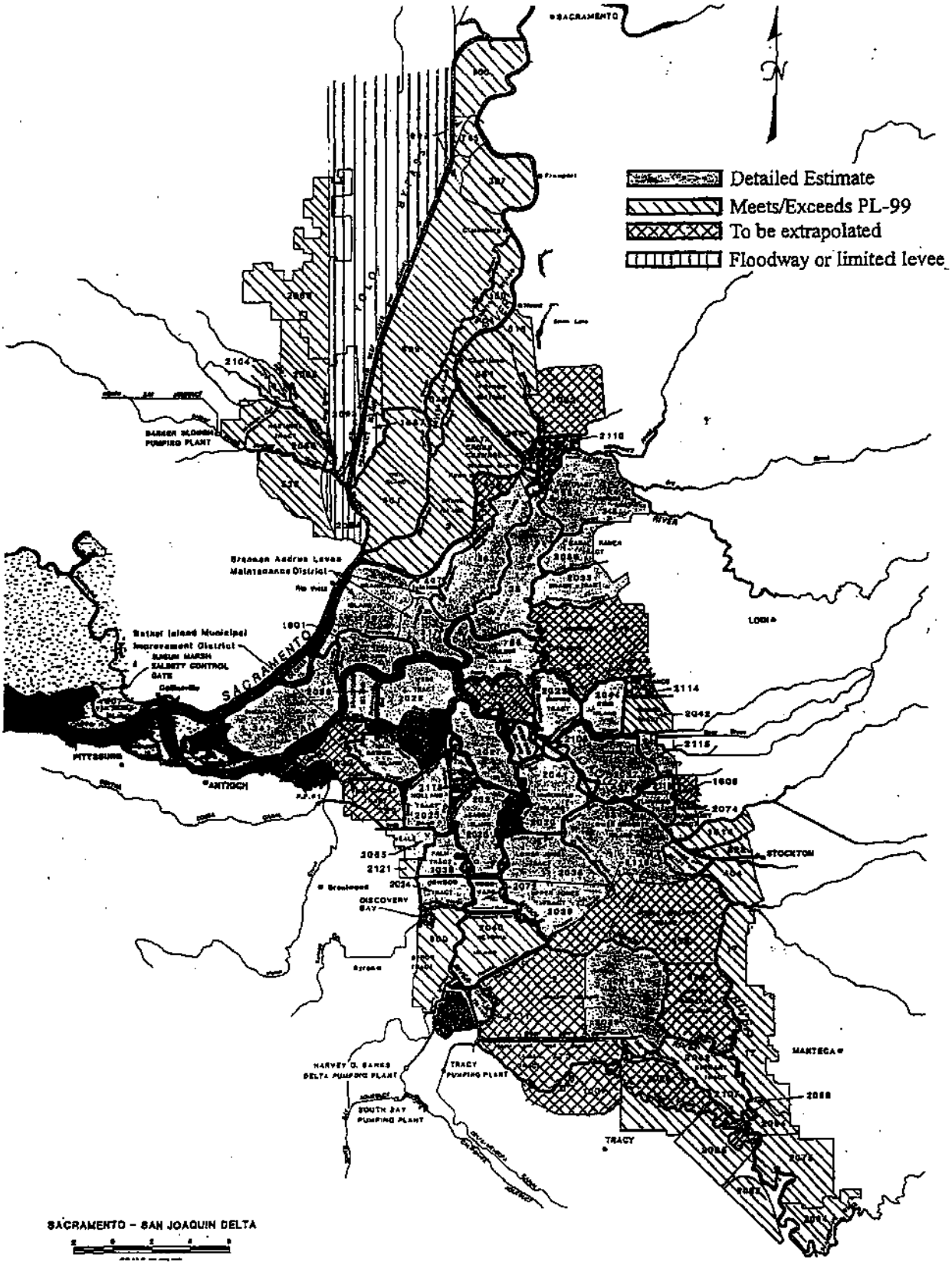


MURRAY BURNS AND KIENLEN - Consulting Civil Engineers
1616 29th Street Ste 300, Sacramento CA 95816 - (916) 456-4400

Local Flood Control Nonproject Levees

Figure 1

CALFED Levee Rehabilitation Study



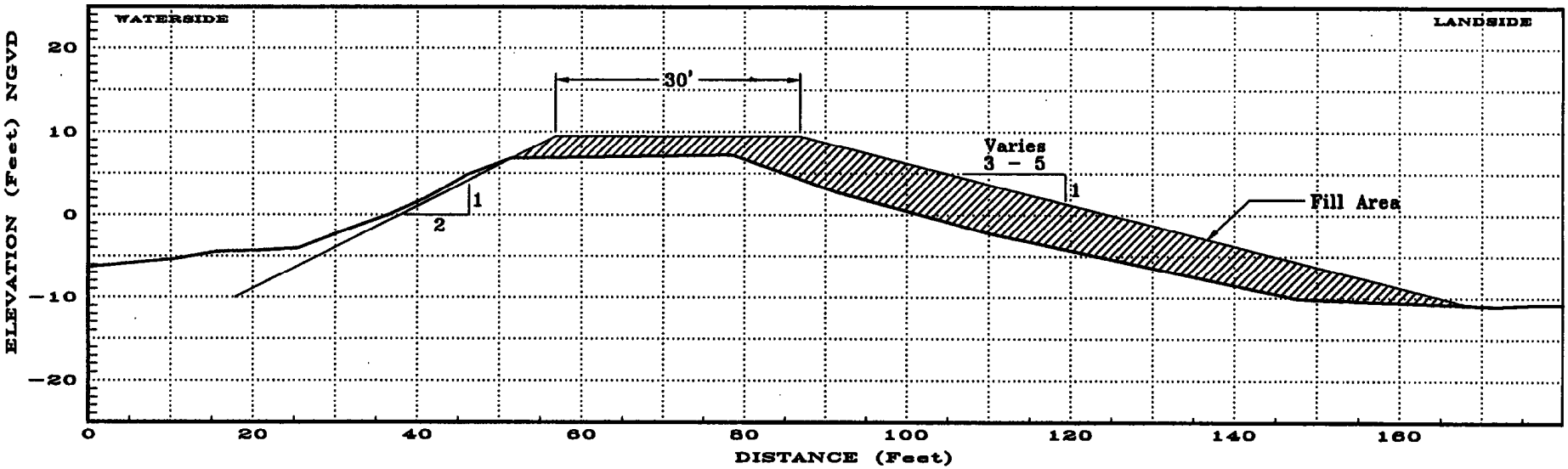
MURRAY BURNS AND KIENLEN - Consulting Civil Engineers
1616 29th Street Ste 300, Sacramento CA 95816 - (916) 456-4400

Reclamation and Levee Maintenance Districts

Figure 2

TYPICAL LEVEE CROSS SECTION

Stations supporting a County Road



Stations not supporting a County Road

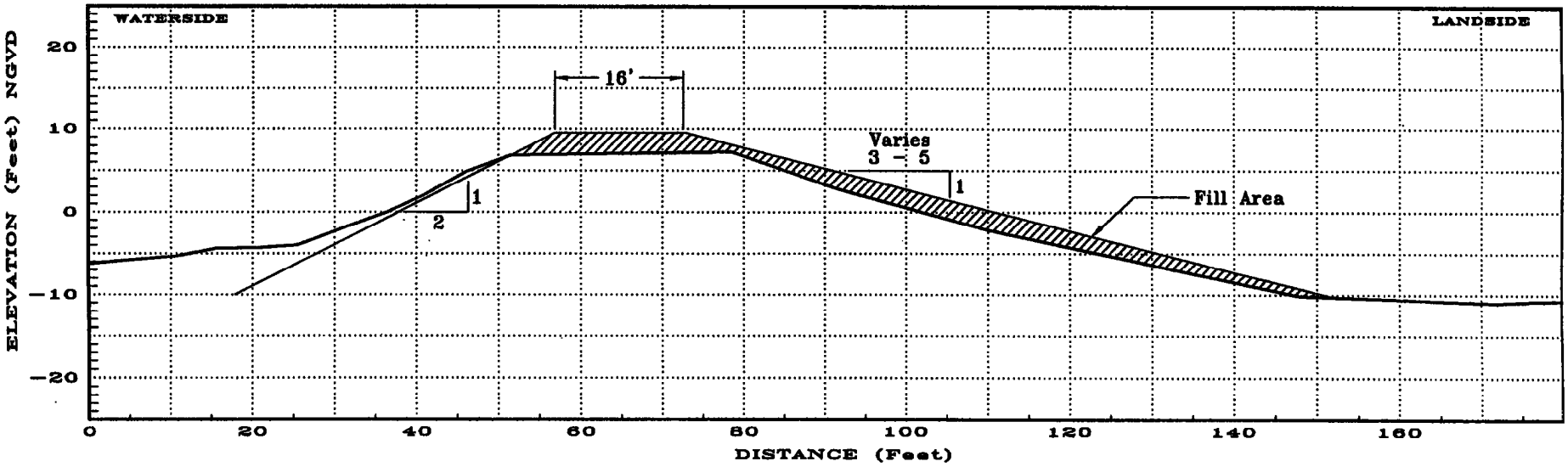


Figure 3

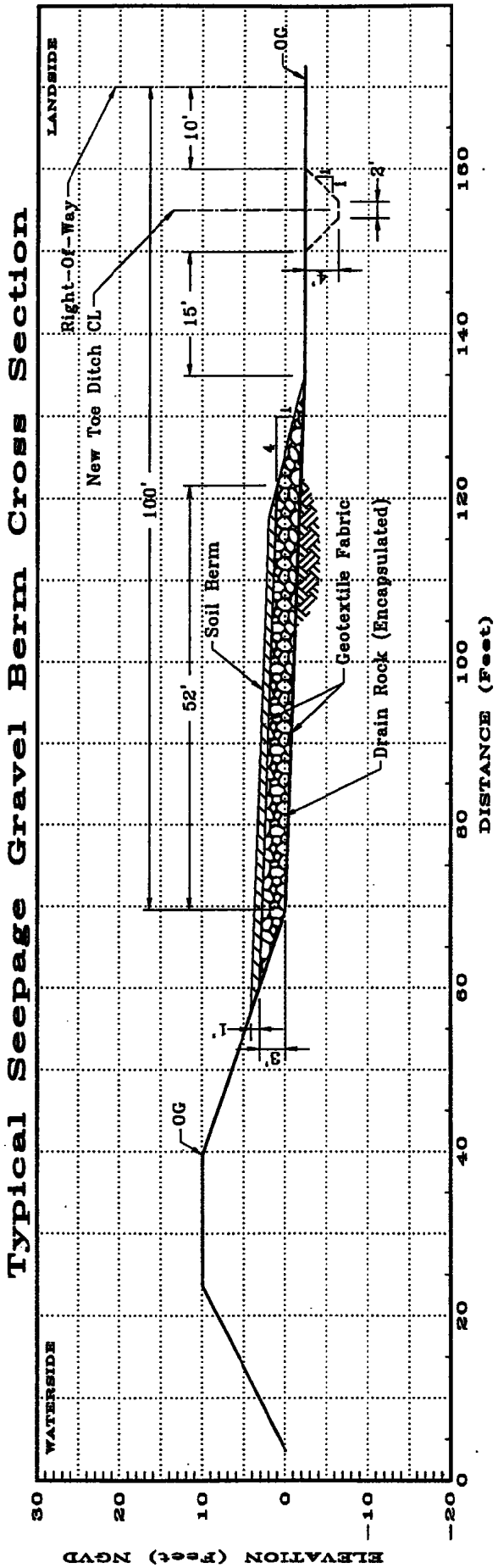

Typical Seepage Gravel Berm Cross Section
WATERSIDE
LANDSIDE
OG
OG
Right-Of-Way
New Toe Ditch CL
100'
52'
15'
10'
Soil Berm
Geotextile Fabric
Drain Rock (Encapsulated)
1'
3'
4
1
2'
DISTANCE (Feet)
ELEVATION (Feet) NGVD
0
20
40
60
80
100
120
140
160
30
20
10
0
-10
-20

Figure 4

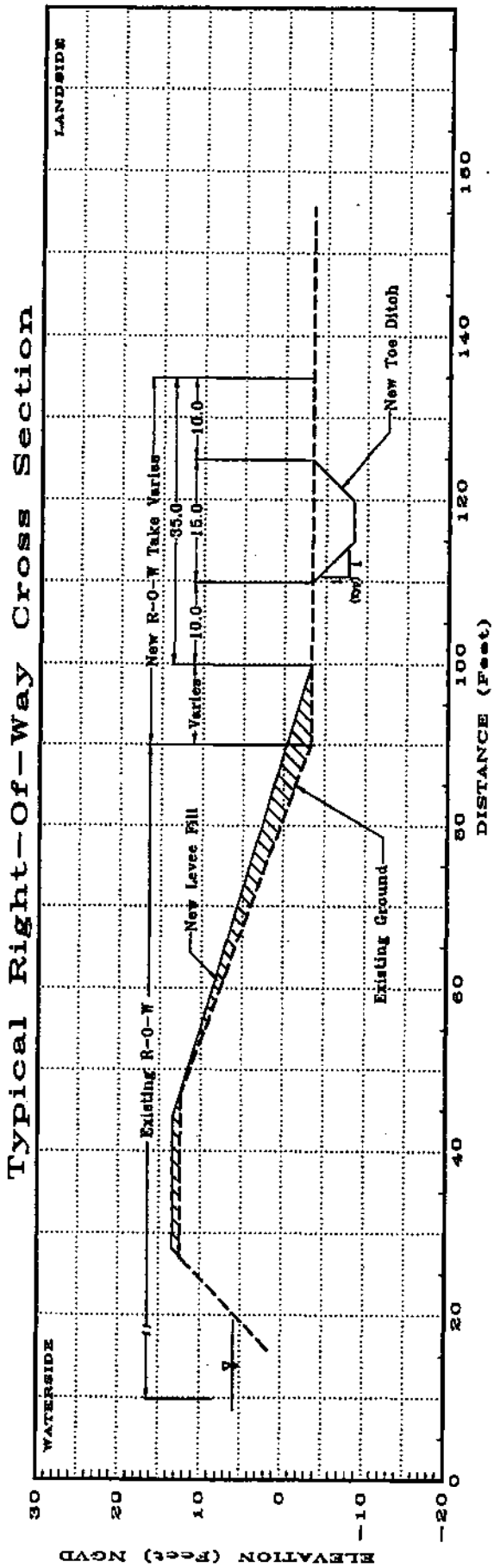
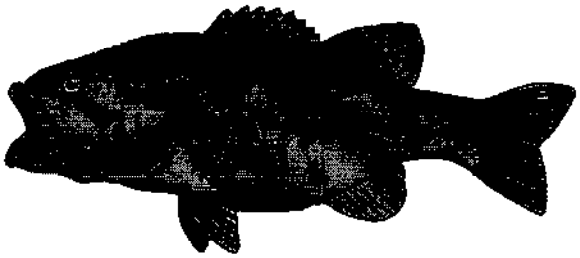

Typical Right-Of-Way Cross Section
WATERSIDE
LANDSIDE
Existing R-O-W
New Levee Fill
Existing Ground
New R-O-W Take Varies
Varies
35.0
15.0
10.0
10.0
New Toe Ditch
DISTANCE (Feet)
ELEVATION (Feet) NGVD
0
20
40
60
80
100
120
140
160
30
20
10
0
-10
-20

Figure 5

APPENDIX C

CALIFORNIA WATER CODE EXCERPTS



DIVISION 1. GENERAL STATE POWERS OVER WATER

Chapter 2. State Administration Genrally
Article 1. Department of Water Resources, Section 128

Article 1. Department of Water Resources, Section 128

128. (a) In times of extraordinary stress and of disaster, resulting from storms and floods, or where damage to watershed lands by forest fires has created an imminent threat of floods and damage by water, mud, or debris upon the occurrence of storms, the department may perform any work required or take any remedial measures necessary to avert, alleviate, repair, or restore damage or destruction to property having a general public and state interest and to protect the health, safety, convenience, and welfare of the general public of the state. In carrying out that work, the department may perform the work itself or through or in cooperation with any other state department or agency, the federal government, or any political subdivision, city, or district.

(b) This section is intended to supplement the emergency services of the state, and nothing in this section overrides or supersedes the authority of the Director of the Office of Emergency Services to coordinate and supervise state action, upon a declaration of a state of emergency, under the California Emergency Services Act (Chapter 7 (commencing with Section 8550) of Division 1 of Title 2 of the Government Code) or the Natural Disaster Assistance Act (Chapter 7.5 (commencing with Section 8680) of that division).

DIVISION 6. CONSERVATION, DEVELOPMENT, AND UTILIZATION OF STATE WATER RESOURCES

PART 4.5 SACRAMENTO-SAN JOAQUIN DELTA

Chapter 1. General Policy - Section 12200
Chapter 2. The Delta - Section 12220
Chapter 3. Sacramento-San Joaquin Delta Levees - Section 12225

Chapter 1. General Policy, Sections 12200-12205

12200. The Legislature hereby finds that the water problems of the Sacramento-San Joaquin Delta are unique within the State; the Sacramento and San Joaquin Rivers join at the Sacramento-San Joaquin Delta to discharge their fresh water flows into Suisun, San Pablo and San Francisco Bays and thence into the Pacific Ocean; the merging of fresh water with saline bay waters and drainage waters and the withdrawal of fresh water for beneficial uses creates an acute problem of salinity intrusion into the vast network of channels and sloughs of the Delta; the State Water Resources

Development System has as one of its objectives the transfer of waters from water-surplus areas in the Sacramento Valley and the north coastal area to water-deficient areas to the south and west of the Sacramento-San Joaquin Delta via the Delta; water surplus to the needs of the areas in which it originates is gathered in the Delta and thereby provides a common source of fresh water supply for water-deficient areas. It is, therefore, hereby declared that a general law cannot be made applicable to said Delta and that the enactment of this law is necessary for the protection, conservation, development, control and use of the waters in the Delta for the public good.

12201. The Legislature finds that the maintenance of an adequate water supply in the Delta sufficient to maintain and expand agriculture, industry, urban, and recreational development in the Delta area as set forth in Section 12220, Chapter 2, of this part, and to provide a common source of fresh water for export to areas of water deficiency is necessary to the peace, health, safety and welfare of the people of the State, except that delivery of such water shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

12202. Among the functions to be provided by the State Water Resources Development System, in coordination with the activities of the United States in providing salinity control for the Delta through operation of the Federal Central Valley Project, shall be the provision of salinity control and an adequate water supply for the users of water in the Sacramento-San Joaquin Delta. If it is determined to be in the public interest to provide a substitute water supply to the users in said Delta in lieu of that which would be provided as a result of salinity control no added financial burden shall be placed upon said Delta water users solely by virtue of such substitution. Delivery of said substitute water supply shall be subject to the provisions of Section 10505 and Sections 11460 to 11463, inclusive, of this code.

12203. It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the channels of the Sacramento-San Joaquin Delta to which the users within said Delta are entitled.

12204. In determining the availability of water for export from the Sacramento-San Joaquin Delta no water shall be exported which is necessary to meet the requirements of Sections 12202 and 12203 of this chapter.

12205. It is the policy of the State that the operation and management of releases from storage into the Sacramento-San Joaquin Delta of water for use outside the area in which such water originates shall be integrated to the maximum extent possible in order to permit the fulfillment of the objectives of this part.

Chapter 2. The Delta, Section 12220

12220. The Sacramento-San Joaquin Delta shall include all the lands within the area bounded as follows, and as shown on the attached map prepared by the Department of Water Resources titled "Sacramento-San Joaquin Delta," dated May 26, 1959:

Beginning at the Sacramento River at the I Street bridge proceeding westerly along the Southern Pacific Railroad to its intersection with the west levee of the Yolo By-Pass; southerly along the west levee to an intersection with Putah Creek, then westerly along the left bank of Putah Creek to an intersection with the north-south section line dividing sections 29 and 28, T8N, R6E; south along this section line to the northeast corner of section 5, T7N, R3E; west to the northwest corner of said section; south along west boundary of said section to intersection of Reclamation District No. 2068 boundary at northeast corner of SE 1/4 of section 7, T7N, R3E; southwesterly along Reclamation District No. 2068 boundary to southeast corner of SW 1/4 of section 8, T6N, R2E; west to intersection of Maine Prairie Water Association boundary at southeast corner of SW 1/4 of section 7, T6N, R2E; along the Maine Prairie Water Association boundary around the northern and western sides to an intersection with the southeast corner of section 6, T5N, R2E; west to the southwest corner of the SE 1/4 of said section; south to the southwest corner of the NE 1/4 of section 7, T5N, R2E; east to the southeast corner of the NE 1/4 of said section; south to the southeast corner of said section; west to the northeast corner of section 13, T5N, R1E; south to the southeast corner of said section; west to the northwest corner of the NE 1/4 of section 23, T5N, R1E; south to the southwest corner of the NE 1/4 of said section; west to the northwest corner of the SW 1/4 of said section; south to the southwest corner of the NW 1/4 of section 26, T5N, R1E; east to the northeast corner of the SE 1/4 of section 25, T5N, R1E; south to the southeast corner of said section; east to the northeast corner of section 31, T5N, R2E; south to the southeast corner of the NE 1/4 of said section; east to the northeast corner of the SE 1/4 of section 32, T5N, R2E; south to the northwest corner of section 4, T4N, R2E; east to the northeast corner of said section; south to the southwest corner of the NW 1/4 of section 3, T4N, R2E; east to the northeast corner of the SE1/4 of said section; south to the southwest corner of the NW 1/4 of the NW 1/4 of section 11, T4N, R2E; east to the southeast corner of the NE 1/4 of the NE 1/4 of said section; south along the east line of section 11, T4N, R2E to a road intersection approximately 1000 feet south of the southeast corner of said section; southeasterly along an unnamed road to its intersection with the right bank of the Sacramento River about 0.7 mile upstream from the Rio Vista bridge; southwesterly along the right bank of the Sacramento River to the northern boundary of section 28, T3N, R2E; westerly along the northern boundary of sections 28, 29, and 30, T3N, R2E and sections 25 and extended 26, T3N, R1E to the northwest corner of extended section 26, T3N, R1E; northerly along the west boundary of section 23, T3N, R1E to the northwest corner of said section; westerly along the northern boundary of sections 22 and 21, T3N, R1E to the Sacramento Northern Railroad; southerly along the Sacramento

Northern Railroad; southerly along the Sacramento Northern Railroad to the ferry slip on Chipps Island; across the Sacramento River to the Mallard Slough pumping plant intake channel of the California Water Service Company; southward along the west bank of the intake channel and along an unnamed creek flowing from Lawler Ravine to the southern boundary of the Contra Costa County Water District; easterly along the southern boundary of the Contra Costa County Water District to the East Contra Costa Irrigation District boundary; southeasterly along the southwestern boundaries of the East Contra Costa Irrigation District, Byron-Bethany Irrigation District, West Side Irrigation District and Banta-Carbona Irrigation District to the northeast corner of the NW 1/4 of section 9, T3S, R6E; east along Linne Road to Kasson Road; southeasterly along Kasson Road to Durham Ferry Road; easterly along Durham Ferry Road to its intersection with the right bank of the San Joaquin River at Reclamation District No. 2064; southeasterly along Reclamation District No. 2064 boundary, around its eastern side to Reclamation District No. 2075 and along the eastern and northern sides of Reclamation District No. 2075 to its intersection with the Durham Ferry Road; north along the Durham Ferry Road to its intersection with Reclamation District No. 17; along the eastern side of Reclamation District No. 17 to French Camp Slough; northerly along French Camp Turnpike to Center Street; north along Center Street to Weber Avenue; east along Weber Avenue to El Dorado Street; north along El Dorado Street to Harding Way; west along Harding Way to Pacific Avenue; north along Pacific Avenue to the Calaveras River; easterly along the left bank of the Calaveras River to a point approximately 1,600 feet west of the intersection of the Western Pacific Railroad and the left bank of said river; across the Calaveras River and then north 18* 26' 36 west a distance of approximately 2,870 feet; south 72* 50' west a distance of approximately 4,500 feet to Pacific Avenue (Thornton Road); north along Pacific Avenue continuing onto Thornton Road to its intersection with the boundary line dividing Woodbridge Irrigation District and Reclamation District No. 348; east along this boundary line to its intersection with the Mokelumne River; continuing easterly along the right bank of the Mokelumne River to an intersection with the range line dividing R5E and R6E; north along this range line to the Sacramento-San Joaquin County line; west along the county line to an intersection with Reclamation District No. 1609; northerly along the eastern boundary of Reclamation District No. 1609 to the Cosumnes River, upstream along the right bank of the Cosumnes River to an intersection with the eastern boundary of extended section 23, T5N, R5E; north along the eastern boundary of said extended section to the southeast corner of the NE 1/4 of the NE 1/4 of said extended section; west to the southeast corner of the NE 1/4 of the NW 1/4 of extended section 14, T5N, R5E; west to an intersection with Desmond Road; north along Desmond Road to Wilder-Ferguson Road; west along Wilder-Ferguson Road to the Western Pacific Railroad; north along the Western Pacific Railroad to the boundary of the Elk Grove Irrigation District on the southerly boundary of the N ½ of section 4, T5N, R5E; northerly along the western boundary of the Elk Grove Irrigation District to Florin Road; west on Florin Road to the eastern boundary of Reclamation District No. 673; northerly around Reclamation District No. 673 to an intersection with the Sacramento River and then north along the left bank of the Sacramento River to I Street bridge. Section, range, and township locations are referenced to the Mount Diablo Base Line and Meridian. Road names and locations are as shown on the following United States Geological Survey Quadrangles, 7.5 minute series: Rio Vista, 1953; Clayton, 1953; Vernalis, 1952; Ripon, 1952; Bruceville, 1953; Florin, 1953; and Stockton West, 1952.

Chapter 3. Sacramento-San Joaquin Delta Levees, Sections 12225-12228

12225. The plan for improvement of the Sacramento-San Joaquin Delta levees, as set forth in Bulletin No. 192 of the Department of Water Resources, dated May 1975, is approved as a conceptual plan to guide the formulation of projects to preserve the integrity of the delta levee system.

12226. The department may prepare detailed plans and specifications for the improvement of the levees or levee segments specified in Section 12225.

12226.1. The department shall report on its recommendations to the Legislature concerning the improvement of the levees specified in Section 12225, including, but not limited to, recommendations concerning construction, cost sharing, land use, zoning, flood control, recreation, fish and wildlife habitat, and aesthetic values. The department shall submit interim reports to the Legislature concerning the status of the delta levees program on or before January 15 of each year beginning in 1978, with the final report on its recommendations to be made on or before January 15, 1980.

12226.2. The department may proceed immediately with the improvement of a pilot levee project which the department determines, after a public hearing, is in critical need of improvement and which is highly susceptible to failure in the absence of such immediate improvement. Prior to commencing such improvement, the department shall enter into an agreement with a local agency whereby the local agency will bear at least 20 percent of the cost of the improvement.

12227. This chapter shall be known and may be cited as the "Nejedly-Mobley Delta Levees Act".

12228. (a) The department shall submit to the Legislature, on or before January 1, 1994, a report on land use patterns within the boundaries of the Sacramento-San Joaquin Delta and the lands immediately adjacent to that delta.

(b) Subdivision (a) shall be implemented only to the extent money is appropriated in the annual Budget Act to carry out this section.

PART 4.6 SAN JOAQUIN RIVER

Sections 12230-12233

12230. The Legislature hereby finds and declares that a serious problem of water quality exists in the San Joaquin River between the junction of the San Joaquin River and the Merced River and the junction of the San Joaquin River with Middle River; that by virtue of the nature and causes of the problem and its effect upon water supplies in the Sacramento-San Joaquin Delta, it is a matter of statewide interest and is the responsibility of the State to determine an equitable and feasible solution to this problem.

12231. It is hereby declared to be the policy of the State that no person, corporation or public or private agency or the State or the United States should divert water from the San Joaquin River and its tributaries to which the users along the portion of the San Joaquin River described in Section 12230 are entitled.

12232. The State Water Resources Control Board, the State Department of Water Resources, the California Water Commission, and any other agency of the state having jurisdiction, shall do nothing, in connection with their responsibilities, to cause further significant degradation of the quality of water in that portion of the San Joaquin River between the points specified in Section 12230.

12233. Nothing in this part shall be construed as affecting the quality of water diverted into the Sacramento-San Joaquin Delta from the Sacramento River, nor as affecting any vested right to the use of water, regardless of origin, or any water project for which an application to appropriate water was filed with the State Water Resources Control Board prior to June 17, 1961.

PART 4.8 DELTA FLOOD PROTECTION

Chapter 1. Delta Flood Protection Fund - Section 12300
Chapter 1.5. Environmental Mitigation and Protection Requirements - Section 12306
Chapter 2. Special Flood Control Projects - Section 12310

Chapter 1. Delta Flood Protection Fund, Sections 12300-12303

12300. (a) The Delta Flood Protection Fund is hereby created in the State Treasury. There shall be deposited in the fund all moneys appropriated to the fund and all income derived from the investment of moneys that are in the fund.

(b) It is the intent of the Legislature to appropriate, in accordance with Section 12938, twelve million dollars ($12,000,000) each year through fiscal year 1998-99 to the Delta Flood Protection Fund from moneys deposited in the California Water Fund pursuant to subdivision (b) of Section 6217 of the Public Resources Code. It is further the intent of the Legislature to appropriate annually moneys in the Delta Flood Protection Fund to the department for expenditure and allocation, without regard to fiscal years, in the following amounts and for the following purposes:

(1) Six million dollars ($6,000,000) annually for local assistance under the delta levee maintenance subventions program pursuant to Part 9 (commencing with Section 12980), and for the administration thereof.

(2) Six million dollars ($6,000,000) annually for special delta flood protection projects under Chapter 2 (commencing with Section 12310) and subsidence studies and monitoring, and the administration thereof. These funds shall only be allocated for projects on Bethel, Bradford, Holland, Hotchkiss, Jersey, Sherman, Twitchell, and Webb Islands, and at other locations in the delta and for the Towns of Thornton and Walnut Grove and for approximately 12 miles of levees on islands bordering the Northern Suisun Bay from Van Sickle Island westerly to Montezuma Slough.

(c) Any moneys unexpended at the end of a fiscal year shall revert to the Delta Flood Protection Fund and shall be available for appropriation by the Legislature for the purposes specified in subdivision (b).

(d) It is the intent of the Legislature that, to the extent consistent with Sections 12314, 12987, and 78543, projects funded under subdivision (b) shall be consistent with the delta ecosystem restoration strategy of the CALFED Bay-Delta Program.

12301. The Delta Flood Protection Fund is hereby abolished on July 1, 2006, and all unencumbered moneys in the fund are transferred to the General Fund.

12303. (a) It is the intent of the Legislature that, subject to subdivision (b) of Section 12929.12, if twelve million dollars ($12,000,000) or any lesser amount is transferred pursuant to paragraph (3) of subdivision (b) of Section 12937 to the California Water Fund from the California Water Resources Development Bond Fund in each of the fiscal years 1990-91 to 1997-98, inclusive, and if six million dollars ($6,000,000) or any lesser amount is so transferred in the 1998-99 fiscal year, that amount shall be appropriated to the Delta Flood Protection Fund for the purposes specified in subdivision (b) of Section 12300, in lieu of the funds deposited in the California Water Fund pursuant to subdivision (b) of Section 6217 of the Public Resources Code. However, that the director, in consultation with the Department of Finance, may accelerate payments to the California

Water Fund for reappropriation to the Delta Flood Protection Fund if the director deems it appropriate to do so.

(b) The obligation of the State Water Resources Development System to reimburse the California Water Fund, pursuant to paragraph (3) of subdivision (b) of Section 12937, shall decrease by amounts equal to the amounts which are transferred from the California Water Resources Development Bond Fund to the California Water Fund and appropriated to the Delta Flood Protection Fund pursuant to subdivision (a).

(c) For any fiscal year, the Director of Finance, in consultation with the Director of Water Resources, may recommend in the Budget Act a source of funding for the Delta Flood Protection Fund which is different from that set forth in subdivision (a). If the Legislature approves the alternative source of funding, the portion of the State Water Resources Development System obligation specified in subdivision (b) which remains outstanding because of the selection of the alternative funding source shall be discharged pursuant to subdivision (b) of Section 11913.

(d) It is the intent of the Legislature, upon the creation of the Delta Levee Rehabilitation Subaccount pursuant to Section 78540, as proposed to be added by S.B. 900 of the 1995-96 Regular Session, that subdivisions (a), (b), and (c) shall not apply to the Delta Levee Rehabilitation Subaccount and that the funds of the subaccount shall be available to fund equally both of the following:

(1) The delta levee maintenance subventions program pursuant to Part 9 (commencing with Section 12980), associated mitigation and habitat improvement programs, and the administration thereof.

(2) The special delta flood protection projects pursuant to Chapter 2 (commencing with Section 12310), associated mitigation and habitat improvement programs, and the administration thereof.

Chapter 1.5. Environmental Mitigation and Protection Requirements, Sections 12306-12308

12306. This chapter applies to special flood control projects subject to Chapter 2 (commencing with Section 12310) and to the payment of delta levee subventions under Part 9 (commencing with Section 12980).

12306.5. The Resources Agency shall supervise the implementation of the programs subject to this chapter.

12307. (a) The Resources Agency, the department, the Reclamation Board, and the Department of Fish and Game shall enter into a memorandum of understanding to coordinate the implementation of the programs subject to this chapter.

(b) The memorandum of understanding shall provide that the Department of Fish and Game shall enforce any mitigation requirements involving programs subject to this chapter.

12308. The Resources Agency shall report to the Legislature not later than January 15 of each year all of the following information for each plan approved pursuant to this part:

(a) The name of each local agency submitting a plan, the island or tract involved, and a map of the island or tract indicating the work and the mitigation sites.

(b) The amount of money allocated to the plan, and the amount of money spent on project construction and on project mitigation.

(c) The number of acres of riparian, wildlife, and fisheries habitat and the number of lineal feet of shaded aquatic areas disturbed by projects funded under this part.

(d) The number and quality of acres of replacement habitat provided as mitigation.

(e) An annual assessment as to whether the cumulative impact of projects funded pursuant to this part has resulted in no net long-term loss of riparian, wildlife, or fisheries habitat. If the Resources Agency determines that a net long-term loss has occurred, it shall include in its assessment the necessary steps to correct those deficiencies.

Chapter 2. Special Flood Control Projects, Sections 12310-12318

12310. As used in this chapter, the following terms have the following meanings:

(a) "Local public agency" means a reclamation district or levee district or other public agency responsible for the maintenance of a nonproject levee as defined in subdivision (d) of Section 12980 or a project levee as defined in subdivision (e) of Section 12980.

(b) "Project" means the flood control improvement and any mitigation and habitat improvement constructed, or interests in land acquired, for those purposes pursuant to this part.

(c) "Department" means the Department of Water Resources.

(d) "Delta" means the Sacramento-San Joaquin Delta as described in Section 12220.

(e) "Net long-term habitat improvement" means enhancement of riparian, fisheries, and wildlife habitat.

(f) "CALFED Bay Delta Program" or "CALFED program" means the program established in May 1995 as a joint effort among state and federal agencies with management and regulatory responsibilities in the San Francisco Bay and Sacramento-San Joaquin River Delta to develop long-term solutions to resource management problems involving the bay-delta.

12311. (a) The department shall develop and implement a program of flood control projects on Bethel, Bradford, Holland, Hotchkiss, Jersey, Sherman, Twitchell, and Webb Islands, and at other locations in the delta and for the Towns of Thornton and Walnut Grove, and for approximately 12 miles of levees on islands bordering Northern Suisun Bay from Van Sickle Island westerly to

Montezuma Slough. This program shall have, as its primary purpose, the protection of discrete and identifiable public benefits, including the protection of public highways and roads, utility lines and conduits, and other public facilities, and the protection of urbanized areas, water quality, recreation, navigation, and fish and wildlife habitats, and other public benefits. The program shall also include net long-term habitat improvement.

(b) Notwithstanding subdivision (a), the department shall develop and recommend a plan of action, including alternatives, for flood control for the Towns of Thornton and Walnut Grove and shall submit the plan to the Legislature by January 1, 1989. The department shall not allocate any funds for implementation of the plan of action for flood control for the Towns of Thornton and Walnut Grove until a plan is approved by the Legislature.

12312. The department may expend any moneys available to it pursuant to paragraph (2) of subdivision (b) of Section 12300 or any moneys available from other sources of funding appropriated by the Legislature for the purposes of this part. In addition, the department shall seek a sharing of costs with the beneficiaries or owners or operators of the public facilities benefitted by the flood protection projects. The department shall also seek cost sharing with, or financial assistance from, federal agencies which have programs applicable to, or which have an interest in, the flood protection projects.

12313. (a) The department shall develop a list of areas where flood control work is needed to protect public facilities or provide public benefits. In developing the list, the department shall consult with all appropriate federal, state, and local agencies. The list shall establish a priority for the areas based upon both of the following:

(1) The importance or degree of public benefit needing protection.

(2) The need for flood protective work.

(b) The list shall be submitted to the California Water Commission for approval, and shall be updated by the department, with the approval of the California Water Commission, as the department may deem appropriate.

12314. (a) Guided by the approved priority list developed pursuant to Section 12313, the department shall develop project plans to accomplish the needed flood protection work in cooperation with the local public agency, the public beneficiary, and the Department of Fish and Game.

(b) The plans shall be subject to the approval of the appropriate local public agency or agencies and subject to any cost-sharing agreement the department may have entered into under Section 12312. 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 which have a negative impact on flood control facilities.

(c) Project plans shall include provision for the protection of fish and wildlife habitat determined to be necessary by the Department of Fish and Game and not injurious to the integrity of flood control works. The Department of Fish and Game shall consider the value of the riparian and fisheries habitat and the need to provide greater flood protection in preparing its requirements, and shall not approve any plan which calls for the use of channel islands or berms with significant riparian communities as borrow sites for levee repair materials, unless fully mitigated, or any plans that will result in a net long-term loss of riparian, fisheries, or wildlife habitat.

(d) After the memorandum of understanding required pursuant to Section 12307 is amended as required by Section 78543, the Department of Fish and Game shall also make a written determination as part of its review and approval of a plan or project pursuant to this section and Section 12987 that the proposed expenditures are consistent with a net long-term habitat improvement program and have a net benefit for aquatic species in the delta. The memorandum of understanding in effect prior to the amendments required by Section 78543 shall remain in effect with regard to levee projects and plans until the memorandum of understanding is amended.

12315. Projects shall be undertaken and completed in accordance with the approved project plans. Project works may be undertaken by the department or, at the department's option, by the local public agency pursuant to an agreement with the department.

12316. In addition to any obligations assumed under an agreement with the department and to the extent consistent with that agreement, the local public agency shall do all of the following:

(a) Provide construction access to lands or rights-of-way which it owns or maintains for flood control purposes or for purposes with which the project's required uses are compatible and necessary to complete the project.

(b) Maintain the completed project pursuant to maintenance criteria developed and adopted in accordance with Section 12984.

(c) Apply for federal disaster assistance, whenever eligible,
under Public Law 93-288.

(d) Hold and save the department, any other agency or department of the state, and their 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.

(e) Acquire easements from the crown along levees for the control and reversal of subsidence in areas where the department determines that such an easement is desirable to maintain structural stability of the levee. The easement shall (1) restrict the use of the land to open-space uses, nontillable 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. The local public agency costs of acquisition of the easements shall be reimbursable by the department from moneys appropriated pursuant to

paragraph (2) of subdivision (b) of Section 12300 or any sources of funding appropriated by the Legislature for purposes of this part.

(f) Comply with all habitat mitigation and improvement requirements pursuant to this part.

(g) Use subsidence control alternatives, where appropriate, to reduce long-term maintenance and improvement costs.

12318. (a) The Resources Agency may establish a team of federal, state, and local agencies, and other persons or entities with a stake in finding a solution to the problems of the delta levees, to develop recommendations for the beneficial reuse of dredged material, consistent with actions identified by the CALFED Bay-Delta Program as core actions, which are those actions included in all bay-delta solutions. The recommendations shall address all of the following needs:

(1) Long-term availability of cost-effective, environmentally safe, and appropriate dredged material for delta levee maintenance and improvements.

(2) Beneficial reuse of dredged or suitable alternative materials.

(3) Coordination of dredging projects to augment on-island stockpiles.

(4) Development of a comprehensive monitoring program of the effects of the reuse of dredged material.

(5) A study of the applicability and appropriateness of constructing channel sediment traps and dredged material rehandling facilities adjacent to frequently dredged channel sections.

PART 9. DELTA LEVEE MAINTENANCE

Sections 12980-12995

12980. As used in this part:

(a) "Board" means the Reclamation Board.

(b) "Delta" means the Sacramento-San Joaquin Delta as described in Section 12220.

(c) "Local agency" means any city, county, district, or other political subdivision of the state which is authorized to maintain levees.

(d) "Net long-term habitat improvement" means enhancement of riparian, fisheries, and wildlife habitat.

(e) "Nonproject levee" means 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 the Department of Water Resources "Sacramento-San Joaquin Delta Atlas," dated 1993.

(f) "Project levee" means a federal flood control levee, as shown on page 40 of the Department of Water Resources "Sacramento-San Joaquin Delta Atlas," dated 1993, that is a project facility under the State Water Resources Law of 1945 (Chapter 1 (commencing with Section 12570) and Chapter 2 (commencing with Section 12639) of Part 6), if not less than a majority of the acreage

within the jurisdiction of the local agency that maintains the levee is within the primary zone of the delta, as defined in Section 29728 of the Public Resources Code.

12981. (a) The Legislature finds and declares that the delta is endowed with many invaluable and unique resources and that these resources are of major statewide significance.

(b) The Legislature further finds and declares that the delta's uniqueness is particularly characterized by its hundreds of miles of meandering waterways and the many islands adjacent thereto; that, in order to preserve the delta's invaluable resources, which include highly productive agriculture, recreational assets, fisheries, and wildlife environment, the physical characteristics of the delta should be preserved essentially in their present form; and that the key to preserving the delta's physical characteristics is the system of levees defining the waterways and producing the adjacent islands. However, the Legislature recognizes that it may not be economically justifiable to maintain all delta islands.

(c) The Legislature further finds and declares that funds necessary to maintain and improve the delta's levees to protect the delta's physical characteristics should be used to fund levee work that would promote agricultural and habitat uses in the delta consistent with the purpose of preserving the delta's invaluable resources.

12982. The Legislature further finds and declares that while most of the delta's levees are privately owned and maintained they are being subjected to varied multiple uses and serve to benefit many varied segments and interests of the public at large, and that as a result of the varied multiple uses of such levees, added maintenance costs are being borne by adjacent landowners.

12983. The Legislature further finds and declares that there is an urgent need for a higher degree of levee maintenance and rehabilitation generally throughout the delta and that the state has an interest in providing technical and financial assistance for delta levee maintenance and rehabilitation. The Legislature also finds and declares that, because of the instability of delta soils, the effect of winds, tides, and flood flows, and the unique problems of erosion, seepage, and subsidence, the same security against levee failure and flooding cannot be achieved by protective works in the delta as in areas less vulnerable to these problems. Although the rehabilitation and maintenance of delta levees is an important undertaking, a significant risk of levee failure will still persist. The purpose of the state's approval of plans and inspection of works, which duties are set forth in this part, is to ensure that subvention funds are properly expended and that delta levees are effectively rehabilitated and maintained, and the state does not thereby assume any responsibility for the safety of any delta levee against failure.

12984. The department shall develop and submit to the board, for adoption by the board, criteria for the maintenance and improvement of nonproject levees. The criteria shall vary as required to meet specific conditions and shall be multipurpose in nature, and include environmental considerations, when feasible. The criteria shall embody and implement both of the following:

(a) The short-term mitigation plan set forth in the "Flood Hazard Mitigation Plan for the Sacramento-San Joaquin Delta," prepared by the department for the Office of Emergency Services, dated September 15, 1983, or as amended.

(b) The "Vegetation Management Guidelines for Local Nonproject Delta Levees" dated April 1994, or any successor guidelines.

12985. Prior to adoption of any such criteria, the board shall hold public hearings and may revise the criteria as it determines necessary.

12986. (a) It is the intention of the Legislature to reimburse an eligible local agency pursuant to this part for costs incurred in any year for the maintenance or improvement of project or nonproject levees as follows:

(1) No costs incurred shall be reimbursed if the entire cost incurred per mile of project or nonproject levee is one thousand dollars ($1,000) or less.

(2) Not more than 75 percent of any costs incurred in excess of one thousand dollars ($1,000) per mile of project or nonproject levee shall be reimbursed.

(3) (A) As part of the project plans approved by the board, the department shall require the local agency or an independent financial consultant to provide information regarding the agency's ability to pay for the cost of levee maintenance or improvement. Based on that information, the department may require the local agency or an independent financial consultant to prepare a comprehensive study on the agency's ability to pay.

(B) The information or comprehensive study of the agency's ability to pay shall be the basis for determining the maximum allowable reimbursement eligible under this part. Nothing in this paragraph shall be interpreted to increase the maximum reimbursement allowed under paragraph (2).

(4) Reimbursements made to the local agency in excess of the maximum allowable reimbursement shall be returned to the department. (5) The department may recover, retroactively, excess reimbursements paid to the local agency from any time after January 1, 1997, based on an updated study of the agency's ability to pay.

(6) All final costs allocated or reimbursed under a plan shall be approved by the reclamation board for project and nonproject levee work.

(7) Costs incurred pursuant to this part that are eligible for reimbursement include construction costs and associated engineering services, financial or economic analyses, environmental costs, mitigation costs, and habitat improvement costs.

(b) This section shall become inoperative on July 1, 2006, and, as of January 1, 2007, is repealed, unless a later enacted statute, that becomes operative on or before January 1, 2007, deletes or extends the dates on which it becomes inoperative and is repealed.

12986. (a) It is the intention of the Legislature to reimburse from the General Fund an eligible local agency pursuant to this part for costs incurred in any year for the maintenance or improvement of project or nonproject levees as follows:

(1) No costs incurred shall be reimbursed if the entire cost incurred per mile of levee is one thousand dollars ($1,000) or less.

(2) Fifty percent of any costs incurred in excess of one thousand dollars ($1,000) per mile of levee shall be reimbursed.

(3) The maximum total reimbursement from the General Fund shall not exceed two million dollars ($2,000,000) annually.

(b) This section shall become operative on July 1, 2006.

12987. (a) Local agencies maintaining project or nonproject levees shall be eligible for reimbursement pursuant to this part upon submission to and approval by the board of plans for the maintenance and improvement of the project or nonproject levees, including plans for the annual routine maintenance of the levees, in accordance with the criteria adopted by the board.

(b) The nonproject plans shall also be compatible with the plan for improvement of the delta levees as set forth in Bulletin No. 192-82 of the department, dated December 1982, and as approved in Section 12225. Both project and nonproject plans shall include provisions to acquire easements along levees that allow for the control and reversal of subsidence in areas where the department determines that such an easement is desirable to maintain structural stability of the levee. The easement shall (1) restrict the use of the land to open-space uses, nontillable 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. The local agency cost of acquisition of the easements shall be reimbursable by the department from moneys appropriated pursuant to paragraph (1) of subdivision (b) of Section 12300, or any other sources appropriated by the Legislature for purposes of this part.

(c) The plans shall also include provision for protection of the fish and wildlife habitat determined to be necessary by the Department of Fish and Game and not injurious to the integrity of the levee. The Department of Fish and Game shall consider the value of the riparian and fisheries habitat and the need to provide safe levees in preparing its requirements. The Department of Fish and Game shall not approve any plan which calls for the use of channel islands or berms with significant riparian communities as borrow sites for levee repair material, unless fully mitigated, or any plans which will result in a net long-term loss of riparian, fisheries, or wildlife habitat.

(d) After the memorandum of understanding required pursuant to Section 12307 is amended as required by Section 78543, the Department of Fish and Game shall also make a written determination as part of its review and approval of a plan or project pursuant to Section 12314 and this section that the proposed expenditures are consistent with a net long-term habitat improvement program and have a net benefit for aquatic species in the delta. The memorandum of understanding

in effect prior to the amendments required by Section 78543 shall remain in effect with regard to levee projects and plans until the memorandum of understanding is amended.

(e) The plans shall also take into account the most recently updated Delta Master Recreation Plan prepared by the Resources Agency.

(f) Upon approval of the plans by the board, the local agencies shall enter into an agreement with the board to perform the maintenance and improvement work, including the annual routine maintenance work, specified in the plans. If applications for state funding in any year exceed the state funds available, the board shall apportion the funds among those levees or levee segments that are identified by the department as most critical and beneficial, considering the needs of flood control, water quality, recreation, navigation, habitat improvements, and fish and wildlife.

12987.5. (a) In an agreement entered into under Section 12987, the board may provide for an advance to the applicant in an amount not to exceed 75 percent of the estimated state share. The agreement shall provide that no advance shall be made until the applicant has incurred costs averaging one thousand dollars ($1,000) per mile of levee.

(b) Advances made under subdivision (a) shall be subtracted from amounts to be reimbursed after the work has been performed. If the department finds that work has not been satisfactorily performed or where advances made actually exceed reimbursable costs, the local agency shall promptly remit to the state all amounts advanced in excess of reimbursable costs. If advances are sought, the board may require a bond to be posted to ensure the faithful performance of the work set forth in the agreement.

(c) This section shall become inoperative on July 1, 2006, and, as of January 1, 2007, is repealed, unless a later enacted statute, that becomes operative on or before January 1, 2007, deletes or extends the dates on which it becomes inoperative and is repealed.

12988. Upon the completion in any year of the maintenance or improvement work, including annual routine maintenance work, as specified in the plans approved by the board, the local agency shall notify the department, and the department shall inspect the completed work. The department, upon completion of such inspection, shall submit to the board a report as to its findings. Upon a finding that the work has been satisfactorily completed in accordance with the approved plans, the board shall certify for reimbursement 75 percent of any costs incurred per mile of levee if the entire cost incurred per mile of levee is greater than one thousand dollars ($1,000).

12989. (a) The department shall conduct at least one annual inspection of every levee for which maintenance or improvement costs have been reimbursed pursuant to this part. In addition, the department shall inspect nonproject levees of local agencies for the purpose of monitoring and ascertaining the degree of compliance with, or progress toward meeting, standards such as those set forth in Section 12984.

(b) The local agency shall cooperate with the department in the conduct of these inspections, including the provision of reasonable access over local agency lands and easements.

12990. Whenever the department finds that the annual routine maintenance work specified in the plans approved by the board is not being performed in accordance with the agreement entered into between the local agency and the board, the department may establish a maintenance area in accordance with the provisions of Chapter 4.5 (commencing with Section 12878) of Part 6 of this division, as nearly as the same may be applicable, except that the work to be performed shall be the routine annual maintenance work for the nonproject levee as specified in the plans approved by the board. Upon the formation of a maintenance area, the department shall thereafter annually maintain the nonproject levee in accordance with such plans and subject to the provisions of Chapter 4.5 (commencing with Section 12878) of Part 6 of this division, as nearly as the same may be applicable.

12991. The board is authorized to make, from time to time, such rules and regulations as may be necessary to carry out, and as are consistent with, this part.

12992. Before any plan is approved, agreement entered into, or moneys advanced or reimbursed under this part, the local agency shall first enter into an agreement with the board indemnifying and holding and saving the State of California, the board, the department, any other agency or department of the state, 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 under this part. Any funds appropriated for any of the purposes of this part may be used to satisfy any judgment against the state covered by this section, pending indemnification by the local agency.

12993. Applicants shall apply for federal disaster assistance, whenever eligible, under Public Law 93-288. If, and to the extent that, it is determined that the work performed does not qualify for federal disaster assistance, the applicant may apply for reimbursement under Section 12986, and the costs shall be deemed incurred by the applicant in the year in which the latter application is filed.

12994. (a) The Legislature finds and declares all of the following:

(1) The CALFED Bay-Delta Program has identified as a core action the need for emergency levee management planning for delta levees to improve system reliability.

(2) Even with active levee maintenance, the threat of delta levee failures from earthquake, flood, or poor levee foundation, will continue to exist.

(3) Because of this threat of failure, and the potential need to mobilize people and equipment in an emergency to protect delta levees and public benefits, the department needs authority that will enable it to act quickly.

(b) The department may do all of the following:

(1) In an emergency, as defined by Section 21060.3 of the Public Resources Code, that requires immediate levee work to protect public benefits in the delta, the department may use funds pursuant to this part without prior approval of a plan by the board or the Department of Fish and Game, in which case the requirements of Sections 12987 and 12314, and the memorandum of understanding pursuant to Section 12307, shall be carried out as soon as possible.

(A) The amount of funds that may be expended each year on emergency levee work under this section shall not be greater than two hundred thousand dollars ($200,000) and the amount that may be expended per emergency levee site shall not be greater than fifty thousand dollars ($50,000). The local agency shall fund 25 percent of the total costs of the emergency repair at a site or shall fund an appropriate share of the costs as approved by the board and based upon information of the local agency's ability to pay for the repairs.

(B) Department contracts executed for emergency levee work under this section shall be exempted from Department of General Services approval required under the Public Contract Code.

(C) As soon a feasible after the emergency repair, the department shall submit a report to the board describing the levee work, costs incurred, and plans for future work at the site, including any necessary mitigation.

(D) This section is intended to supplement emergency services provided by the state or the United States. Nothing in this section overrides or supersedes the authority of the Director of the Office of Emergency Services under the California Emergency Services Act (Chapter 7 (commencing with Section 8550) of Division 1 of Title 2 of the Government Code) or the Natural Disaster Assistance Act (Chapter 7.5 (commencing with Section 8680) of Division 1 of Title 2 of the Government Code).

(2) Prepare and submit to the board for adoption a delta emergency response plan for levee failures. The plan is exempt from Chapter 3.5 (commencing with Section 11340) of Part 1 of Division 3 of Title 2 of the Government Code. The plan may include recommendations of the multiagency response team established pursuant to paragraph (3) and may include, but not be limited to, the following:

(A) Standardized contracts for emergency levee work to be executed by the department, local agencies, or other appropriate entities.

(B) Criteria for eligible emergency levee work.

(C) Definition of an emergency levee site.

(D) Documentation requirements.

(E) Proposals for complying with the federal Endangered Species Act of 1973 (16 U.S.C. Sec. 1531 et seq.) and the California Endangered Species Act (Chapter 1.5 (commencing with Section 2050) of Division 3 of the Fish and Game Code) in an emergency.

(F) Stages of emergency response that may occur in various situations.

(3) Establish a multiagency emergency response team, consisting of representatives from the department, the board, the Department of Fish and Game, the California Conservation Corps, the

Office of Emergency Services, the Federal Emergency Management Agency, the United States Army Corps of Engineers, and the United States Fish and Wildlife Service to advise on methods to ensure that levee emergencies will be resolved as quickly and safely as possible.

12995. (a) The Legislature hereby finds and declares both of the following:

(1) There is an urgent need for rehabilitation and improvement of delta levees, and that the United States Army Corps of Engineers has a crucial and continuing role in that work.

(2) The department and the board have been cooperating with the United States Army Corps of Engineers in a feasibility study for rehabilitation and improvement of the levees in the delta. That feasibility study identified a federal interest in levee rehabilitation and improvements due to benefits to navigation, commerce, the environment, and flood damage reduction.

(b) The department and the board may cooperate with the United States Army Corps of Engineers to develop and implement delta levee rehabilitation, improvement, and realignment, and to enhance the environment.

DIVISION 24. SAFE, CLEAN, RELIABLE WATER SUPPLY ACT

Chapter 4. Delta Improvement Program, Sections 78525-78572
- Article 1. The Delta Improvement Account, Section 78525
- Article 2. Central Valley Project Improvement Program, Section 78530
- Article 3. Bay-Delta Agreement Program, Section 78535
- Article 4. Delta Levee Rehabilitation Program, Section 78540
- Article 5. South Delta Barriers Program, Section 78550
- Article 6. Delta Recreation Program, Section 78560
- Article 7. CALFED Bay-Delta Program, Section 78570

Article 1. The Delta Improvement Account, Sections 78525-78526

78525. Unless the context otherwise requires, as used in this chapter, "account" means the Delta Improvement Account created by Section 78526.

78526. The Delta Improvement Account is hereby created in the fund. The sum of one hundred ninety-three million dollars ($193,000,000) is hereby transferred from the fund to the account.

Article 2. Central Valley Project Improvement Program, Sections 78530-78531

78530. (a) There is hereby created in the account the Central Valley Project Improvement Subaccount.

(b) For the purposes of this article, "subaccount" means the Central Valley Project Improvement Subaccount created by subdivision (a).

78530.5. The sum of ninety-three million dollars ($93,000,000) is hereby transferred from the account to the subaccount for the purpose of implementing this article.

78531. (a) Notwithstanding Section 13340 of the Government Code, the money in the subaccount is hereby continuously appropriated, without regard to fiscal years, to the Controller, to be allocated to pay the state's share of the costs for fish and wildlife restoration measures required by Section 3406 of the Central Valley Project Improvement Act (P.L. 102-575), in accordance with subdivisions (b) and (c).

(b) Funds appropriated pursuant to subdivision (a) shall be allocated to the Department of Fish and Game or the department for expenditure pursuant to the terms of the cost-sharing agreement between the United States and the State of California as required by subsection (h) of Section 3406 of the Central Valley Project Improvement Act, or any agreements supplemental thereto, for the payment of costs allocated to the state for the protection and restoration of fish and wildlife resources and habitat pursuant to Section 3406 of that federal act.

(c) The money in the subaccount may be used for both of the following purposes:

(1) To pay for the state's cost-sharing allocations or for actions directly undertaken by the department or the Department of Fish and Game relating to fish and wildlife restoration actions required by Section 3406 of the Central Valley Project Improvement Act (P.L. 102-575). For purposes of this paragraph, and consistent with Attachment C of the "Principles for Agreement on Bay-Delta standards between the State of California and the Federal Government," dated December 15, 1994, preference for the screening of diversions shall be given to projects, and projects within programs, identified in the Central Valley Project Improvement Act (P.L. 102-575) for which deadlines have been established by state or federal agencies, or by a state or federal court. Any preference established under this paragraph shall be revised if the deadlines are extended or eliminated.

(2) To pay for administrative costs incurred in connection with the implementation of this section by the department and the Department of Fish and Game related to fish and wildlife restoration measures undertaken pursuant to Section 3406 of the Central Valley Project Improvement Act (P.L. 102-575), as follows:

(A) Not more than 3 percent of the total amount deposited in the subaccount for the use of the department may be used to pay the costs incurred in connection with the administration of this article by the department.

(B) Not more than 3 percent of the total amount deposited in the subaccount for the use of the Department of Fish and Game may be used to pay the costs incurred in connection with the administration of this article by the Department of Fish and Game.

Article 3. Bay-Delta Agreement Program, Sections 78535-78538

78535. (a) There is hereby created in the account the Bay-Delta Agreement Subaccount.

(b) For the purposes of this article, "subaccount" means the Bay-Delta Agreement Subaccount created by subdivision (a).

78535.5. The sum of sixty million dollars ($60,000,000) is hereby transferred from the account to the subaccount for the purpose of implementing this article.

78536. Notwithstanding Section 13340 of the Government Code, the money in the subaccount is hereby continuously appropriated, without regard to fiscal years, to the Resources Agency, to pay for the administration of this article and for non-flow-related projects called for in the Water Quality Control Plan for the Bay-Delta, adopted by the board in Resolution No. 95-24, and as it may be amended. Those projects are known as "Category III" activities called for in the "Principles for Agreement on Bay-Delta Standards Between the State of California and the Federal Government," dated December 15, 1994.

78536.5. The Secretary of the Resources Agency shall carry out this article in accordance with procedures established by CALFED for the purposes of undertaking Category III activities and other ecosystem restoration programs until the Legislature, by statute, authorizes another entity that is recommended by CALFED, to carry out this article.

78537. The state shall, to the greatest extent possible, secure federal and nonfederal matching funds to implement this article.

78538. Not more than 3 percent of the total amount deposited in the subaccount may be used to pay the costs incurred in connection with the administration of this article.

Article 4. Delta Levee Rehabilitation Program, Sections 78540-78545

78540. (a) There is hereby created in the account the Delta Levee Rehabilitation Subaccount.

(b) For the purposes of this article, "subaccount" means the Delta Levee Rehabilitation Subaccount created by subdivision (a).

78540.5. The sum of twenty-five million dollars ($25,000,000) is hereby transferred from the account to the subaccount for the purpose of implementing this article.

78541. Notwithstanding Section 13340 of the Government Code, the money in the subaccount is hereby continuously appropriated, without regard to fiscal years, to the department, as follows:

(a) Twelve million five hundred thousand dollars ($12,500,000) for local assistance under the delta levee maintenance subventions program under Part 9 (commencing with Section 12980) of Division 6, and for the administration of that assistance.

(b) Twelve million five hundred thousand dollars ($12,500,000) for special flood protection projects under Chapter 2 (commencing with Section 12310) of Part 4.8 of Division 6, subsidence studies and monitoring, and for the administration of this subdivision. Allocation of these funds shall be for flood protection projects on Bethel, Bradford, Holland, Hotchkiss, Jersey, Sherman, Twitchell, and Webb Islands, and at other locations in the delta.

78542. The expenditure of funds under this article is subject to Chapter 1.5 (commencing with Section 12306) of Part 4.8 of Division 6.

78543. (a) No expenditure of funds may be made under this article unless the Department of Fish and Game makes a written determination as part of its review and approval of a plan or project pursuant to Section 12314 or 12987 that the proposed expenditures are consistent with a net long-term habitat improvement program, and have a net benefit for aquatic species in the delta. The Department of Fish and Game shall make its determination in a reasonable and timely manner following the submission of the project or plan to that department. For the purposes of this article, an expenditure may include more than one levee project or plan.

(b) The memorandum of understanding entered into pursuant to Section 12307 shall be amended to require, in accordance with this section, that projects or plans be consistent with a net long-term habitat improvement program in the delta. The memorandum of understanding shall define the term "net long-term habitat improvement program in the delta" for purposes of this section. The

memorandum of understanding in effect prior to the amendment required by this section shall continue to apply to levee projects and plans until the memorandum of understanding is amended.

78544. For the purposes of this article, a levee project includes levee improvements and related habitat improvements which may be undertaken in the delta at a location other than the location of that levee improvement.

78545. The expenditure of funds under this article shall result in levee rehabilitation improvement projects that, to the greatest extent possible, are consistent with the CALFED program.

Article 5. South Delta Barriers Program, Sections 78550-78552

78550. (a) There is hereby created in the account the South Delta Barriers Subaccount.

(b) For the purposes of this article, "subaccount" means the South Delta Barriers Subaccount created by subdivision (a).

78550.5. The sum of ten million dollars ($10,000,000) is hereby transferred from the account to the subaccount for the purpose of implementing this article.

78551. (a) Notwithstanding Section 13340 of the Government Code, the money in the subaccount is hereby continuously appropriated, without regard to fiscal years, to the department, to pay the costs incurred by the department that are not attributable to the State Water Project's or the Central Valley Project's share of costs for the South Delta Barriers Program, and for the administration of this article.

(b) The costs identified in subdivision (a) include costs incurred for the purpose of mitigating non-State Water Project or non-Central Valley Project impacts and for the purpose of environmental enhancement in the delta.

(c) No funds shall be expended under this article unless the Department of Fish and Game determines, in writing, that a net habitat benefit will result.

78552. Not more than 3 percent of the total amount deposited in the subaccount may be used to pay the costs incurred in connection with the administration of this article.

Article 6. Delta Recreation Program, Sections 78560-78568

78560. (a) There is hereby created in the account the Delta Recreation Subaccount.

(b) For the purposes of this article, "subaccount" means the Delta Recreation Subaccount created by subdivision (a).

78560.5. The sum of two million dollars ($2,000,000) is hereby transferred from the account to the subaccount for the purposes of implementing this article.

78562. Notwithstanding Section 13340 of the Government Code, the money in the subaccount is hereby continuously appropriated, without regard to fiscal years, to the Department of Parks and Recreation to provide for, and improve, public access to, and to maximize public recreational opportunities on, the lands and waters of the delta in a way that is consistent with existing uses of the islands, sound resource conservation principles, and appropriate protection for the rights of private property owners, and for the administration of this article.

78564. The Department of Parks and Recreation may use funds in the subaccount for grants to local public agencies and nonprofit organizations for the purposes of acquiring fee title, development rights, easements, or other interests in land located in the delta to provide for, or improve, public access in the delta. The amount of any grant and the degree of local participation shall be determined by the fiscal resources of the grant applicant, the degree of public benefit provided by the proposed project, and other factors prescribed by the Department of Parks and Recreation.

78565. Any acquisition pursuant to this article shall be from willing sellers.

78566. The Department of Parks and Recreation may adopt regulations to carry out this article.

78568. Not more than 3 percent of the total amount deposited in the subaccount may be used to pay the costs incurred in connection with the administration of this article.

Article 7. CALFED Bay-Delta Program, Sections 78570-78572

78570. (a) There is hereby created in the account the CALFED Subaccount.

(b) For the purposes of this article, "subaccount" means the CALFED Subaccount created by subdivision (a).

78571. The sum of three million dollars ($3,000,000) is hereby transferred from the account to the subaccount for the purposes of Section 78572.

78572. Notwithstanding Section 13340 of the Government Code, the money in the subaccount is continuously appropriated, without regard to fiscal years, to the department, for the purpose of paying for the state's share of costs incurred in connection with the CALFED Bay-Delta Program.

APPENDIX D

SPECIAL PROJECTS INFORMATION MATRIX

INTRODUCTION

The information matrix presents attribute data for the reclamation districts within the lowlands of the legal Delta (as defined by Section 12220 of the Water Code). The information matrix, an Excel spreadsheet, is organized by subject or objective. For each subject area, an introductory table lists the sources of information for the attribute data and includes comments on the data set or additional information pertinent to the subject area.

NOTES ON THE ISLANDS AND RECLAMATION DISTRICTS

The information matrix displays island names and reclamation districts with the lowlands of the legal Delta. Because Brannan/Andrus Island, Jones Tract, Roberts Island, and Tyler Island/Walnut Grove include more than one reclamation district, information is presented for each reclamation district wherever possible. Where information is available for the entire island only, the cumulative information for the island is presented under the complete island name (e.g., Jones Tract), and a "-" is included in the column for the individual reclamation districts (e.g., Lower Jones RD 2038).

Three islands do not have a reclamation district number. The Bethel Island reclamation district is the Bethel Island Municipal Improvement District. Shim Kee Tract and Rough & Ready Island levees are managed and maintained privately by the independent landowner.

Information for Winters Island is not complete for many attributes. A member of the Levee and Channel Technical Team recommended that Winter Island - RD2122, located south of Collinsville and immediately east of Browns Island, be included in the study area. The island has been included in the information spreadsheet but little attribute data has been compiled to complete the matrix information on this small west Delta island.

Instances where no data was available for an island or reclamation district are indicated by "N/D".

ISLAND ACREAGE AND LEVEE MILEAGE

ISLAND ATTRIBUTE	DATA SOURCE and NOTES
Island size	California Department of Water Resources. 1994. Land use mapping program. Sacramento, CA. (DWR Land use mapping data)
Length of project levees	California Department of Water Resources. 1993. Sacramento-San Joaquin Delta atlas. Sacramento, CA. (DWR Delta atlas)
Length of nonproject levees	DWR Delta atlas The data for levee lengths is taken from both the Delta Atlas and GIS coverage produced by Jones & Stokes Associates.

		Island Acres & Levee Miles		
ISLAND	Reclamation District	Island Size (Acres)	Flood-Control Levees, federal (Miles)	Flood-Control Levees, local (Miles)
Bacon Island	2028	5569	0	14.3
Bethel Island	-	3532	0	11.5
Bishop Tract	2042	2975	0	5.8
Boggs (Moss Tract)	404	3211	4	1.2
Bouldin Island	756	6020	0	18.0
Brack Tract	2033	4621	0	10.6
Bradford Island	2059	2183	0	7.4
Brannan/Andrus Island	-	15383	30.5	10.6
Andrus	317	3606		
Andrus, Isleton	407	1648		
Andrus, Upper	556	2351		
Brannan	2067	7778		
Byron Tract	800	6249	0	9.7
Canal Ranch	2066	3213	0	7.5
Coney Island	2117	996	0	5.4
Dead Horse Island	2111	225	0	2.6
Empire Tract	2029	3868	0	10.5
Fabian Tract	773	6725	0	18.8
Fay	2113	99	0	1.6
Glanville Tract	1002	6994	0	13.0
Grand Island	3	16892	29.0	0.0
Hastings Tract	2060	4519	16.0	0.0
Holland Tract	2025	4254	0	10.9
Holt Station	2116	197	0	0.4
Hotchkiss Tract	799	3621	0	6.3
Jersey Island	630	3571	0	15.6
Jones Tract	-			
Jones, Lower	2038	5743	0	8.8
Jones, Upper	2039	6501	0	9.3
King Island	2044	3258	0	9.0
Little Mandeville	2118	360	0	4.5
Mandeville Island	2027	5266	0	14.3
McCormack Williamson Tract	2110	2139	0	8.8
McDonald Island	2030	6058	0	13.7
Medford Island	2041	1205	0	5.9
Merritt Island	150	4901	18.1	0.0
Mildred Island	2021	1001	0	7.3
Naglee Burke	1007	5917	0	8.3
New Hope Tract	348	9796	0	18.6
Orwood Island	2024	2431	0	10.9
Palm Tract	2036	2505	0	7.5
Pescadero	2058	9004	6.7	2.2
Pierson District	551	9427	8.4	7.0
Prospect Island	1667	2275	2.9	7.1
Quimby Island	2090	809	0	7.0
Rindge Tract	2037	6840	0	15.7
Rio Blanco Tract	2114	959	0	4.0
Roberts Island	-	36189		
Roberts, Lower	684	10819	0.0	16.0
Roberts, Middle	524	12839	8.1	3.7
Roberts, Upper	544	8248	10.8	4.4
Rough and Ready Island	-	1461	0	6.7
Ryer Island	501	11955	20.6	0.0
Sargent Barnhart Tract	2074	1051	1.5	2.6
Sherman Island	341	11321	9.7	9.6
Shima Tract	2115	1848	0	6.6
Shin Kee Tract	-	960	0	3.9
Smith	1614	2183	6	2.8
Stark	2089	742	2.8	0.7
Staten Island	36	9229	0	25.4
Stewart Tract	2062	5364	12.3	0.0
Sutter Island	349	2619	12.5	0.0
Terminous	548	12187	0	16.1
Twitchell	1601	3648	2.5	9.3
Tyler Island	563	9453	12.2	10.7
Walnut Grove	554	459	1	1.2
Union Island	-	25016	1.0	29.2
Van Sickle Island	1607	2193	0	3.6
Veale Tract	2065	1499	0	5.7
Venice Island	2023	3159	0	12.3
Victoria Island	2040	7266	0	15.1
Webb Tract	2026	5507	0	12.8
Weber	828	1149	0	1.2
Winter Island	2122	482	0	4.8
Woodward Island	2072	1859	0	8.8
Wright-Elmwood Tract	2119	2134	0	6.8
-	307	6016.9	7.8	5.2
-	369	532.3	1	0.7
-	536	6389.7	14	0
-	765	1348.8	1.7	4
-	813	2537.5	2	6
-	900	10832.3	12	1.3
-	999	25775.7	27	6.8
-	1808	906.1	0	4
-	2084	3170.4	0	7
-	2093	5031.3	0	20.5
-	2095	5552.1	4	0
-	2098	6033.7	18.5	0
-	2121	527.9	0	2.3

LIFE AND PERSONAL PROPERTY

ISLAND ATTRIBUTE	DATA SOURCE and NOTES
Permanent population (1990)	DWR Delta atlas
Towns	DWR Delta atlas
Housing units	DWR Delta atlas
Residential lands	DWR Land use mapping data Residential lands include farmsteads (see Agricultural data). In some cases, residential lands = 0 yet housing units are shown (see for example, Victoria Island). This is probably because some housing units are located on lands that are not considered 'residential". Specifically, agricultural farmworker housing is often located on lands categorized as "incidental agricultural lands" or a specific crop rather than farmsteads or residential lands.

		Life and Property			
ISLAND	Reclamation District	Permanent Population (1990)	Towns	Housing Units	Residential Lands (Acres)
Bacon Island	2028	260		39	35.7
Bethel Island	-	2115		1257	133.8
Bishop Tract	2042	52		23	16.6
Boggs (Moss Tract)	404	N/D		N/D	3.7
Bouldin Island	756	74		19	17.5
Brack Tract	2033	80		22	18.5
Bradford Island	2059	0		0	43.4
Brannan/Andrus Island	-	2093	-	1014	-
Andrus	317	-		-	167.6
Andrus, Isleton	407	-	Isleton	-	57.4
Andrus, Upper	556	-		-	36.0
Brannan	2067	-		-	38.9
Byron Tract	800	6336	Byron, Disco Bay	2964	12.2
Canal Ranch	2086	103		30	10.7
Coney Island	2117	0		0	2.8
Dead Horse Island	2111	39		23	0.0
Empire Tract	2029	5		3	10.8
Fabian Tract	773	130		28	45.9
Fay	2113	N/D		N/D	0.0
Glanville Tract	1002	N/D		N/D	24.6
Grand Island	3	1021	Ryde	411	193.8
Hastings Tract	2060	94	Hastings	22	17.8
Holland Tract	2025	35		28	14.1
Holt Station	2116	N/D		N/D	8.0
Hotchkiss Tract	799	847		373	122.8
Jersey Island	830	13		3	8.7
Jones Tract	-	-	-	-	-
Jones, Lower	2038	112		14	30.2
Jones, Upper	2039	46		8	57.0
King Island	2044	185		94	4.2
Little Mandeville	2118	N/D		N/D	0.0
Mandeville Island	2027	118		5	29.9
McCormack Williamson Tr	2110	0		0	2.5
McDonald Island	2030	95		0	73.2
Medford Island	2041	14		9	0.0
Merritt Island	150	238		97	68.7
Mildred Island	2021	0		0	0.0
Naglee Burke	1007	24		5	0.0
New Hope Tract	348	1376	Thornton	501	124.3
Orwood Island	2024	98		22	31.3
Palm Tract	2036	18		5	3.2
Pescadero	2058	54		19	164.2
Pierson District	551	355	Courtland	140	145.1
Prospect Island	1667	N/D		N/D	3.1
Quimby Island	2090	N/D		N/D	0.0
Rindge Tract	2037	33		29	31.8
Rio Blanco Tract	2114	10		5	7.4
Roberts Island	-	-	-	-	-
Roberts, Lower	684	221		88	113.6
Roberts, Middle	524	435		95	114.4
Roberts, Upper	544	231		75	91.2
Rough and Ready Island	-	174		43	0.0
Ryer Island	501	246		98	83.6
Sargent Barnhart Tract	2074	1902		806	0.0
Sherman Island	341	233		105	46.7
Shima Tract	2115	101		N/D	6.2
Shin Kee Tract	-	8		3	0.0
Smith	1814	N/D		N/D	0.0
Stark	2089	N/D		N/D	3.2
Staten Island	38	35		13	16.6
Stewart Tract	2062	213		104	29.6
Sutter Island	349	173		48	31.9
Terminous	548	602	Terminous	279	52.5
Twitchell	1601	87		41	15.4
Tyler Island	563	644		286	40.0
Walnut Grove	554	-	Walnut Grove	-	-
Union Island	1,2	779		144	151.6
Van Sickle Island	1607	0		0	0.0
Veale Tract	2065	4		2	0.0
Venice Island	2023	0		0	4.1
Victoria Island	2040	155		6	10.8
Webb Tract	2026	0		0	24.1
Weber	828	N/D		N/D	0.0
Winter Island	2122	0		N/D	0.0
Woodward Island	2072	6		1	4.6
Wright-Elmwood Tract	2119	31		0	20.3
-	307	N/D		N/D	33.9
-	369	N/D	Locke	N/D	4.1
-	536	N/D		N/D	53.9
-	765	N/D		N/D	5.5
-	813	N/D		N/D	15.4
-	900	N/D		N/D	130.7
-	999	303	Clarksburg	11652	375.6
-	1608	N/D		N/D	0.0
-	2084	N/D		N/D	0.0
-	2093	N/D		N/D	220.6
-	2095	N/D		N/D	43.5
-	2098	N/D		N/D	38.8
-	2121	N/D		N/D	2.9

AGRICULTURAL PRODUCTION

ISLAND ATTRIBUTE	DATA SOURCE and NOTES
Total agricultural lands	DWR Land use mapping data Includes grain and hay crops, field crops, truck and berry crops, pasture, rice, idle agricultural area, deciduous fruits and nuts, vineyards, and semiagricultural and incidental to agricultural area. Farmstead lands, shown here, are included in the "residential" land category.
Value of damageable crops	DWR Land use mapping data and California Department of Food and Agriculture. 1996. County Agriculture Commissioner's Reports for 1995. Sacramento, CA. Value is determined by crop acreages multiplied by the average values for each major agricultural classification. Crop values are based on 1995 production value information for Sacramento, San Joaquin, Contra Costa, Yolo, and Solano counties. In some instances, value of crops is $0 although agricultural acres are shown. This is the result of those lands being categorized as idle, semiagricultural and incidental to agricultural, or farmsteads which are not included in the value of damageable crops analysis.

Agricultural Production

Crop Acreages and Values

ISLAND	Reclamation District	Grain & Hay Crops (Acres)	Field Crops (Acres)	Truck & Berry Crops (Acres)	Pasture (Acres)	Rice (Acres)	Subtropical Fruits (Acres)	Deciduous Fruits & Nuts (Acres)	Vineyards (Acres)	Idle (Acres)	Semiagricultural & Incidental to Agriculture w/farms(Acres)	Farmsteads (Acres)	Semiagricultural & Incidental to Agriculture (Acres)	Total Agricultural (Acres)	Total Value ($1,000)
Bacon Island	2028	0.0	2148.9	2905.8	0.0	0.0	0.0	0.0	56.7	29.0	35.7	35.7	0.0	5140.4	$10,988
Bethel Island	-	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	2484.8	136.5	14.8	121.7	2614.2	$4
Bishop Tract	2042	523.6	293.9	191.8	1730.8	0.0	0.0	0.0	0.0	0.0	50.1	16.6	33.5	2773.6	$1,815
Boggs (Moss Tract)	404	0.0	0.0	0.0	78.1	0.0	0.0	0.0	0.0	0.0	152.3	3.7	148.6	228.7	$37
Bouldin Island	756	1982.9	3393.1	0.0	0.0	0.0	0.0	0.0	0.0	4.1	17.5	17.5	0.0	5380.1	$2,828
Brack Tract	2033	607.2	2182.4	404.8	567.3	0.0	0.0	2.7	472.3	145.5	18.5	18.5	0.0	4382.2	$4,429
Bradford Island	2059	0.0	0.0	0.0	636.7	0.0	0.0	0.0	0.0	1286.2	8.6	8.5	0.1	1923.0	$308
Brannan/Andrus Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Andrus	317	440.3	2741.1	0.0	0.0	0.0	0.0	0.0	0.0	34.1	1.6	1.6	0.0	3215.5	$1,900
Andrus, Isleton	407	406.9	713.7	0.0	0.0	0.0	0.0	122.7	20.8	3.4	8.8	8.8	0.0	1267.3	$964
Andrus, Upper	556	534.7	704.3	233.7	217.5	0.0	0.0	426.6	0.0	0.0	28.4	28.4	0.0	2116.8	$2,600
Brannan	2067	1528.4	5164.4	25.3	82.9	0.0	0.0	164.5	102.5	43.4	36.3	0.0	36.3	7067.7	$4,580
Byron Tract	800	802.9	731.0	1204.2	1103.9	0.0	0.0	0.0	0.0	119.9	12.2	12.2	0.0	3961.9	$5,176
Canal Ranch	2085	476.6	1891.8	419.8	167.1	0.0	0.0	0.0	34.7	0.0	10.7	10.7	0.0	2990.0	$2,904
Coney Island	2117	347.9	526.1	30.9	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	0.0	904.9	$552
Dead Horse Island	2111	0.0	0.0	190.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	190.1	$618
Empire Tract	2029	1343.9	1979.7	122.6	0.0	0.0	0.0	0.0	0.0	0.0	10.8	10.8	0.0	3446.2	$2,109
Fabian Tract	773	260.6	743.0	2972.9	2240.0	0.0	0.0	52.7	0.0	36.8	34.5	34.5	0.0	6308.2	$11,436
Fay	2113	0.0	63.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.9	$41
Glanville Tract	1002	931.1	2346.5	534.9	2108.9	0.0	0.0	131.4	309.8	0.0	63.8	24.6	39.2	6401.8	$5,713
Grand Island	3	4576.2	6485.5	1820.4	1047.9	0.0	0.0	1903.1	0.0	0.0	177.7	174.1	3.6	15816.7	$17,015
Hastings Tract	2060	291.8	1564.3	517.1	1970.8	0.0	0.0	0.0	28.5	1368.6	21.4	17.6	3.8	5784.9	$3,811
Holland Tract	2025	2923.7	82.7	0.0	303.9	0.0	0.0	0.0	0.0	461.2	14.1	14.1	0.0	3771.5	$1,181
Holt Station	2116	96.5	17.1	0.0	18.7	0.0	0.0	0.0	0.0	37.3	8.0	8.0	0.0	189.6	$52
Hotchkiss Tract	799	179.9	6.6	1.0	1709.4	0.0	0.0	54.7	0.0	476.4	60.5	32.9	27.6	2457.6	$1,031
Jersey Island	830	0.0	0.0	0.0	2803.0	0.0	0.0	0.0	0.0	16.2	8.7	8.7	0.0	2819.2	$1,345
Jones Tract	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jones, Lower	2038	1752.9	929.2	2568.7	0.0	0.0	0.0	0.0	0.0	266.2	30.2	30.2	0.0	5517.0	$9,521
Jones, Upper	2039	1103.5	3140.5	3868.4	1810.1	0.0	0.0	0.0	0.0	18.0	57.0	57.0	0.0	9760.6	$15,230
King Island	2044	1888.7	668.7	511.4	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.2	0.0	3089.8	$2,727
Little Mandeville	2118	0.0	269.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	269.2	$172
Mandeville Island	2027	400.3	2634.9	1015.2	5.6	0.0	31.8	1.1	464.0	48.8	28.6	28.5	0.1	4600.0	$6,422
McCormack Williamson Tr	2110	180.7	1271.5	275.9	0.0	0.0	0.0	0.0	0.0	65.9	2.5	2.5	0.0	1794.0	$1,770
McDonald Island	2030	911.8	1000.9	2369.8	558.4	0.0	0.0	0.0	0.0	533.8	73.2	73.2	0.0	5395.7	$8,977
Medford Island	2041	134.2	942.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1077.0	$648
Merritt Island	150	839.2	845.1	778.9	547.3	0.0	0.0	380.1	1092.2	24.7	68.7	68.6	0.1	4505.6	$7,455
Mildred Island	2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Naglee Burke	1007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
New Hope Tract	348	1646.1	3333.5	2050.2	390.2	0.0	0.0	279.9	1174.2	0.8	124.1	108.8	15.3	8890.2	$13,331
Orwood Island	2024	172.2	438.1	1146.8	381.2	0.0	0.0	0.0	0.0	31.6	31.3	31.3	0.0	2169.9	$4,247
Palm Tract	2036	1308.6	573.8	15.1	282.2	0.0	0.0	0.0	0.0	61.3	3.2	3.2	0.0	2271.0	$968
Pescadero	2058	116.4	1868.1	1778.7	3511.6	0.0	0.0	247.8	0.0	99.9	216.1	117.3	98.8	7723.3	$9,345
Pierson District	551	871.2	2535.8	0.0	332.1	0.0	0.0	1840.4	1002.2	312.1	146.1	146.1	0.0	6893.6	$8,480
Prospect Island	1667	388.9	489.2	226.9	0.0	0.0	0.0	0.0	0.0	7.4	3.1	3.1	0.0	1112.4	$1,178
Quimby Island	2090	303.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	285.4	0.0	0.0	0.0	588.6	$100
Rindge Tract	2037	710.9	4532.4	1024.6	19.3	0.0	0.0	0.0	0.0	132.4	31.8	31.8	0.0	6419.8	$8,475
Rio Blanco Tract	2114	351.1	126.1	0.0	326.4	0.0	0.0	0.0	0.0	0.0	7.4	7.4	0.0	803.6	$353
Roberts Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Roberts, Lower	884	2829.2	2791.8	3134.8	1266.3	0.0	0.0	14.1	0.0	202.8	113.6	113.6	0.0	10241.0	$13,554
Roberts, Middle	524	1063.7	3675.9	2958.5	3902.6	0.0	0.0	31.9	0.0	33.2	142.5	114.4	28.1	11713.9	$14,282
Roberts, Upper	544	1712.9	2012.2	957.8	2882.8	0.0	0.0	228.0	121.8	20.2	91.2	91.2	0.0	7939.7	$7,282
Rough and Ready Island	-	357.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	357.9	$118
River Island	501	3252.4	3868.4	2122.4	1163.6	0.0	19.8	418.7	536.6	22.4	79.3	79.3	0.0	11404.3	$13,551
Sargent Barnhart Tract	2074	129.5	25.8	0.0	147.2	0.0	0.0	0.0	0.0	79.8	0.0	0.0	0.0	382.1	$130
Sherman Island	341	1731.2	6581.4	462.5	379.8	0.0	0.0	0.0	0.0	845.8	46.7	46.7	0.0	9800.3	$6,469
Shima Tract	2115	263.9	176.0	266.2	783.9	0.0	0.0	208.8	0.0	8.1	6.2	6.2	0.0	1700.9	$1,985
Shin Kee Tract	-	283.6	321.6	147.9	180.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	933.1	$868
Smith	1614	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.4	0.0	130.4	130.4	$0
Stark	2089	129.8	209.7	0.9	306.1	0.0	0.0	0.0	0.0	0.0	3.2	3.2	0.0	648.5	$328
Staten Island	38	3201.3	5196.6	336.8	0.0	18.2	0.0	0.0	0.0	0.0	16.6	16.6	0.0	8752.9	$5,494
Stewart Tract	2062	760.5	355.4	1268.3	2223.4	0.0	0.0	153.3	0.0	0.0	22.9	22.9	0.0	4780.9	$6,131
Sutter Island	349	180.4	453.8	284.3	186.9	0.0	12.6	1078.8	152.9	0.9	31.9	31.9	0.0	2330.6	$4,592
Terminous	548	3532.2	5618.9	331.4	1345.1	0.0	0.0	0.0	190.6	205.7	90.7	52.5	38.2	11262.1	$6,964
Twitchell	1601	188.9	2567.1	242.2	319.9	0.0	0.0	0.0	0.0	24.7	15.4	15.4	0.0	3342.8	$2,646
Tyler Island	583	2671.7	4918.8	198.8	350.9	0.0	0.0	274.5	0.0	4.9	39.9	39.9	0.0	8419.6	$8,658
Walnut Grove	554	137.6	0.1	0.0	179.2	0.0	0.0	0.0	0.0	3.8	4.4	0.1	4.3	325.2	$132
Union Island	-	1099.2	9100.7	5025.9	8372.9	0.0	0.0	512.9	0.0	45.8	151.6	151.6	0.0	24157.4	$27,874
Van Sickle Island	1607	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Veale Tract	2065	926.2	0.0	0.0	73.7	0.0	0.0	0.0	0.0	311.5	0.0	0.0	0.0	1311.4	$341
Venice Island	2023	1145.4	1566.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	4.1	0.0	2713.7	$1,382
Victoria Island	2040	1316.9	933.9	3235.9	1400.9	0.0	0.0	0.0	0.0	0.0	10.8	10.8	0.0	6867.8	$12,221
Webb Tract	2028	1332.8	3461.6	0.0	0.0	0.0	0.0	0.0	0.0	45.9	24.1	24.1	0.0	4840.3	$2,855
Weber	828	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Winter Island	2122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Woodward Island	2072	898.1	0.0	748.6	0.0	0.0	0.0	0.0	0.0	40.1	4.6	4.6	0.0	1686.8	$2,729
Wright-Elmwood Tract	2119	1238.1	601.3	143.7	0.0	0.0	0.0	0.0	0.0	0.0	20.3	20.3	0.0	1983.1	$1,260
-	307	882.7	2315.3	1091.9	1049.0	0.0	18.8	21.0	201.9	23.1	33.9	33.9	0.0	5603.7	$6,458
-	369	0.0	0.0	0.0	59.3	0.0	0.0	89.2	0.0	0.8	4.2	4.1	0.1	149.2	$260
-	536	475.6	1640.4	0.0	1159.7	0.0	0.0	0.0	0.0	1489.6	42.0	42.0	0.0	4766.3	$1,764
-	766	227.7	201.0	385.6	390.1	0.0	0.0	0.0	0.0	0.0	5.5	5.5	0.0	1184.4	$1,578
-	813	113.8	714.6	336.3	204.9	0.0	0.0	166.7	767.6	25.1	15.4	15.4	0.0	2349.2	$4,183
-	900	1183.8	2602.9	256.7	603.1	0.0	0.0	93.7	50.3	426.0	193.7	130.7	63.0	5478.5	$3,864
-	939	5876.1	8191.2	4199.2	4442.3	0.0	0.0	74.4	711.9	367.6	375.6	375.6	0.0	23982.7	$25,053
-	1608	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1	0.0	30.1	30.1	$0
-	2084	3.5	1786.6	283.3	559.7	0.0	0.0	0.0	0.0	289.2	0.0	0.0	0.0	2902.3	$2,321
-	2093	2533.1	1230.1	284.5	0.0	0.0	0.0	0.0	0.0	24.9	220.6	220.6	0.0	4052.6	$2,463
-	2095	260.6	1413.5	1236.6	1832.5	0.0	0.0	36.7	0.0	39.3	62.5	31.4	31.1	4670.3	$5,991
-	2098	985.2	496.8	561.7	1801.8	0.0	0.0	0.0	0.0	666.9	53.0	38.8	14.2	4548.6	$3,400
-	2121	261.9	0.0	1.7	0.0	0.0	0.0	0.0	0.0	233.9	2.9	2.9	0.0	497.5	$82
CROP VALUES	($/ACRE)	$330	$640	$3,250	$480	$930	$2,600	$2,600	$2,620	$0		–	$0		

Agricultural Production

Crop Acreages and Values

ISLAND	Reclamation District	Grain & Hay Crops (Acres)	Field Crops (Acres)	Truck & Berry Crops (Acres)	Pasture (Acres)	Rice (Acres)	Subtropical Fruits (Acres)	Deciduous Fruits & Nuts (Acres)	Vineyards (Acres)	Idle (Acres)	Semiagricultural & Incidental to Agriculture w/farms(Acres)	Farmsteads (Acres)	Semiagricultural & incidental to Agriculture (Acres)	Total Agricultural (Acres)	Total Value ($1,000)
Bacon Island	2028	0.0	2148.9	2905.8	0.0	0.0	0.0	0.0	56.7	29.0	35.7	35.7	0.0	5140.4	$10,968
Bethel Island	-	0.0	0.0	0.0	7.7	0.0	0.0	0.0	0.0	2484.8	136.5	14.8	121.7	2614.2	$4
Bishop Tract	2042	523.6	293.9	191.8	1730.8	0.0	0.0	0.0	0.0	0.0	50.1	16.6	33.5	2773.6	$1,815
Boggs (Moss Tract)	404	0.0	0.0	0.0	76.1	0.0	0.0	0.0	0.0	0.0	152.3	3.7	148.6	228.7	$37
Bouldin Island	756	1962.9	3393.1	0.0	0.0	0.0	0.0	0.0	0.0	4.1	17.5	17.5	0.0	5380.1	$2,826
Brack Tract	2033	607.2	2162.4	404.8	567.3	0.0	0.0	2.7	472.3	145.6	18.5	18.5	0.0	4382.2	$4,429
Bradford Island	2059	0.0	0.0	0.0	836.7	0.0	0.0	0.0	0.0	1286.2	8.6	8.5	0.1	1923.0	$308
Brannan/Andrus Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Andrus	317	449.3	2741.1	0.0	0.0	0.0	0.0	0.0	0.0	34.1	1.8	1.8	0.0	3215.5	$1,800
Andrus, Isleton	407	406.9	713.7	0.0	0.0	0.0	0.0	122.7	20.8	3.4	6.8	6.8	0.0	1267.3	$964
Andrus, Upper	556	534.7	704.3	233.7	217.5	0.0	0.0	428.6	0.0	0.0	28.4	28.4	0.0	2116.8	$2,800
Brannan	2087	1528.4	5104.4	25.3	62.9	0.0	0.0	184.5	102.5	43.4	36.3	0.0	36.3	7067.7	$4,580
Byron Tract	600	602.9	731.0	1204.2	1103.9	0.0	0.0	0.0	0.0	119.9	12.2	12.2	0.0	3961.9	$4,176
Canal Ranch	2086	476.6	1991.8	419.8	167.1	0.0	0.0	0.0	34.7	0.0	10.7	10.7	0.0	2990.0	$2,904
Coney Island	2117	347.9	526.1	30.8	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	0.0	904.9	$552
Dead Horse Island	2111	0.0	0.0	190.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	190.1	$618
Empire Tract	2029	1343.9	1979.7	122.8	0.0	0.0	0.0	0.0	0.0	0.0	10.8	10.8	0.0	3448.2	$2,109
Fabian Tract	773	260.8	743.0	2972.9	2240.0	0.0	0.0	52.7	0.0	36.6	34.5	34.5	0.0	6308.2	$11,436
Fay	2113	0.0	63.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.9	$41
Glanville Tract	1002	931.1	2346.5	534.9	2108.9	0.0	0.0	131.4	309.8	0.0	83.8	24.6	39.2	6401.6	$5,713
Grand Island	3	4576.2	6465.5	1820.4	1047.8	0.0	0.0	1803.1	0.0	0.0	177.7	174.1	3.6	15816.7	$17,015
Hastings Tract	2060	291.8	1584.3	817.1	1970.8	0.0	0.0	0.0	28.5	1388.6	21.4	17.8	3.6	5784.9	$3,811
Holland Tract	2025	2923.7	62.7	0.0	303.9	0.0	0.0	0.0	0.0	481.2	14.1	14.1	0.0	3771.5	$1,151
Holt Station	2116	96.5	17.1	0.0	18.7	0.0	0.0	0.0	0.0	37.3	8.0	8.0	0.0	189.6	$52
Hotchkiss Tract	799	179.9	8.6	1.0	1709.4	0.0	0.0	54.7	0.0	478.4	60.5	32.8	27.8	2457.6	$1,031
Jersey Island	830	0.0	0.0	0.0	2803.0	0.0	0.0	0.0	0.0	16.2	6.7	6.7	0.0	2819.2	$1,345
Jones Tract	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Jones, Lower	2038	1752.8	929.2	2568.7	0.0	0.0	0.0	0.0	0.0	266.2	30.2	30.2	0.0	5517.0	$9,521
Jones, Upper	2039	1103.5	3140.5	3688.4	1810.1	0.0	0.0	0.0	0.0	16.0	57.0	57.0	0.0	9760.6	$15,230
King Island	2044	1588.7	689.7	611.4	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.2	0.0	3089.8	$2,727
Little Mandeville	2118	0.0	269.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	269.2	$172
Mandeville Island	2027	400.3	2634.9	1015.2	5.8	0.0	31.8	1.1	464.0	46.8	28.5	28.5	0.1	4600.0	$6,422
McCormack Williamson Tr	2110	180.7	1271.5	275.9	0.0	0.0	0.0	0.0	0.0	85.9	2.5	2.5	0.0	1794.0	$1,770
McDonald Island	2030	611.8	1000.9	2389.8	559.4	0.0	0.0	0.0	0.0	533.8	73.2	73.2	0.0	5395.7	$8,977
Medford Island	2041	134.2	942.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1077.0	$848
Merritt Island	150	839.2	845.1	776.9	547.3	0.0	0.0	380.1	1092.2	24.7	68.7	68.6	0.1	4565.6	$7,455
Mildred Island	2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Naglee Burke	1007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
New Hope Tract	348	1646.1	3333.5	2050.2	390.2	0.0	0.0	279.9	1174.2	0.8	124.1	108.8	15.3	8890.2	$13,331
Orwood Island	2024	172.2	438.1	1148.8	361.2	0.0	0.0	0.0	0.0	31.8	31.3	31.3	0.0	2189.9	$4,247
Palm Tract	2038	1308.8	573.8	15.1	292.2	0.0	0.0	0.0	0.0	81.3	3.2	3.2	0.0	2271.0	$968
Pescadero	2058	118.4	1868.1	1778.7	3511.8	0.0	0.0	247.8	0.0	99.9	219.1	117.3	98.8	7723.3	$9,345
Pierson District	551	871.2	2535.6	0.0	332.1	0.0	0.0	1840.4	1002.2	312.1	146.1	146.1	0.0	8893.6	$9,480
Prospect Island	1667	388.9	469.2	226.9	0.0	0.0	0.0	0.0	0.0	7.4	3.1	3.1	0.0	1112.4	$1,179
Quimby Island	2090	303.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	295.4	0.0	0.0	0.0	598.6	$100
Rindge Tract	2037	710.9	4532.4	1024.6	19.3	0.0	0.0	0.0	0.0	132.4	31.6	31.6	0.0	6419.6	$8,475
Rio Blanco Tract	2114	351.1	126.1	0.0	326.4	0.0	0.0	0.0	0.0	0.0	7.4	7.4	0.0	803.6	$353
Roberts Island	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Roberts, Lower	584	2629.2	2791.8	3134.8	1268.3	0.0	0.0	14.1	0.0	202.6	113.6	113.6	0.0	10241.0	$13,554
Roberts, Middle	524	1083.7	3875.9	2958.5	3902.6	0.0	0.0	31.9	0.0	33.2	142.5	114.4	28.1	11713.9	$14,282
Roberts, Upper	544	1712.9	2012.2	957.8	2882.5	0.0	0.0	228.0	121.8	20.2	91.2	91.2	0.0	7935.7	$7,262
Rough and Ready Island	-	357.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	357.9	$118
River Island	501	3252.4	3868.4	2122.4	1163.6	0.0	19.8	439.7	536.6	22.4	79.3	79.3	0.0	11404.3	$13,551
Sargent Barnhart Tract	2074	129.5	25.6	0.0	147.2	0.0	0.0	0.0	0.0	79.8	0.0	0.0	0.0	382.1	$130
Sherman Island	341	1731.2	6581.4	462.6	379.8	0.0	0.0	0.0	0.0	845.6	46.7	46.7	0.0	9800.3	$8,469
Shima Tract	2115	263.9	178.0	268.2	783.9	0.0	0.0	208.8	0.0	8.1	6.2	6.2	0.0	1708.9	$1,985
Shin Kee Tract	-	283.6	321.6	147.9	180.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	833.1	$866
Smith	1614	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	130.4	0.0	130.4	130.4	$0
Stark	2089	129.8	209.7	0.8	306.1	0.0	0.0	0.0	0.0	0.0	3.2	3.2	0.0	648.5	$328
Staten Island	38	3201.3	5196.6	336.6	0.0	18.2	0.0	0.0	0.0	0.0	16.6	16.6	0.0	8752.9	$5,494
Stewart Tract	2062	760.5	355.4	1288.3	2223.4	0.0	0.0	153.3	0.0	0.0	22.9	22.9	0.0	4780.9	$8,131
Sutter Island	349	180.4	453.8	284.3	166.9	0.0	12.6	1078.8	152.9	0.9	31.9	31.9	0.0	2330.6	$4,592
Terminous	548	3532.2	5618.9	331.4	1345.1	0.0	0.0	0.0	190.6	205.7	90.7	52.5	38.2	11262.1	$6,984
Twitchell	1601	188.9	2567.1	242.2	319.9	0.0	0.0	0.0	0.0	24.7	15.4	15.4	0.0	3342.8	$2,646
Tyler Island	563	2671.7	4918.8	196.8	350.9	0.0	0.0	274.5	0.0	4.9	39.9	39.9	0.0	8419.6	$5,558
Walnut Grove	554	137.8	0.1	0.0	179.2	0.0	0.0	0.0	0.0	3.8	4.4	0.1	4.3	325.2	$132
Union Island	-	1099.2	9100.7	5025.9	8372.9	0.0	0.0	512.9	0.0	45.8	151.6	151.6	0.0	24157.4	$27,874
Van Sickle Island	1607	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Veale Tract	2085	926.2	0.0	0.0	73.7	0.0	0.0	0.0	0.0	311.5	0.0	0.0	0.0	1311.4	$341
Venice Island	2023	1145.4	1568.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	4.1	0.0	2713.7	$1,382
Victoria Island	2040	1316.9	933.9	3235.9	1400.9	0.0	0.0	0.0	0.0	0.0	10.8	10.8	0.0	6897.6	$12,221
Webb Tract	2026	1332.8	3461.6	0.0	0.0	0.0	0.0	0.0	0.0	45.9	24.1	24.1	0.0	4840.3	$2,655
Weber	828	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Winter Island	2122	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	$0
Woodward Island	2072	898.1	0.0	748.6	0.0	0.0	0.0	0.0	0.0	40.1	4.6	4.6	0.0	1686.8	$2,729
Wright-Elmwood Tract	2119	1238.1	601.3	143.7	0.0	0.0	0.0	0.0	0.0	0.0	20.3	20.3	0.0	1983.1	$1,280
-	307	882.7	2315.3	1091.9	1049.0	0.0	18.8	21.0	201.9	23.1	33.9	33.9	0.0	5603.7	$8,458
-	369	0.0	0.0	0.0	59.3	0.0	0.0	89.2	0.0	0.6	4.2	4.1	0.1	149.2	$260
-	538	476.6	1640.4	0.0	1159.7	0.0	0.0	0.0	0.0	1498.6	42.0	42.0	0.0	4766.3	$1,764
-	766	227.7	201.0	365.6	390.1	0.0	0.0	0.0	0.0	0.0	5.5	5.5	0.0	1184.4	$1,578
-	813	113.8	714.8	336.3	204.9	0.0	0.0	186.7	787.6	25.1	15.4	15.4	0.0	2349.2	$4,183
-	900	1183.8	2902.9	256.7	603.1	0.0	0.0	93.7	50.3	428.0	193.7	130.7	63.0	5479.5	$3,884
-	999	5976.1	8191.2	4199.2	4442.3	0.0	0.0	74.4	711.9	387.6	375.6	375.6	0.0	23982.7	$26,053
-	1608	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	30.1	0.0	30.1	30.1	$0
-	2084	3.5	1766.6	283.3	559.7	0.0	0.0	0.0	0.0	289.2	0.0	0.0	0.0	2902.3	$2,321
-	2093	2533.1	1230.1	284.6	0.0	0.0	0.0	0.0	0.0	24.9	220.6	220.6	0.0	4052.6	$2,463
-	2095	280.6	1413.5	1238.6	1832.5	0.0	0.0	36.7	0.0	38.3	62.5	31.4	31.1	4870.3	$5,991
-	2096	985.2	499.6	581.7	1601.8	0.0	0.0	0.0	0.0	666.9	63.0	39.8	14.2	4548.6	$3,400
-	2121	261.9	0.0	1.7	0.0	0.0	0.0	0.0	0.0	233.9	2.9	2.9	0.0	497.5	$92
CROP VALUES	($/ACRE)	$330	$640	$3,250	$450	$930	$2,600	$2,600	$2,620	$0		–	$0		

WATER QUALITY

ISLAND ATTRIBUTE	DATA SOURCE and NOTES
Long-term salinity intrusion induced	Enright, Chris. n.d. Western Delta Island Flood Assumptions - DWRDSM Modeling Analysis. California Department of Water Resources, Delta Modeling Section. Sacramento, CA. Represents the long-term average change in salinity at Clifton Court Forebay based on DWR's Delta Simulation Model (DWRDSM) analysis.
Critical to water quality (SB-34)	California Water Code Section 12311(a) The Delta Flood Protection Act (SB-34) identified eight islands as critical to water quality.
Island volume	DWR Delta atlas and DWR Land use mapping data The island volume is used as an indicator of short-term water quality effects during specific hydrologic conditions in the Delta. An island breach would have a short-term, immediate effect on salinity intrusion only if the rate of filling of an island is greater than the outflow of water through the Delta. These elements are a function of the inflow of water into the Delta, the rate of water being exported out of the Delta, and the location and size of the breached island. Because most levee breaches occur during high inflows when outflow would exceed the rate of island filling, short-term effects on water quality (i.e., salinity) would seldom occur. However, the team felt it important to capture the possible of water quality effects of a levee breach during low inflow periods. Island volume estimates are derived from information on the "Land Surface Below Sea Level" and "Lowest surface Elevation" maps in the DWR Delta atlas. Weighted average surface elevations are multiplied by the island acreage (from DWR land use mapping data) to produce the estimated island volume.

		Water Quality		
ISLAND	Reclamation District	Salinity Intrusion Induced (% salinity increase @ Clifton Court)	Critical to Water Quality SB 34	Island Volume (short-term water quality effects) (Acre Feet; estimate)
Bacon Island	2026		No	77700
Bethel Island	-		Yes	29800
Bishop Tract	2042		No	10400
Boggs (Moss Tract)	404		No	0
Bouldin Island	756	2%	No	83700
Brack Tract	2033		No	32900
Bradford Island	2059		Yes	25100
Brannan/Andrus Island	-	-5%	-	-
Andrus	317		No	52400
Andrus, Isleton	407		No	10700
Andrus, Upper	556		No	11800
Brannan	2067		No	117200
Byron Tract	800		No	37500
Canal Ranch	2088		No	19700
Coney Island	2117		No	5000
Dead Horse Island	2111		No	1100
Empire Tract	2029		No	50500
Fabian Tract	773		No	16800
Fay	2113		No	500
Glanville Tract	1002		No	0
Grand Island	3		No	110000
Hastings Tract	2060		No	5600
Holland Tract	2025	12%	Yes	38800
Holt Station	2118		No	1000
Hotchkiss Tract	799		Yes	10000
Jersey Island	830	40%	Yes	33500
Jones Tract	-		-	-
Jones, Lower	2038		No	45900
Jones, Upper	2039		No	71500
King Island	2044		No	30900
Little Mandeville	2118		No	1600
Mandeville Island	2027		No	76400
McCormack Williamson Tr	2110		No	2100
McDonald Island	2030	2%	No	83000
Medford Island	2041		No	15100
Merritt Island	150		No	0
Mildred Island	2021		No	0
Naglee Burke	1007		No	0
New Hope Tract	348		No	17100
Orwood Island	2024		No	21300
Palm Tract	2036		No	23800
Pescadero	2058		No	0
Pierson District	551		No	35400
Prospect Island	1667		No	8500
Quimby Island	2090		No	7100
Rindge Tract	2037		No	71800
Rio Blanco Tract	2114		No	2900
Roberts Island	-		-	-
Roberts, Lower	684		No	97400
Roberts, Middle	524		No	32100
Roberts, Upper	544		No	0
Rough and Ready Island	-		No	3700
Ryer Island	501		No	88700
Sargent Barnhart Tract	2074		No	3200
Sherman Island	341	41%	Yes	133600
Shima Tract	2115		No	8200
Shin Kee Tract	-		No	3800
Smith	1814		No	0
Stark	2089		No	3000
Staten Island	38	-4%	No	108400
Stewart Tract	2062		No	0
Sutter Island	349		No	10500
Terminous	548		No	102100
Twitchell	1601	19%	Yes	47900
Tyler Island	563		No	85600
Walnut Grove	554		No	2300
Union Island	1,2		No	103200
Van Sickle Island	1607	-	No	0
Veale Tract	2095		No	7500
Venice Island	2023	-	No	44700
Victoria Island	2040		No	74500
Webb Tract	2028	24%	Yes	80400
Weber	828		No	0
Winter Island	2122		No	0
Woodward Island	2072		No	21600
Wright-Elmwood Tract	2119		No	10700
-	307		No	0
-	369		No	2100
-	536		No	9600
-	765		No	0
-	813		No	0
-	900		No	0
-	999		No	6400
-	1608		No	3600
-	2084		No	15100
-	2093		No	8800
-	2095		No	0
-	2098		No	1500
-	2121		No	800
		941		139600

RECREATION

ISLAND ATTRIBUTE	DATA SOURCE and NOTES
State or regional parks, wildlife areas, and easements	Parisi, Monica. Geographic information System specialist. California Department of Fish and Game, Sacramento, CA. January 2 and 3, 1997 - telephone conversations. These figures do not include parks and boating facilities external to the levee system.
Recreation lands	DWR Land use mapping data. 1993. Recreational lands include commercial lands related to recreational activities. There are many areas of the Delta that are used for private recreation (e.g., waterfowl hunting) but are not categorized as 'recreational' lands. We were unable to get island-specific data on private recreation lands and hunting clubs. Therefore, these figures most likely underestimate all the recreational resources in the area.
Recreation resorts	DWR Delta atlas and Schnell, Hal. n.d. San Joaquin River - Sacramento River California Delta boating map. Stockton, CA. Most of these 'resorts' are marinas and boating facilities external to the levee system.

		Recreation		
ISLAND	Reclamation District	State or Regional Parks (Acres)	Recreation Lands (Acres)	Recreation Resorts
Bacon Island	2028	0	0.0	0
Bethel Island	-	0	6.4	19
Bishop Tract	2042	0	17.7	1
Boggs (Moss Tract)	404	0	0.0	2
Bouldin Island	756	0	0.0	0
Brack Tract	2033	358	0.0	0
Bradford Island	2059	0	0.0	0
Brannan/Andrus Island	-		0.0	24
Andrus	317	0	7.2	-
Andrus, Isleton	407	0	0.0	-
Andrus, Upper	556	0	5.2	-
Brannan	2067	0	93.4	-
Byron Tract	800	0	0.0	1
Canal Ranch	2086	0	0.0	0
Coney Island	2117	0	0.0	0
Dead Horse Island	2111	0	0.0	0
Empire Tract	2029	0	7.0	1
Fabian Tract	773	0	0.0	2
Fay	2113	0	0.0	0
Glanville Tract	1002	0	0.0	1
Grand Island	3	0	4.9	9
Hastings Tract	2060	0	0.0	0
Holland Tract	2025	0	0.0	2
Holt Station	2116	0	0.0	0
Hotchkiss Tract	799	0	0.0	18
Jersey Island	830	0	0.0	0
Jones Tract	-		0.0	-
Jones, Lower	2038	0	0.0	1
Jones, Upper	2039	0	0.0	1
King Island	2044	0	0.0	3
Little Mandeville	2118	0	0.0	0
Mandeville Island	2027	0	0.0	0
McCormack Williamson Tr	2110	0	0.0	0
McDonald Island	2030	0	0.0	0
Medford Island	2041	0	0.0	0
Merritt Island	150	0	0.0	1
Mildred Island	2021	0	0.0	0
Naglee Burke	1007	0	0.0	0
New Hope Tract	348	915	0.0	3
Orwood Island	2024	0	0.0	1
Palm Tract	2036	0	0.0	0
Pescadero	2058	0	9.3	0
Pierson District	551	0	0.0	3
Prospect Island	1667	0	0.0	1
Quimby Island	2090	0	0.0	0
Rindge Tract	2037	0	0.0	0
Rio Blanco Tract	2114	0	0.0	1
Roberts Island	-		-	-
Roberts, Lower	684	0	47.6	4
Roberts, Middle	524	0	0.0	0
Roberts, Upper	544	0	0.0	0
Rough and Ready Island	-	0	0.0	0
Ryer Island	501	0	17.0	2
Sargent Barnhart Tract	2074	0	32.5	3
Sherman Island	341	3100	66.7	7
Shima Tract	2115	0	0.0	0
Shin Kee Tract	-	0	0.0	2
Smith	1614	0	0.0	1
Stark	2089	0	0.0	0
Staten Island	38	0	0.0	0
Stewart Tract	2062	0	0.0	2
Sutter Island	348	0	0.0	1
Terminous	548	0	0.0	5
Twitchell	1601	0	0.0	1
Tyler Island	563	0	0.0	2
Walnut Grove	554	0	4.5	3
Union Island	1,2	0	0.0	0
Van Sickle Island	1607	0	0.0	0
Veale Tract	2065	0	0.0	0
Venice Island	2023	0	0.0	0
Victoria Island	2040	0	0.0	0
Webb Tract	2026	285	0.0	0
Weber	828	0	0.0	3
Winter Island	2122	0	0.0	0
Woodward Island	2072	0	0.0	0
Wright-Elmwood Tract	2119	0	0.0	1
-	307	0	0.0	1
-	369	0	0.0	0
-	536	0	0.0	0
-	765	0	0.0	N/D
-	813	0	0.0	0
-	900	0	0.0	2
-	999	0	0.0	1
-	1608	0	15.4	2
-	2084	0	0.0	1
-	2093	0	0.0	0
-	2095	0	0.0	0
-	2098	0	0.0	0
-	2121	0	0.0	0
			93.4	24
			0.0	