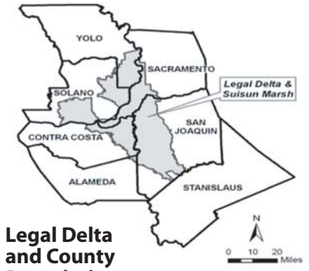
Levee Failures in the Sacramento-San Joaquin River Delta



Legal Delta and County Boundaries

The State of California has undertaken several major initiatives to define the risk of levee failure and improve physical systems and response capabilities necessary to reduce the impact of levee failures. As part of this effort, California's Department of Water Resources (DWR) has initiated the following:

Delta Risk Management Strategy (DRMS)

The focus of DRMS is to assess the potential risks associated with levee failures in the Delta. The DRMS project is part of a strategy for Delta sustainability that assesses major risks to Delta resources from floods, climate change, seepage, subsidence, and earthquakes. The DRMS project is evaluating the consequences of levee failures and developing recommendations to reduce and manage the risk. The first DRMS phase, risk analysis development, is essentially complete. The risk analysis and evaluation includes the assessment of various Delta assets and infrastructure, as well as preparation of detailed geographic maps. The second phase includes the development of an inventory of measures to reduce risk; this will be completed in November 2007. The resulting analyses will provide DWR with scenarios that can be used to identify desired response capabilities and gaps in capabilities and to develop recommendations for improvements.

Development of an Emergency Operations Plan (EOP)

The EOP will provide procedures for emergency preparedness and incident management to ultimately enhance the state's capabilities to prepare for, respond to, and recover from a catastrophic levee failure event. DWR will develop an initial response strategy based on the potential impact of an earthquake that causes levee failures on 20 islands; it will test hydrodynamic and other quantitative modeling for use in response decision making. The EOP will consider short-term, life-safety requirements as well as long-term tabilization procedures. In developing the EOP, DWR will engage its partners in local, state, and federal government and in the private sector to ensure consistent regional and statewide procedures are implemented and to facilitate effective use of available resources during such an event.

Emergency Response Pre-Event Early Implementation Actions

DWR is committed to implementing pre-event activities that will significantly enhance response capabilities for a Delta levee failure disaster. Through recent bond measures, up to $75 million have been earmarked to enhance DWR's response capabilities through pre-event actions. For example, DWR is developing real-time modeling tools that will provide analytical capabilities for decision makers during the emergency response phase and facilitate long-range planning during the recovery phase. Consideration also has been given to actions to decrease response time, such as stockpiling material at key locations; installing physical measures to reduce impact, such as design of barriers or gates; and implementing operational components, such as reservoir releases. Throughout the process, DWR may select improvements for immediate implementation as they are identified, depending on the criticality, cost, and constraints associated with implementation.

INTRODUCTION

The Sacramento-San Joaquin Delta (Delta) is an important resource to California for:

- AGRICULTURAL,
- URBAN,
- INDUSTRIAL,
- ENVIRONMENTAL, and
- RECREATIONAL USES.

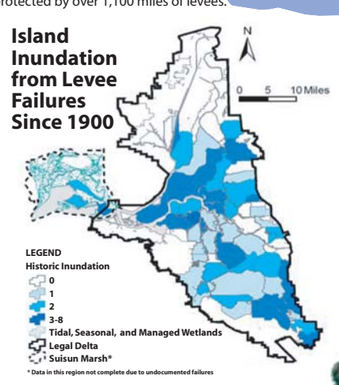
The Delta supplies about two-thirds of Californians with drinking water and millions of acres of agricultural land with irrigation water. It includes approximately 60 islands, which are protected by over 1,100 miles of levees.

The Delta is particularly vulnerable to levee failures due to its location, aging infrastructure, low elevation, and subsidence.

Levee failures can be caused by:

- OVERTOPPING – due to floods, tidal fluctuations, and wind-driven waves; and
- STRUCTURAL FAILURE – caused by inadequate foundations, subsidence, seepage, erosion, and burrowing animals. Earthquakes also can cause soil liquefaction and levee failure.

Island Inundation from Levee Failures Since 1900



During the last century, there have been over 160 levee failures. In addition to threatening life and property and disrupting the economy, Delta levee failures can threaten the water supply by allowing seawater from San Francisco Bay to enter areas that are critical to the distribution of freshwater.

2004 JONES TRACT

Date of Breach: June 3, 2004 at approximately 7:50 a.m.

Breach Location: West Levee of Upper Jones Tract (Lower Jones Tract was flooded by water passing under railroad trestle)

Cause of Breach: Unknown

Water Body: Middle River

Area of Island: 12,000 acres

Volume of Water: 160,000 acre-feet (average depth of 12 feet)

Flood-Fight Response:
- Protect Highway 4 from failure by Trapper Slough
- Prevent the failure of Jones Tract perimeter levees and adjacent levee islands
- Close the levee breach
- Minimize saltwater intrusion into the Delta

Repair Time:
- Raising of Trapper Slough was completed on June 8, 2004
- Breach closure and protection of interior levee slopes were completed on June 30, 2004
- Dewatering was completed December 18, 2004

Cost of Repair: Approximately $90 million

Distribution of Levee Failures Since 1900

DECADE	NUMBER OF ISLANDS	NUMBER OF BREACHES
1900 - 1910	28	57
1911 - 1920	2	3
1921 - 1930	3	3
1931 - 1940	15	18
1941 - 1950	12	14
1951 - 1960	9	12
1961-1970	4	5
1971 - 1980	10	10
1981 - 1990	15	24
1991 - 2000	12	15
2001 - Present	2	2
TOTAL:	114	163

Total Number of Levee Breaches over the Decades

Number of Islands Flooded by Levee Breaches over the Decades

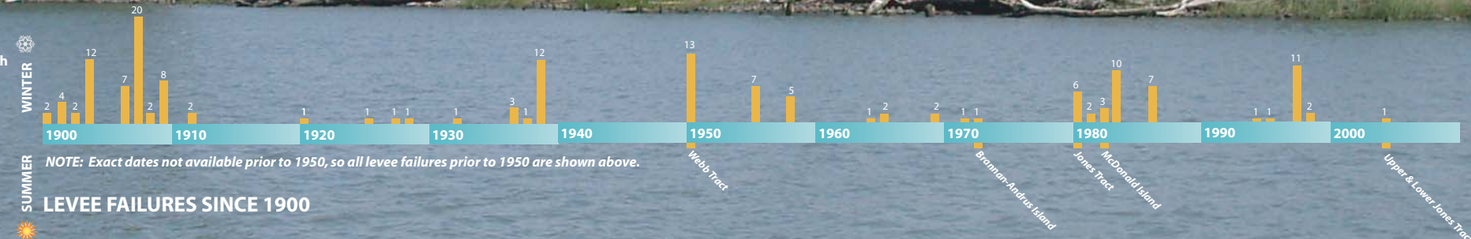
THE RISK

Delta levees are particularly vulnerable to failure. Since the Delta is near active earthquake faults, one earthquake could cause the failure of multiple levees during a non-high water event. This not only threatens life and property in the Delta itself, but would disrupt water supplies throughout California. Risk is a combination of the likelihood that something will happen and the costs of the event.

WINTER VS. SUMMER

The time of year of a failure is an important factor in determining risk. Overtopping is common during high water events in the winter. Multiple failures during large floods generally do not pose an immediate threat to water supplies outside the Delta.

In contrast, a structural failure during a period of low inflow, such as summer, can draw ocean salinity into the Delta. The saline water could cause a multi-year disruption to statewide water use. Large-scale disruptions could cost hundreds of billions of dollars annually.



NOTE: Exact dates not available prior to 1950, so all levee failures prior to 1950 are shown above.

LEVEE FAILURES SINCE 1900

This poster was prepared by Vivian Gaddie (URS Corporation), Michael Mierza (DWR, River Forecasting Section), and Jenny Marr (URS Corporation).

Please visit DWR's website for more information on Delta levee programs:
www.water.ca.gov

Acknowledgments: Maury Roos, Herb Hereth