

Chapter 7

Reduce Risk to People, Property, and State Interests in the Delta

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Water Code sections 85305, 85306, 85307, and 85309 require the Delta Plan to include or otherwise consider specific ~~objectives~~ components to attempt to reduce risk.

85305. (a) The Delta Plan shall attempt to reduce risks to people, property, and state interests in the Delta by promoting effective emergency preparedness, appropriate land uses, and strategic levee investments.

(b) The council may incorporate into the Delta Plan the emergency preparedness and response strategies for the Delta developed by the California Emergency Management Agency pursuant to Section 12994.5.

85306. The council, in consultation with the Central Valley Flood Protection Board, shall recommend in the Delta Plan priorities for state investments in levee operation, maintenance, and improvements in the Delta, including both levees that are a part of the State Plan of Flood Control and non-project levees.

85307. (a) The Delta Plan may identify actions to be taken outside of the Delta, if those actions are determined to significantly reduce flood risks in the Delta.

(b) The Delta Plan may include local plans of flood protection.

(c) The council, in consultation with the Department of Transportation, may address in the Delta Plan the effects of climate change and sea level rise on the three state highways that cross the Delta.

(d) The council, in consultation with the State Energy Resources Conservation and Development Commission and the Public Utilities Commission, may incorporate into the Delta Plan additional actions to address the needs of Delta energy development, energy storage, and energy transmission and distribution.

85309. The department, in consultation with the United States Army Corps of Engineers and the Central Valley Flood Protection Board, shall consider a proposal to coordinate flood and water supply operations of the State Water Project and the federal Central Valley Project, and submit the proposal to the council for considerations for incorporation into the Delta Plan. In drafting the proposal, the department shall consider all related actions set forth in the Strategic Plan.

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Chapter 7

Reduce Risk to People, Property, and State Interests in the Delta

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4 Reducing flood risks to people, property, and State interests ~~in the Delta~~ is critical to achieving the Delta
5 Reform Act's coequal goals and protecting the Delta as a place. The Legislature has found that the ~~Delta's~~
6 ~~Delta leveed islands and tracts, and portions of its uplands are~~ "inherently floodprone" ~~areas of critical~~
7 ~~statewide significance due to the public safety risks and the costs of public emergency responses to~~
8 ~~floods. Improvement and ongoing maintenance of the levee system is a matter of continuing urgency to~~
9 ~~protect the reliability of water supplied from the Delta; the Delta's ecosystems; the quality of its water;~~
10 ~~and its residents, farmlands, cities, towns, and businesses. The Legislature has recognized that the Delta is~~
11 ~~inherently floodprone,~~ and that further improvements and continuing maintenance of the levee system
12 will not resolve all flood risks (Public Resources Code 29704). Living with risk, whether from floods,
13 earthquakes, fires, coastal storms, or other hazards, is often part of life in California. The Delta's hazards,
14 however, are exceptional because they affect so many State interests, including the reliability of its water
15 supplies, the health of the Delta's ecosystem, and the qualities that make the Delta an attractive place to
16 live, work, and recreate.

17 To reduce these risks to people, property, and State interests in the Delta, ~~t~~The Delta Reform Act requires
18 that the Delta Plan promote effective emergency response and emergency preparedness and promote
19 appropriate land use ~~to attempt to reduce risks to people, property, and State interests in the Delta~~ (Water
20 Code section 85305). The Delta Reform Act also directs the Delta Stewardship Council (Council), in
21 consultation with the Central Valley Flood Protection Board (Flood Protection Board), to recommend
22 priorities for State investments in levee operation, maintenance, and improvements in the Delta, including
23 both levees that are a part of the State Plan of Flood Control and non-project levees (Water Code section
24 85306). ~~The provisions that follow fulfill these requirements.~~

25 The Council envisions a future in which risks of flooding in the Delta are reduced, despite an increase in
26 sea levels and altered runoff patterns. ~~The Council sees a future, and~~ where Delta residents, local
27 governments, and water project operators, and businesses are better prepared to respond when floods
28 threaten. The Council envisions a future where bBypasses are expanded; channels are improved; and
29 strong, well-maintained levees protect local communities—but also protect State interests in a more
30 reliable water supply for California; and a protected and restored Delta ecosystem. Delta cities and, where
31 needed, water project facilities, from flood threats. These improvements will include new or expanded;
32 floodways and bypasses, maintaining and improving levees, and floodproofing existing and new
33 development. The Council envisions that Inrural areas and the Delta's Delta's Legacy Communitlegacy
34 communities will also be protected from; flood risks; ~~will be reduced~~ by careful land use planning that
35 discourages urban development in flood-threatened areas, designating floodways maintaining and
36 improving levees, and flood proofing development. Also, expanded or new bypasses and setback levees
37 will be contributing to restoration of the Delta ecosystemThe Council envisions that lLocal agencies will
38 be better financed and protected through a locally controlled emergency response and flood protection

~~district, with fee assessment authority. will be more capable of financing flood management projects, with access to State funds for desired projects will be focused at State interests in the Delta, but some of that activity will protect local interests as well. that reduce risks to water supplies from the Delta; protect, enhance, or restore the Delta ecosystem; or protect the unique values of the Delta as a place. Eliminating flood risks will be impossible, but prudent planning, reasonable land development, and improved organization of flood management activities will significantly reduce risk, and serve the coequal goals of a more reliable water supply, and a protected and restored Delta ecosystem. -vulnerabilities and exposure to flood damage.~~

About this Chapter

This chapter provides an overview of flood risk in the Delta, current flood management efforts, and the most pertinent agencies and regulations. It presents a detailed discussion of the Council's core strategies to reduce risk to people, property, and State interests in the Delta. These core strategies form the basis of the policies and recommendations found at the end of the chapter. The Council's core strategies for reducing flood risks in the Delta are as follows:

- ◆ Improve emergency preparedness and response
- ◆ Finance and implement flood management activities
- ◆ Prioritize flood management investment
- ◆ Improve residential flood protection
- ◆ Protect and expand floodways, floodplains, and bypasses
- ◆ Integrate Delta levees and ecosystem function
- ◆ Limit liability

Reducing flood risks in the Delta also relies on locating urban development in the ~~Delta's~~ cities where levees are stronger, as proposed in Chapter 5, and retaining rural lands for agriculture, so that development in the most floodprone areas is minimized.

Delta Hazards Threaten Both Coequal Goals and the Delta as a Place

The risks that flooding, earthquakes, and other hazards pose to the Delta imperil California's water supplies and the health of the Delta ecosystem. The channels that convey water through the Delta to users in the Bay Area, San Joaquin Valley, or southern California and the islands that prevent saltwater intrusion into Delta water supplies depend upon levees for their preservation. Should the levees that protect these channels fail, the impacts on water supplies could be felt statewide. Improving these Delta levees is an investment in water supply reliability. Another way to reduce these risks is for areas that use Delta water to develop plans for possible interruption of these supplies in a catastrophic event, as recommended in Chapter 3. Integrating water supply and flood control efforts is also important to optimize the management of the multi-purpose reservoirs that store water for the CVP, SWP, and other water users. For example, a potential benefit of wide flood bypasses leading to the Delta may be greater flexibility in these reservoir operations, creating new opportunities to manage water supplies or generate hydroelectric power.

The Delta levees also affect the health of the ecosystem. Many birds, such as waterfowl or sandhill cranes, thrive in areas that depend on levees for their management. In some locations, careful removal or breaching of levees may create new habitats that benefit fish and wildlife and the ecosystem. Setting levees back deliberately, when feasible, can create both more capacity for flood flows and more habitat for fish and wildlife. But unplanned levee failures often create weed-infested depths that harbor nonnative

1 [species rather than refuges for smelt, salmon, or other preferred species. Changes in the area protected by](#)
 2 [levees also alter water circulation through the Delta, changing the benefit of flows released to protect its](#)
 3 [ecosystem.](#)

4 [The Delta's residents, farms, and businesses also depend on its levees. They shape the Delta landscape,](#)
 5 [protecting its farms and communities from destruction. The levee system is the foundation on which the](#)
 6 [entire Delta economy is built, the Delta Protection Commission's \(DPC's\) Economic Sustainability Plan](#)
 7 [reports \(DPC 2010a\). Delta residents built the levee system over generations, and they are keenly](#)
 8 [interested in its maintenance and improvement.](#)

DELTA DISASTER RECALLED

[On a moonlit Wednesday night in June 1972, the San Joaquin River flowed slowly after one of the driest winters on record. It gnawed at the Andrus Island levee 6 miles south of Isleton between Bruno's Yacht Harbor and Spindrift Resort, opening a small hole that grew rapidly. By the time sheriff's deputies arrived on scene shortly after 1 a.m., the river had carved a 100-foot break. By 3 a.m., water covered Highway 12. Shortly after sunrise, the breach had grown to 300 feet, and volunteers were hard at work on a 1.5-mile-long bow levee to protect Isleton.](#)

[The battle to save Isleton continued throughout the day, but a rising tide and waves created by 30- to 45-mile-per-hour Delta winds hampered efforts. Within a few hours, officials ordered the evacuation of 1,400 Isleton residents and an additional 1,500 residents of Andrus and Brannan Islands. At 9:45 p.m. Thursday, the bow levee breached and a wall of water rushed in to the low-lying residential area of Isleton. Although the city's business district was spared, almost all of Andrus Island and portions of Brannan Island were flooded, in some places up to 20 feet deep.](#)

[Then-Governor Ronald Reagan declared the islands a disaster area and asked President Richard Nixon to do the same. Over the next 6 months, the levee was repaired, the 12,000-acre lake that had been Brannan and Andrus Islands was drained, and life began returning to normal. A full year after the levee break, however, more than one-third of the residents had neither moved back into their homes nor begun to rebuild.](#)

[Officials estimated that damages were \\$21.8 million, slightly more than half of that from crop loss and saltwater damage to farmland. The cost for levee repairs was put at \\$800,000, and \\$500,000 went to pump the 20 square miles of flooded land dry. More than \\$1.5 million in federal disaster relief was made available. No definitive cause was ever determined for the levee breach, and a subsequent court case absolved the State of liability. \(DWR 1973, Sacramento River Delta Historical Society 1996\)](#)

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9 **Flood Risk in the Delta**

10 The Delta is an inherently floodprone area. This section provides an overview of the causes and risks of
 11 floods in the Delta. The Sacramento and San Joaquin rivers collectively drain approximately
 12 42,500 square miles of land. Before the Delta was modified by levees and other human structures, these
 13 rivers' natural flows overflowed the Delta's low-lying islands and floodplains for long periods each
 14 spring. The biggest floods occurred when warm Pacific storms swept in from the west and southwest,
 15 picking up moisture over the ocean and causing torrential rains when intercepted by the mountains
 16 surrounding the Central Valley. The risks of flooding were increased when large amounts of sediment
 17 were discharged to ~~the~~ Central Valley's rivers during the Gold Rush, choking their channels and raising
 18 their beds above their natural levels and surrounding lands.

19 Today, flooding of the Delta's complex labyrinth of islands and waterways is prevented by its levees.
 20 This system of flood control is supplemented by the flood facilities of the Sacramento [River and -](#)
 21 San Joaquin [River](#) ~~F~~lood ~~C~~ontrol ~~P~~rojects and multipurpose reservoirs like Shasta, Folsom, and

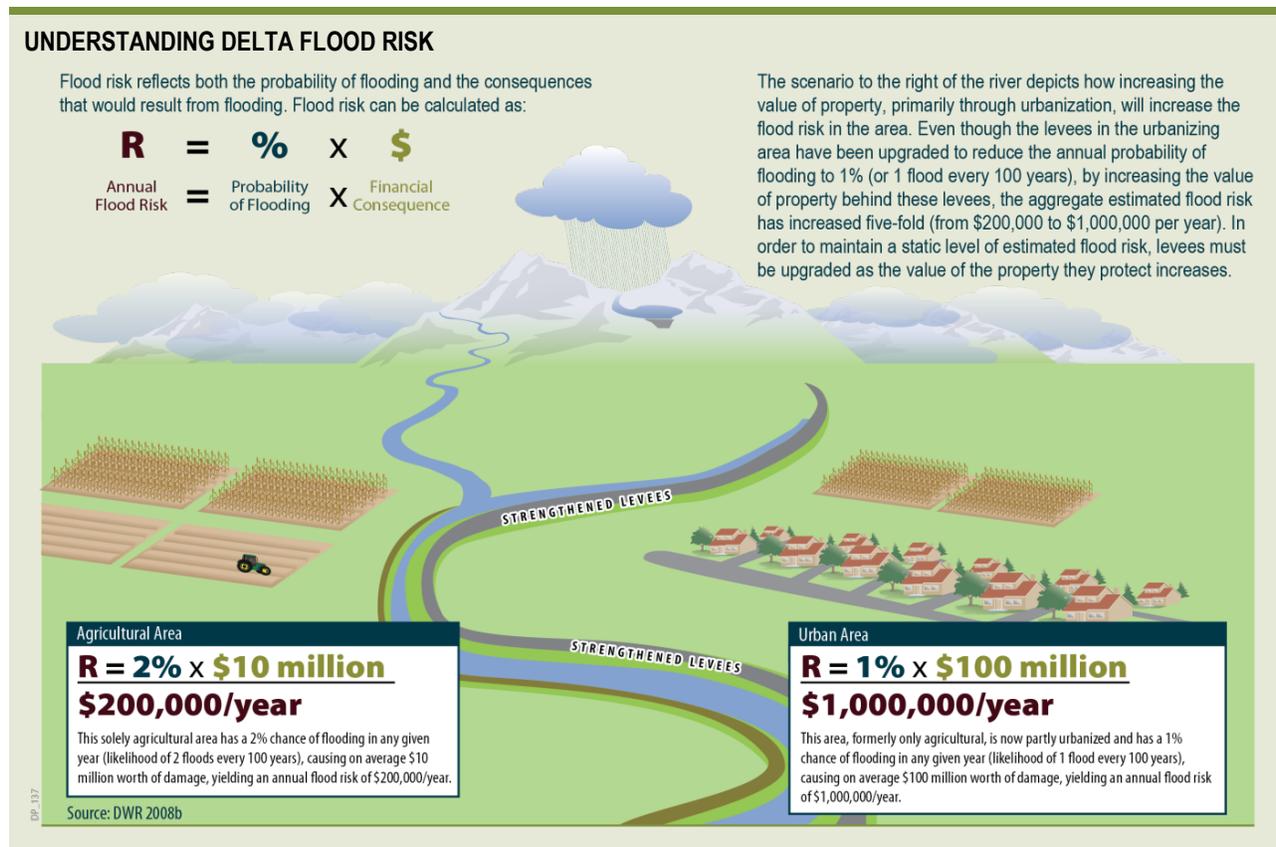
1 Millerton lakes and Lake Oroville on the Sacramento and San Joaquin rivers and their tributaries, which
2 hold back floodwater and provide water supplies and other benefits described in Chapter 3.

3 Many Delta levees were initially constructed more than a century ago using primitive materials and
4 equipment. History has shown that structural failures of the levee system occur as a result of
5 extraordinary events, imperfect knowledge, and imperfect materials. Delta levees face potential threats
6 such as large runoff events, extreme high tides, wind-generated waves, earthquakes, subsidence, and sea-
7 level rise. Individually, each of these threats is enough to cause serious concern; together, they represent
8 the potential for catastrophic disruption of the Delta and its economic and ecological services.

9 A mass or even partial failure of the levee system would have real life-and-death impacts, and property
10 losses that could total billions of dollars. Delta flooding could interrupt the conveyance of water through
11 the Delta for the State Water Project (SWP), the Central Valley Project (CVP), in-Delta users, the Contra
12 Costa Water District, the ~~C~~ities of Antioch and Stockton, and others who depend on the Delta for
13 reliable water supplies (see Chapter 3 for a discussion of water supply reliability). Levee failures could
14 also damage key features of the Delta ecosystem, including managed wetlands in Suisun Marsh and
15 habitats of wintering greater sandhill cranes at Staten Island and nearby tracts. Unplanned levee failure
16 could also degrade water quality in the Delta, because tidewaters would flood into the bowl created by
17 ~~Delta islands~~ subsidence of Delta islands. These failures would draw saltwater from San Francisco Bay
18 and pollute Delta water with flood debris, farm chemicals, and other pollutants.

19 Levee failures also could flood homes, farms, and businesses, including historic structures in the Legacy
20 ~~Communit~~ legacy communities, and interrupt recreation and tourism. As noted in Chapter 5, about
21 116,000 residential structures are located in the 100-year floodplain of the Delta, mostly near Sacramento,
22 West Sacramento, and Stockton. Also, 8,000 residences are below mean higher high water, mostly on
23 ~~Bethel and Brannan-Andrus islands and Wright Elmwood Tract~~ (DWR 2008). Serious consequences also
24 could result from flood-related ~~loss of~~ damage to critical infrastructure in the Delta, including radio,
25 cellular telephone, and television transmission towers; electrical transmission lines, including Pacific Gas
26 and Electric Company, Sacramento Municipal Utility District, and Western Area Power Administration
27 lines; natural gas pipelines serving local gas fields and regional transmission systems; petroleum
28 pipelines; three State highways; and three interstate highways (DWR 2011a).

29 In simplistic terms, the concept of flood risk can be described as the likelihood of a flood event occurring
30 and the consequences of that event. To many, flood risk simply means the chance a storm event will
31 overwhelm the flood control system to some extent. ~~Figure 7-1 illustrates~~ The sidebar, Understanding
32 Delta Flood Risk, illustrates the variables ~~in understanding Delta flood risk~~, namely the probability of
33 flooding and the financial consequences. However, there are many other causes of flood risk, and the
34 consequences can be far more complicated than the immediate damage to property.



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1 **Figure 7-1**
 2 **Understanding Delta Flood Risk**
 3 *Source: DWR 2008b*

4 **NOTE: This graphic has been modified from the final staff draft (May 14, 2012) to make a stylistic correction.**

5 The best defense against these risks is first to better understand the Delta’s flood hazards, and then
 6 manage and control those risks to the extent possible through public awareness; adequate emergency
 7 management planning; structural and nonstructural improvements, including enforcement of existing
 8 flood management regulations; and repairs, rehabilitation, and improvement of levees (including setback
 9 levees) and flood channels. Improving our understanding of risks through further evaluation and analysis
 10 of the flood control system and the assets it protects is essential to developing a rational, prioritized
 11 approach to flood management and public investment.

12 **Floods**

13 Floodings during winter storms that results in cause high water surface elevations and high winds have
 14 been a common cause of levee failures in the Delta. For example, the Sacramento River at Rio Vista may
 15 flow in excess of 300,000 cubic feet per second (cfs) during winter and early spring floods, 30 times
 16 typical late-summer flows of 10,000 cfs. Peak discharges place high stress on Delta levees and can create
 17 flood conditions, especially when coupled with high tides.

18 The likelihood of levee failures caused by high water is substantial, based on the historical performance
 19 of these levees over the last century. During the last century, there have been more than 140 levee failures
 20 and island inundations, most of which occurred during flood seasons (DWR 2005). High water in the
 21 Delta can overtop levees, as well as increase the hydrostatic pressure on levees and their foundations,

1 causing instability and increasing the risk of failure due to through-levee and/or under-levee seepage.
2 Most levee failures in the Delta have occurred during winter storms and related high-water conditions,
3 often in conjunction with high tides and strong winds.

4 Earthquakes

5 The Delta's levees are also at risk from the active seismic zones west of the Delta, including the San
6 Andreas and Hayward faults. [Less-active faults underlie the Delta](#). A strong earthquake ~~here~~ could
7 damage Delta levees because of the potential for liquefaction of levee embankments and foundations.
8 Saturated levees composed of dredged materials in other parts of the country and the world have
9 performed poorly during moderate to strong earthquake shaking (DWR 2009a; Delta Stewardship Council
10 Staff 2010a). If a levee failed during high flows or if a flood were to occur soon after an earthquake, the
11 protected area could be inundated.

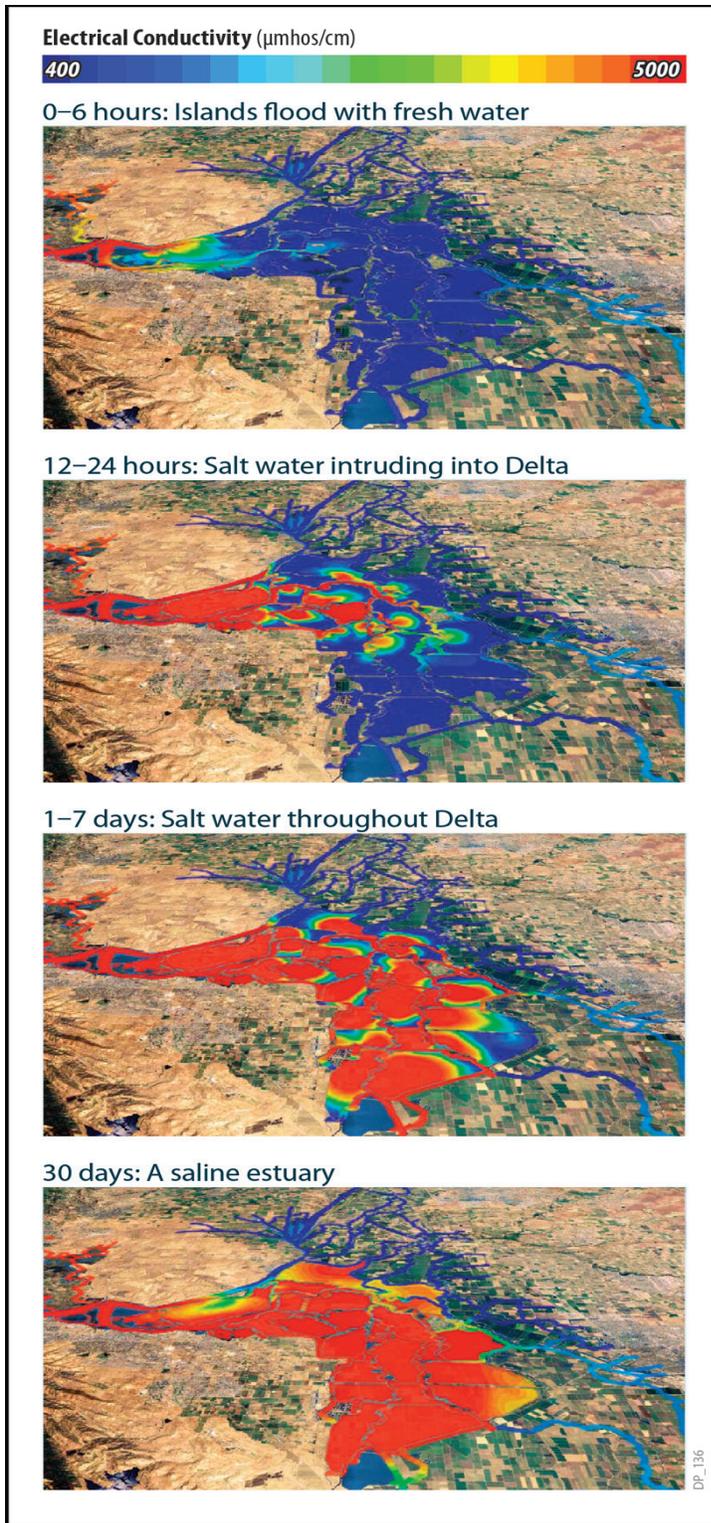
12 [The risks of earthquakes causing levee breaches and island inundations in the Delta have long been](#)
13 [recognized. A California Department of Water Resources \(DWR\) report begins:](#)

14 *[There is a long history of levee failures in the Delta that have resulted in extensive economic](#)*
15 *[damage, but no failures of Delta levees are known to be directly attributable to](#)*
16 *[earthquakes. Even so, two factors indicate a possible bleak picture for the future of many Delta](#)*
17 *[levees. First, no serious causative quakes have occurred on the nearby major faults](#)*
18 *[since the San Francisco earthquake of 1906. Second, the Delta levees of today are vastly different](#)*
19 *[than those in the 1906 Delta, which had limited size and extent. \(DWR 1980\)](#)*

20 ~~The California Department of Water Resources'~~ (DWR) Delta Risk Management Strategy Phase 1 study
21 evaluated the performance of Delta levees under various seismic threat scenarios, and analyzed potential
22 consequences ~~to a variety of factors including~~for water supply, water quality, ecosystem values, and
23 public health and safety. The study concluded that a major earthquake of magnitude 6.7 or greater in the
24 vicinity of the Delta Region has a 62 percent probability of occurring sometime between 2003 and 2032
25 (DWR 2009a). Figure 7-1~~2~~ illustrates a potential flood scenario in which a 6.5-magnitude earthquake
26 causes a 20-island failure. Although the probabilistic nature of earthquake prediction makes it difficult to
27 quantify the timing and magnitude of seismic threats, [it is important to address the threats posed by](#)
28 [earthquakes to the Delta levee system](#) because of the potential adverse effects of such ~~an events,~~ ~~it is~~
29 ~~important to address the threats posed by earthquakes to the Delta levee system.~~

30 High Tides and Sunny-day Risks

31 Even without an earthquake or flood, Delta levees can fail during high tides or even on sunny days.
32 Generally, these failures may be the result of a combination of high tide and pre-existing internal levee
33 and foundation weaknesses caused by burrowing animals, internal erosion of the levee and foundation
34 through time, and human interventions such as dredging or excavation at the toe of the levee (DWR
35 2008b). Examples of sunny-day failures include the Brannon Andrus Tract in 1972 and Upper Jones Tract
36 in 2004. It is estimated that, based on current conditions, a sunny-day failure would occur once every
37 9 years on average (DWR and DFG 2008).



1
 2 **Figure 7-12**
 3 **Simulation of Delta Salinity After a 20-island Failure Caused by a Magnitude 6.5 Earthquake**
 4 *Source: MWD 2010*

5 **NOTE: This graphic has been modified from the final staff draft (May 14, 2012) to make a stylistic correction.**

1 | Other hazards that affect the performance of [Delta](#) levees ~~within the Delta~~ include encroachments,
2 | penetrations, and burrowing animals. Encroachments such as structures or farming practices on or close to
3 | the levee; penetrations of the levee, such as culverts or pipelines; and burrows created by rodents,
4 | especially beavers, muskrats, and squirrels, can weaken the structural integrity of levees. Because of
5 | unregulated historical construction, levees also contain many hidden hazards. Active programs of
6 | inspection, oversight, and maintenance are essential to minimize these hazards.

7 | Land Subsidence

8 | Because of the land subsidence described in Chapter 5, much of the central Delta is below sea level. Some
9 | islands are 12 to 15 feet below sea level, requiring levees 20 to 25 feet in height that act as dikes, holding
10 | back water continually rather than only during seasonal floods or extreme tides. As subsidence
11 | progresses, accommodation space increases and levees must be continually maintained, strengthened, and
12 | periodically raised to support the increasing hydraulic stresses (Miller 2008; Mount and Twiss 2005). The
13 | hydraulic stress also can drive seepage through and under levees, and place levee foundations under more
14 | stress. The thinning of the peat soil layer also causes shallow or artesian groundwater conditions. More
15 | seepage onto islands will increase the drainage costs associated with additional pumping and decrease
16 | levee stability. ~~As organic soils disappear and drainage ditches on deeply subsided islands are deepened,
17 | coarse-grained materials under levees will mobilize to drainage ditches and cause levee foundational
18 | instability~~ (Deverel and Leighton 2010).

19 | Climate Change and Flood Risk

20 | Climate change has major implications for the Delta, and especially for flood risk management. It is
21 | estimated that by the year 2100, sea levels may rise 31 to 69 inches (California Climate Action Team
22 | 2010; California Ocean Protection Council 2011), putting additional stress on levees and increasing their
23 | risk of failure. Projected changes in the timing and intensity of runoff may increase peak storm runoff and
24 | high-frequency flood events (DWR 2008c). Such floods could interrupt water conveyance through the
25 | Delta for those who depend on the Delta for water.

26 | Additionally, scientific understanding of large-scale precipitation events is growing, as demonstrated by
27 | the ARkStorm scenarios being investigated by the U.S. Geological Survey, which indicate that massive
28 | storms and subsequent flooding have occurred and are likely to occur again (USGS 2011). Failure of
29 | significant parts of the Delta's flood management system may be unavoidable.

30 | Planning for Flood Management

31 | This section summarizes the current state of flood management planning for the Delta. To reduce the risk
32 | of flooding, Delta landowners, local governments, and State and federal agencies have planned and built
33 | an extensive levee system in the Delta, and significant flood control works upstream of the Delta. Other
34 | government flood control programs plan for emergency response in the event of floods, or help manage
35 | flood risks through land use planning, building standards, and flood insurance. The Delta Reform Act
36 | refers to these government-sponsored flood control programs in its provisions regarding covered actions
37 | (Water Code section 85057.5(a)(4)). The sidebar, [What Is a Government-Sponsored Flood Control
38 | Program?](#), highlights those programs referenced in statute, and proposed actions in the Delta that will
39 | have a significant impact on the implementation of one of these programs may be considered covered
40 | actions. Chapter 2 provides details about covered actions.

41 | ~~The Delta includes~~ [There are](#) more than 1,335,000 miles ~~of levees of project and non-project levees in the~~
42 | [Delta and Suisun Marsh. Differences in how levees are classified can influence reports about their length](#)
43 | [and condition](#). Approximately 65 percent of the levees in the Delta and all levees in the Suisun Marsh are
44 | owned or maintained by local agencies or private owners and are not part of the ~~State and federal~~

1 ~~government's flood control projects on the~~ Sacramento ~~River~~ and ~~San Joaquin Rivers Flood Control~~
 2 ~~projects~~. Most of these “non-project” levees are maintained by local reclamation districts created and
 3 funded by landowners, initially for the purpose of draining (“reclaiming”) ~~the Delta's~~ islands and tracts.
 4 The reclamation districts continue to maintain levees and other water control facilities today. [These non-](#)
 5 [project levees are defined in Water Code section 12980\(e\).](#)

6 Many facilities throughout the Delta also drain
 7 rainfall runoff from land into Delta channels.
 8 Local cities and districts own and maintain urban
 9 storm drains in developed areas. Stockton,
 10 Sacramento, West Sacramento, [Lathrop](#),
 11 [Manteca](#), and Tracy are Delta cities with storm
 12 drainage facilities. Most [Delta islands in the](#)
 13 [Delta](#) have a network of agricultural drains and
 14 pumps to pump runoff into the Delta channels.
 15 Some Delta channels have been dredged to
 16 increase their capacity to carry floodwater and to
 17 obtain material for levee construction and
 18 maintenance.

19 The [flood control projects on the](#) Sacramento
 20 ~~River~~ and ~~San Joaquin Rivers Flood Control~~
 21 ~~Project~~ includes approximately one-third of the
 22 Delta's levees. Known as “project levees,” they
 23 begin on the left bank of the Sacramento River at
 24 Sherman Island, and line most of the river's
 25 banks, as well as the Sacramento River
 26 Deepwater Ship Channel and some connecting
 27 waterways, north to Sacramento and beyond. The
 28 Delta Cross Channel's control gates are an
 29 important feature of this levee system, closing
 30 during high flows to keep the Sacramento River's
 31 floodwaters out of the central Delta. The flood
 32 control project also includes the Yolo Bypass, the
 33 broad, managed floodplain in Yolo County west
 34 of West Sacramento. The wide bypass, which is
 35 confined by project levees, draws floodwater through weirs above Sacramento to lower flood heights on
 36 the Sacramento River and its tributaries, discharging back to the Delta above Rio Vista. The Yolo Bypass
 37 floods about once every 3 years, between December and February. On the San Joaquin River, project
 38 levees line the river banks from Old River to Stockton. Figure 7-23 shows the locations of project and
 39 non-project levees in the Delta.

40 Recent evaluations show that some facilities of the [flood control projects on the](#) Sacramento ~~River~~ and
 41 ~~San Joaquin Rivers Flood Control Project~~ are not adequate. Because the system was intended partly to
 42 flush Gold Rush-era sediment from rivers and channels, the project levees were often built close to the
 43 river banks, and are prone to erosion. Many of the system's channels have inadequate capacity to carry
 44 the flows for which they were designed, and many levees do not meet contemporary design standards
 45 (DWR 2011c).

46 The Flood Protection Board, as part of its responsibility to oversee the [flood control projects on the](#)
 47 Sacramento ~~River~~ and San Joaquin ~~Rivers Flood Control Project~~, has adopted regulations to control
 48 encroachments on the project and some of the streams that flow into it. It also regulates encroachments
 49 within designated floodways, which are the channels of a river or other watercourse and the adjacent land

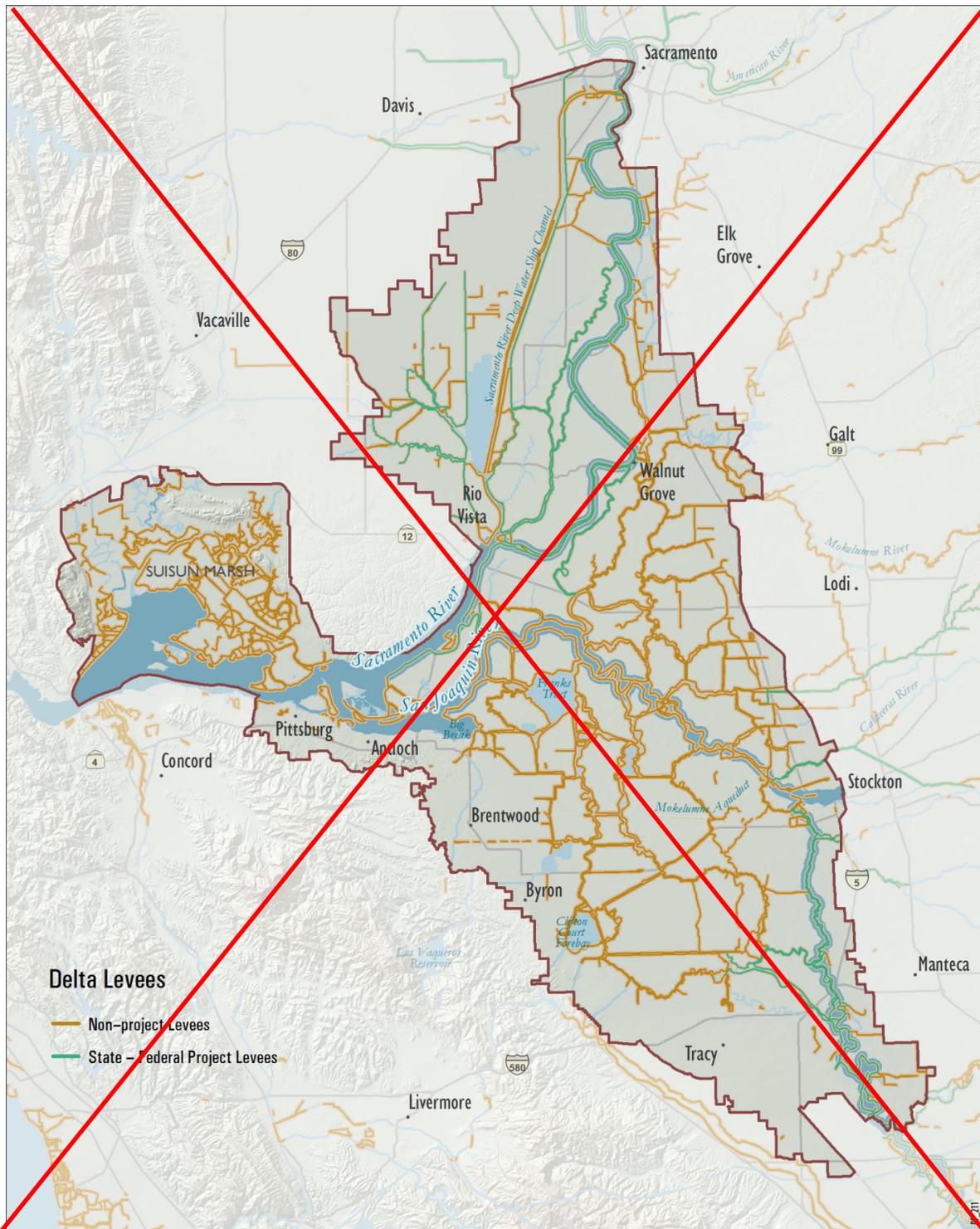
WHAT IS A GOVERNMENT-SPONSORED FLOOD CONTROL PROGRAM?

Any state or federal strategy, project, approval, funding, or other effort that is intended to reduce the likelihood and/or consequence of flooding of real property and/or improvements, including risks to people, property, and State interests in the Delta, that is carried out pursuant to applicable law, including but not limited to the following code:

- ~~Subventions Program, Special Projects Program~~ (State Water Resources Law of 1945, Water Code section 12570 et seq.)
- *Sacramento-San Joaquin River Flood Control Projects* (Flood Control Act of 1941, Public Law 77-228)
- *Local Plans of Flood Protection, (Water Code Section 8201)*
- *Central Valley Flood Protection Plan (Water Code section 9600 et seq.)*
- *Subventions Program, Special Projects Program (Water Code section 12300 et seq.)*
- *Way Bill 1973 – Subventions Program, Special Projects Program (Water Code section 12980 et seq.)*
- *Central Valley Flood Protection Board Authority (California Code of Regulations Title 23 Division 1)*
- *National Flood Insurance Program (National Flood Insurance Act of 1968, 42 U.S.C. 4001 et seq., Public Law 90-448)*

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- 1 areas that convey floodwaters (California Code of Regulations, Title 23, Division 1, Chapter 1, Article 2,
- 2 Section 4). In the Delta, designated floodways include the Cosumnes River's floodplain and the
- 3 confluence of the San Joaquin River and the Stanislaus River upstream from Paradise Cut.



4
5 **Figure 7-23**
6 **Project and Non-project or Unattributed Levees in the Delta**
7 *Source: DWR 2009b*

1 [Some levees are neither project levees nor non-project levees. These “unattributed levees” include](#)
 2 [hundreds of miles of levees in Suisun Marsh and the Delta and are not part of any State-financed flood](#)
 3 [control program. They also include some that are unmaintained along the perimeter of permanently](#)
 4 [flooded islands and no longer serve flood control or drainage purposes.](#)

5 Multipurpose reservoirs in the Sacramento and San Joaquin River watersheds that play a role in
 6 California’s water supply also serve critically important roles in managing floods that affect the Delta.
 7 The CVP’s Shasta, Folsom, and Millerton lakes and New Melones Reservoir; the SWP’s Lake Oroville;
 8 and other reservoirs are operated in accordance with flood control rules established by U.S. Army Corps
 9 of Engineers (USACE), reserving space to capture flood flows that can be released downstream gradually
 10 so that channels are not overwhelmed.

11 Many studies and planning efforts addressing flood management and emergency preparedness, response,
 12 and mitigation are under way, and will be considered by the Council for ongoing Delta flood risk
 13 management. These studies, efforts, and programs include the following:

- 14 ♦ *Central Valley Flood Protection Plan (CVFPP)*. This strategic plan for improving the [flood](#)
 15 [control projects on the Sacramento River and San Joaquin Rivers Flood Control Project](#)
 16 recommends approaches for reducing flood risk and improving the flood control project,
 17 including expansion of the Yolo Bypass and construction of a new San Joaquin River Bypass at
 18 Paradise Cut (DWR 2011c) (see sidebar).

CENTRAL VALLEY FLOOD PROTECTION PLAN

The Central Valley Flood Protection Act of 2008 directed the California Department of Water Resources (DWR) to prepare the *Central Valley Flood Protection Plan (CVFPP)*. The CVFPP is a flood management planning effort that addresses flood risks and ecosystem restoration opportunities in an integrated manner. It specifically proposes a systemwide approach to flood management for the areas currently protected by facilities of the State Plan of Flood Control (SPFC). The CVFPP ~~will be considered for adoption~~ [was adopted](#) by the Central Valley Flood Protection Board ~~by July 1~~ [in June](#), 2012. It is expected that the CVFPP will be updated every 5 years thereafter.

The CVFPP proposes a systemwide approach to address the following issues:

- Physical improvements in the Sacramento and San Joaquin River basins
- Urban flood protection
- Small community flood protection
- Rural/Agricultural area flood protection
- System improvements
- Non-SPFC levees
- Ecosystem restoration opportunities
- Climate change considerations

The geographic scope of the CVFPP includes ~~only~~ the portions of the Delta covered by the SPFC, [including about 65 miles of urban, non-project levees at Stockton](#); approximately two-thirds of Delta levees are not addressed in the CVFPP.

The effects of systemwide improvements directed by the CVFPP and the potential of redirected impacts to areas within the Delta will be monitored by the Delta Stewardship Council (Council) to ensure alignment with the coequal goals and the Delta Reform Act. Additionally, the Council may, at its discretion, incorporate those portions of the CVFPP into the Delta Plan to the extent that those portions promote the coequal goals (Water Code section 85350).

The 2012 CVFPP is only a descriptive document, highlighting a planning perspective at a reconnaissance level. Follow-on feasibility studies and project-specific development activities will be conducted over the next several years. The Council will continue to monitor and provide input to those activities to ensure that Delta flood risk issues are considered. Flood system improvement actions undertaken upstream of the Delta are of particular concern if not coupled with in-Delta actions that reduce overall systemwide flood risk.

DP_184

- 1 ♦ DWR’s FloodSAFE Initiative. In 2006, DWR launched FloodSAFE California – a
2 multifaceted initiative to improve public safety through integrated flood management.
- 3 ♦ DWR’s Delta Levees Program. This program encompasses both the Delta Levees Maintenance
4 Subventions and Delta Levees Special [Flood Control](#) Projects programs, which ~~focus on~~
5 providing State cost-share funding for Delta levee maintenance and upgrades.
- 6 ♦ *Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force Report*. This report
7 responds to Senate Bill (SB) 27 (Water Code section 12994.5), which called for the task force to
8 make recommendations to the Governor about Delta multi-hazard emergency response and
9 recovery issues.
- 10 ♦ USACE Delta Islands Levees Feasibility Study, Long-Term Management Strategy for Dredging
11 and Dredge Material Placement, Periodic Inspection Program, and Levee Safety Portfolio Risk
12 Management System. USACE has multiple programs addressing Delta-related flood management
13 issues, including levee safety, levee integrity, and the beneficial reuse of dredged material.
- 14 ♦ CVP and SWP Reoperation Studies. DWR’s Forecast-coordinated Operations Program and
15 Systems Reoperation Program address reservoir operational criteria, as noted in Chapter 3.

16 | The Council will consider these ~~studies’~~ findings [of these studies](#) and may incorporate them into future
17 Delta Plan updates. The CVFPP and FloodSAFE include many concepts relevant to flood protection in
18 the Delta. At the federal level, the National Committee on Levee Safety (2009) submitted a report to
19 Congress that outlined the critical components of a National Levee Safety Program and a high-level
20 timeframe and steps for its creation. It is up to Congress to act on these recommendations, which will be
21 monitored by the Council as they relate to the Delta Plan.

22 The Flood Protection Board, DWR, and USACE each play unique and critical roles in Delta flood risk
23 management. Because of this, the Council’s role in facilitation, coordination, and integration of various
24 agencies and other parties is of particular importance. Frequent, ongoing collaboration with other State,
25 federal, and local agencies to improve communication and coordination is essential to meeting the Delta
26 Plan’s flood management objectives.

27 **The Delta’s Levees**

28 The levees within the legal Delta protect approximately 740,000 acres of land. They define the Delta’s
29 physical characteristics; influence the reliability of its water supplies and its ecosystem’s health; and are
30 critical to the Delta’s residents, farms, businesses, cities, and ~~Legacy Communities~~ [legacy communities](#).
31 Because many Delta levees protect land below sea level, they hold back water all day, year-round, rather
32 than only during floods, and so are called “the hardest working levees” in America.

33 **Existing Levee Standards and Guidance**

34 It is more important than ever that the Delta’s levees are designed, constructed, and maintained to provide
35 a level of flood risk reduction commensurate with the coequal goals and protection of the Delta’s unique
36 values as a place. Over the last few decades, State and federal agencies have developed guidelines and
37 standards for levees. These standards establish minimum criteria for levee design and maintenance. The
38 standards include (1) the level of flood protection California has prescribed for the Central Valley’s urban
39 areas, (2) whether sufficient protection is provided by the levees to exempt development financed with
40 federally backed mortgages from requirements to obtain flood insurance, and (3) whether property and
41 infrastructure protected by the levees (including the levees themselves) are eligible for assistance in ~~ease~~
42 [the event](#) of a catastrophic emergency, including aid from USACE to rehabilitate levees damaged in an
43 emergency or for disaster assistance from the Federal Emergency Management Agency (FEMA).

1 ~~The f~~our levee standards and guidance applicable to the Delta are discussed below (and shown in
2 Figure 7-34); they are ordered from highest to lowest level of flood protection:

- 3 ◆ **DWR 200-year Urban Levee Protection (DWR - 200 Year):** This standard ~~is currently under~~
4 ~~development by DWR (2011b)~~. It goes beyond criteria for levee height and geometric design to
5 include requirements for freeboard, slope stability, seepage/underseepage, erosion, settlement,
6 and seismic stability (2011b). It protects against a flood that has a 0.5 percent chance of being
7 equaled or exceeded in any given year (a 200-year level of flood protection). ~~DWR's~~ ~~This~~ urban
8 levee standard is the only levee standard that specifically links land uses to levee criteria. State
9 law requires that by 2025, floodprone urban areas with over 10,000 residents must meet this
10 200-year flood protection standard (Government Code section 65865.5(a)(3)). Compliance likely
11 will be achieved by upgrading levees to meet the 200-year design standard, under development
12 by DWR. Sacramento, West Sacramento, and Stockton are planning levee improvements to attain
13 this level of protection.

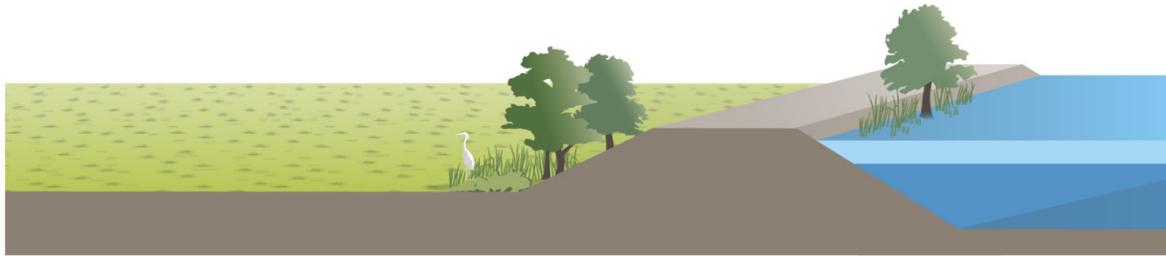
14 ~~Almost~~ ~~Very few~~ ~~no~~ levees in the Delta meet this standard because most Delta levees do not
15 protect urban areas. Under existing law, rural levees are not required to meet this standard.

- 16 ◆ **FEMA 100-year (Base Flood) Protection (FEMA - 100 Year):** This “insurance” standard,
17 often called the “1 percent annual chance flood” level of protection, provides criteria that levees
18 must meet to protect against the flooding that is the basis for FEMA’s flood insurance rate maps
19 (44 Code of Federal Regulations 65.10). It is often used with established USACE criteria to
20 prescribe requirements for levees’ freeboard, slope stability, seepage/underseepage, erosion, and
21 settlement. The standard generally does not address seismic stability. In communities where
22 levees provide this level of flood protection, new developments are not required to meet federal
23 floodproofing standards and can obtain federally guaranteed mortgages without purchasing
24 flood insurance.

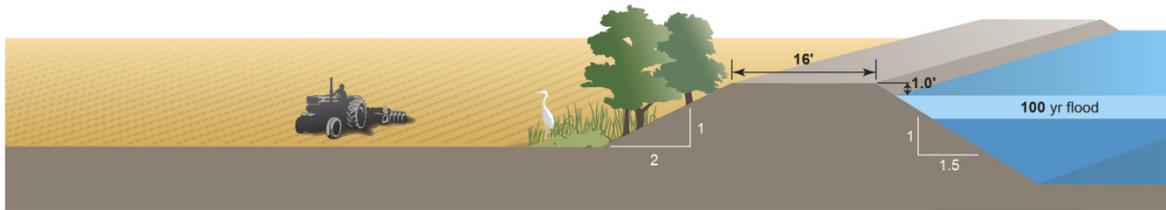
25 Few Delta levees outside of cities meet this standard, and many urban levees need improvement
26 to meet it.

- 27 ◆ **Public Law 84-99 (PL 84-99):** The PL 84-99 standard is a minimum requirement established by
28 USACE for levees that participate in its Rehabilitation and Inspection Program (33 United
29 States Code 701n) (69 Stat. 186). Twenty-five Delta reclamation districts, protecting about
30 31 percent of the legal Delta’s land behind about 516 miles of levees, are at or above this
31 standard, according to a recent report to the Council by DWR (DWR 2012). Delta islands or
32 tracts that meet this standard are eligible for USACE funding for levee rehabilitation, island
33 restoration after flooding, and emergency assistance, provided that the reclamation district is
34 accepted into ~~the~~ USACE’s program and passes a rigorous initial inspection and periodic follow-
35 up inspections. Eligibility for PL 84-99 was formerly based primarily on levee geometry with
36 minimum freeboard and maximum steepness of slopes. USACE’s periodic inspection program
37 incorporates other elements into eligibility, including presence of structure encroachments,
38 vegetation, rodent control programs, and more. The standard for levee geometry implies a
39 minimum levee height and a slope stability factor of safety, but is not associated with a level of
40 protection (such as a 100-year flood) and does not address seismic stability. In 1987, USACE
41 developed a Delta-specific standard based on the Delta’s particular organic soils and levee
42 foundation conditions. The CALFED Record of Decision set a goal of improving Delta levees to
43 the PL 84-99 standard, ~~as does the DPC Economic Sustainability Plan~~, but funding has been
44 inadequate to attain this objective.

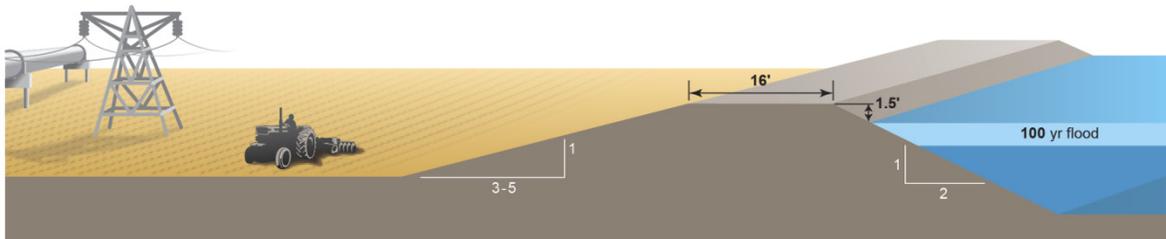
- 45 ◆ **FEMA Hazard Mitigation Plan (HMP) Guidance:** FEMA, DWR, the California Office of
46 Emergency Services (now the California Emergency Management Agency [Cal EMA]), and the
47 Delta levee maintaining agencies negotiated the HMP ~~standard~~ ~~guidance~~ to reduce the likelihood
48 of repetitive flood damage to Delta levees and islands, so that FEMA disaster assistance would



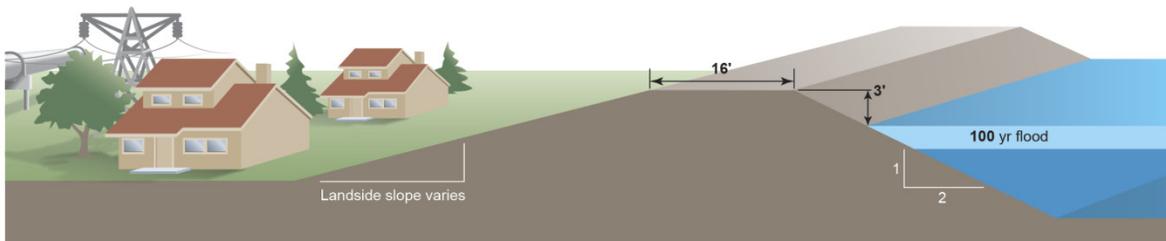
Wetlands/Habitat



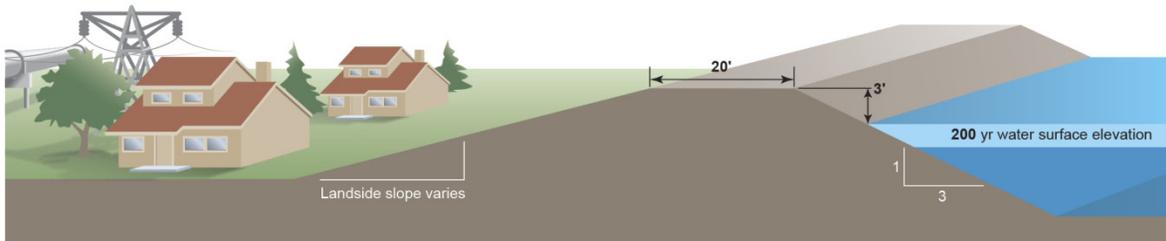
Hazard Mitigation Plan (HMP)



PL 84-99



FEMA - 100 year



DWR - 200 year (DWR Urban Levee Design Criteria 2011)

- 1
- 2 | **Figure 7-34**
- 3 | **Levee Guidance**
- 4 | *Source: Adapted from Delta Vision Blue Ribbon Task Force 2008 and DWR 2011b*

1 not be requested repetitively for the same islands after minor floods. Fifty-three of the Delta's
2 reclamation districts, protecting over 47 percent of the legal Delta's acreage, fall below this
3 standard, which ~~395~~139 miles of Delta levees do not meet (DWR 2012). Local communities that
4 do not meet the HMP ~~standard~~ guidance are not eligible for FEMA disaster reimbursement for
5 flood fights or assistance if levees fail or islands flood. If even a portion of the levee around an
6 island or tract does not meet the HMP ~~standard~~ guidance, assistance from FEMA to recover from
7 levee damage is unavailable. Fifteen districts comply with this ~~standard~~ guidance, but are below
8 the PL 84-99 standard. FEMA and Cal EMA have a memorandum of understanding, updated in
9 2010, that sets forth the requirements for FEMA public assistance funding for emergency flood
10 fighting, emergency repair, permanent restoration, and/or replacement of eligible damaged non-
11 project levees within Delta reclamation districts (Cal EMA and FEMA 2010). The ~~standard~~
12 ~~guidance~~ is based on geometric criteria for the levees. The HMP ~~standard~~ guidance, negotiated
13 between 1983 and 1987, was intended as an interim ~~standard~~ guidance, but has not been adjusted
14 based on subsequent or projected flood elevations.

15 No State standards currently address design criteria for flood protection of the State highways and
16 interstate highways that traverse the Delta. Federal standards require that ~~roads~~ interstate highways must
17 be protected from 50-year flood events to qualify for Federal Highway Administration funds (23 Code of
18 Federal Regulations 650.115). Because most roads in the Delta were constructed before these standards
19 were developed, they do not meet the standards. For example, sections of State Route 12 are 10 feet or
20 more below sea level. A flood on the islands this highway traverses could interrupt transportation and
21 trade, and put motorists at risk.

22 ***Levees and Ecosystem Function***

23 Historically, most discussion of levees has emphasized reducing flood risks to life and property.
24 However, habitat and ecosystem values and functions can provide multiple benefits, and must be
25 considered in flood management planning and actions. For example, the CVFPP includes a conservation
26 framework and strategy that outline how environmental elements can be integrated into flood
27 management activities and provide an environmental guide for flood project planning. Setting levees back
28 from the riverbank can expand flood conveyance capacity and reduce flood risk while providing
29 ecosystem restoration and recreational opportunities (USACE 2002). Setback levees also allow
30 opportunities for construction of an improved levee foundation and section using modern design and
31 construction practices, thereby reducing risk of failure.

32 Much discussion has occurred on how to more effectively accommodate ecosystem function with the
33 current levee system, highlighting the following issues (Healey and Mount 2007):

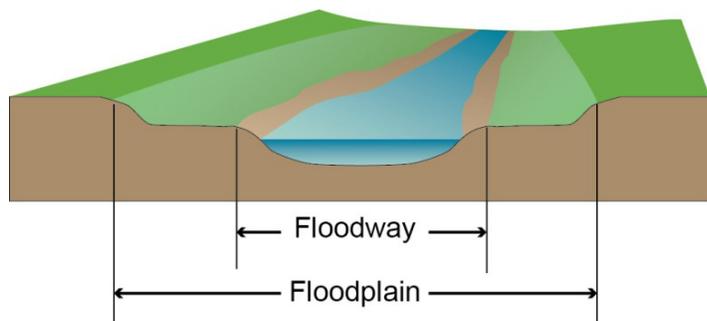
- 34 ♦ Current levees tend to be narrow, with steep waterside slopes that provide little upland
35 habitat value.
- 36 ♦ Setback levees may provide habitat value and increased levee integrity.
- 37 ♦ Levees can be used to promote specific habitat types (such as waterfowl habitat) by ensuring that
38 some areas of freshwater marsh are sustained.
- 39 ♦ Where lands are not heavily subsided, levees can allow for multiple land uses including habitat
40 management and wildlife-friendly agriculture.
- 41 ♦ Allowing levees to fail on deeply subsided islands would not generate any obvious
42 ecological benefits.
- 43 ♦ Subsidence reversal on deeply subsided islands would rely on levees to appropriately manage
44 water levels during tule growth.

1 As management efforts in the Delta proceed, it will be important to consider ecosystem functions and
2 their interactions with the levee system, as discussed in Chapter 4. An example where these interactions
3 are already being debated is the USACE’s current policy requiring removal of vegetation from levees.
4 Scientific support for and against this policy is mixed. Concerns with maintaining woody vegetation on
5 levees include difficulties with inspection and flood fighting, potential for root holes, and trees toppling
6 with from erosion. Other evidence, however, suggests that woody shrubs and small trees on levees
7 enhance levee structural integrity while providing environmental benefits. A study on a channel levee
8 along the Sacramento River concluded that roots reinforced the levee soil and increased shear resistance
9 by providing increased stability against slope failures (Shields and Gray 1992). In either case, the
10 widespread removal of vegetation from Delta levees could have significant adverse environmental
11 impacts that are not well understood.

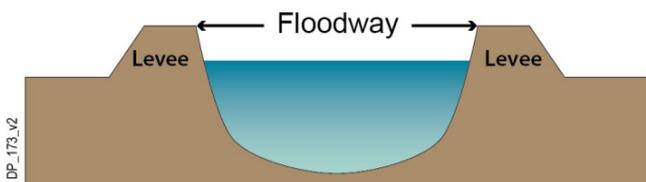
12 Floodplains and Channels

13 Floodplains and channels that provide the capacity to carry and store flood flows are critical for managing
14 flood risks and for overall Delta water management and ecosystem integrity. The Flood Protection Board
15 and FEMA both play roles in designating floodways and floodplains to accommodate flood flows.

16 The Flood Protection Board regulates encroachment in floodplains by designating floodways in the
17 Sacramento River and San Joaquin River drainages, including the Delta (Water Code section 8609). A
18 “designated floodway” is the channel of the stream and that portion of the adjoining floodplain, as shown
19 in Figure 7-45, reasonably required to provide for the passage of a specified flood. It may also be the
20 floodway between existing levees as determined by the Flood Protection Board or the Legislature.



Conceptual Diagram of a Floodway within a Floodplain



Conceptual Diagram of Floodway within a Leveed Channel

21

22 Figure 7-45

23 Conceptual Diagrams of a Floodways within a Floodplain

24 The floodway is the channel of the stream and that portion of the adjoining floodplain reasonably required to provide for the
25 passage of a specified flood; it is also the floodway between existing levees as determined by the Flood Protection Board or
26 the Legislature.

27 Source: FEMA 2006

28 NOTE: This graphic has been modified from the final staff draft (May 14, 2012) to respond to Delta Stewardship Council
29 direction.

1 The Flood Protection Board regulates encroachments within designated floodways and regulated streams
2 through its permitting authority. The encroachment permit process applies to all projects, existing and
3 proposed (including habitat restoration projects), within State/federal flood control project levees,
4 designated floodways, bypasses, and regulated streams (California Code of Regulations Title 23,
5 Division 1). The Flood Protection Board should be consulted prior to the consideration of any projects
6 that may be in a designated floodway in the Delta. Appendix M includes a map of the Flood Protection
7 Board's jurisdictional areas in the Delta.

8 Additionally, under the National Flood Insurance Program, FEMA maps floodplains that have a 1 percent
9 chance of flooding in any year (a 100-year flood). FEMA works with participating communities to
10 regulate development within these floodplains ~~in accordance with~~ federal regulations. No new
11 construction, substantial improvements, or other development (including fill) may be permitted within
12 specified flood zones on the community's Flood Insurance Rate Map unless it is demonstrated that the
13 cumulative effect of the proposed development, when combined with all other existing and anticipated
14 development, will not increase the water surface elevation of the base flood more than 1 foot at any point
15 within the community.

16 In some flood channels and bypasses, dredging may have benefits because it increases channel capacity
17 and also provides material that can be used for levee maintenance and other flood risk management
18 activities. Because ~~the Delta has~~ some portions ~~of the Delta are~~ within a tidal pool and other areas are
19 riverine, the efficacy of dredging must be addressed on a site-specific basis and cannot simply be
20 considered useful on a Delta-wide basis.

21 The benefits and impacts of dredging Delta channels are being investigated by a consortium of federal
22 and State agencies, including U.S. Environmental Protection Agency, USACE, DWR, and the Regional
23 Water Quality Control Boards, under the Delta Dredged Sediment Long-Term Management Strategy
24 (LTMS) Program. The LTMS is designed to improve operational efficiency and coordination of the
25 collective and individual agency decision-making responsibilities resulting in approved dredging and
26 dredged material management actions in the Delta. Approved dredging and dredged material management
27 actions will take place in a manner that protects and enhances Delta water quality, identifies appropriate
28 opportunities for the beneficial reuse of Delta sediments for levee rehabilitation and ecosystem
29 restoration, and establishes safe disposal for materials that cannot be reused (USACE 2007).

30 Investment in Reducing Risk

31 Because the Delta's levees protect residents; agricultural land; water supplies; and energy,
32 communications, and transportation facilities, the State has invested considerable funding in Delta levees
33 over several decades through various legislative actions. [Legislation sponsored by Senator Howard Way](#)
34 ~~in 1973~~~~The Way Bill (1973)~~ established the Delta Levees Maintenance Subventions Program, SB 34
35 (1988) established the Delta Levees Special [Flood Control](#) Projects Program, and Assembly Bill 360
36 (1996) extended these two programs and initiated a requirement for net habitat enhancement. Bond
37 measures passed since the late 1990s have provided sizeable but one-time funding ~~sources from which for~~
38 levee maintenance, repair, and improvements ~~are still conducted~~. Propositions 84 and 1E provided
39 substantial public financing toward most of the recent Delta levee projects. An estimated \$~~700~~~~242~~ million
40 of State taxpayer money ~~have has~~ been spent ~~by DWR~~ on Delta levee maintenance and improvements
41 since ~~DWR's the~~ Delta levee funding programs began in the 1970s. ~~This includes~~ ~~An additional~~
42 \$274 million of bond funds ~~that~~ are encumbered for future Delta levee projects. Funding to improve
43 levees that protect urban and urbanizing areas within the Delta is currently provided by the State via
44 ~~DWR's the~~ Early Implementation Program [managed by DWR](#).

1 The Delta’s project levees are authorized as part of the federal flood control project and so are eligible for
2 federal funding (as well as the maintenance subventions mentioned below). The Flood Protection Board
3 serves as the nonfederal partner to USACE for the Delta’s project levees.

4 State investments for non-project levees in the legal Delta are distributed according to guidelines and
5 criteria of ~~DWR’s~~ the Delta Levees Maintenance Subventions Program or ~~DWR’s~~ Delta Levees Special
6 Flood Control Projects Program. These two programs provide State matching funds for maintaining and
7 improving Delta levees. Local agencies in the legal Delta receive partial reimbursement for levee
8 maintenance and rehabilitation from the State when funding is available. Currently, the State contributes
9 up to 75 percent of qualifying costs for maintenance of many Delta levees. Local levee maintaining
10 agencies provide local cost-share matches, and both local and State efforts contribute to Delta flood risk
11 reduction by maintaining continuous efforts to preserve Delta levees. It is often difficult for local agencies
12 to raise funds for the local cost share of State and federal assistance programs. Funding assistance
13 provided by ~~DWR’s~~ the Delta Levees Maintenance Subventions Program is governed by guidelines
14 developed by DWR and adopted by the Flood Protection Board. State funds are not available for levee
15 maintenance or improvement in most of Suisun Marsh.

16 Although the State has contributed the majority of costs for maintaining and improving Delta non-project
17 levees for many years, the concept of shared responsibility with local landowners is key to the long-term
18 success of the Delta levee system. ~~Local reclamation districts~~ Neither the State nor the federal
19 government are legally obligated to pay the full cost of Delta flood protection projects. The continued
20 participation and financial support of local reclamation districts is essential. As noted in the Delta Reform
21 Act’s Section 85003(b), “Delta property ownership developed pursuant to the federal Swamp Land Act of
22 1850, and state legislation enacted in 1861, and as a result of the construction of levees to keep previously
23 seasonal wetlands dry throughout the year. That property ownership, and the exercise of associated rights,
24 continue to depend on the landowners’ maintenance of those non-project levees and do not include any
25 right to state funding of levee maintenance or repair.”

26 **Prioritizing State Investment in Levees**

27 The Delta Reform Act ~~expresses the Legislature’s intention~~ requires that State investments in Delta levees
28 ~~must~~ be prioritized to reduce risks to people, property, and State interests in the Delta (Water Code
29 sections 85305(a) and 85306). Prioritizing investment is necessary to ensure that limited public funds are
30 expended responsibly for improvements ~~that are~~ critical to State interests, rather than simply applying one
31 objective to all Delta levees regardless of priority. These priorities, in combination with the Delta Reform
32 Act’s directive that State agencies act consistently with the Delta Plan, will ensure that State spending on
33 Delta levees reflects these priorities in the future. The Delta Reform Act provides that activities of the
34 Council in determining priorities for State levee investments in Delta levees do not increase the State’s
35 liability for flood protection in the Delta or its watershed (Water Code section 85032(j)).

36 This Delta Plan outlines a process to prioritize State investments in levee operation, maintenance, and
37 improvements in the Delta, including those set forth in RR P1. Although RR P1 describes actions to be
38 conducted over the next few years, it is also important to prioritize interim actions while longer term
39 guidelines are being established. Interim actions taken should consider and, where feasible, incorporate
40 habitat and ecosystem values and enhancement in their development and implementation. This will allow
41 for a more coordinated, ~~robust~~ effective approach to reducing Delta flood risk and prioritizing both
42 immediate and long-term State investments. This approach will also ~~need to~~ take into account future
43 actions that may be proposed through other planning efforts such as the CVFPP and Bay Delta
44 Conservation Plan.

1 To effectively prioritize State investments in levees, a framework is needed to adequately assess Delta
2 flood risk. This framework should include the following steps:

- 3 ♦ Assess existing Delta levee conditions. Initially, a sufficient understanding of the current status of
4 Delta levees is needed to establish baseline conditions against which future risk reduction efforts
5 can be gauged. Because Delta levee conditions change, it is critical to conduct periodic
6 assessments so that maintenance and improvement actions can be directed rationally. Assessment
7 methods should be used that provide sufficient information to portray a reasonable snapshot
8 of conditions.
- 9 ♦ Develop an economics-based risk analysis ~~of~~ for each Delta tract and island. ~~Such an~~ This analysis
10 must address several critical parameters, including life safety, private property, impacts on State
11 water supply, critical infrastructure, Delta water quality, ecosystem values, and systemwide
12 integrity. Accepted risk analysis methods should be used, such as those developed by USACE
13 (1996, 2006). ~~Such an~~ This analysis could include “expected annual damage” assessments as a
14 metric for analyzing flood risk. This approach, which integrates the likelihood and consequences
15 of flooding, provides values that are useful for comparing ~~a~~ flood risk at various locations and for
16 ranking ~~of~~ alternative levee projects.
- 17 ♦ Conduct ongoing Delta flood risk analyses in ~~a transparent, public~~ an open manner for the public.
18 Baseline and subsequent analytical efforts should always be conducted in manner open to
19 scrutiny, with results being readily available for decision makers, interested parties, and the
20 general public. Flood risk analyses will need to take into account future actions that may be
21 proposed through other planning efforts such as the CVFPP and Bay Delta Conservation Plan.
- 22 ♦ Develop an updated understanding of Delta hydrology. An updated understanding of water
23 surface elevations in the Delta is critical for levee design purposes and should be addressed.

24 The approach must be based on sound scientific and engineering principles, and incorporate appropriate
25 economic and hydrologic data.

26 ~~Although~~ As these long-term priorities for State investments in levee operation, maintenance, and
27 improvements are developed, State funds for Delta levee projects should focus on the priorities set forth
28 in RR P1, including the following actions:

- 29 ♦ Provide a 200-year level of flood protection for existing urban and adjacent urbanizing areas
30 (Water Code section 9600 et seq.).
- 31 ♦ Improve the levees that protect aqueducts crossing the Delta and the freshwater pathway to
32 Clifton Court Forebay, as depicted in Figure 7-~~5~~6, to improve the reliability of these
33 water supplies.
- 34 ♦ Improve other Delta levees not specifically planned for ecosystem restoration to the FEMA HMP
35 guidance level to ensure that the Delta’s reclamation districts are eligible for public funding for
36 emergency flood fighting, emergency repair, permanent restoration, and/or replacement of
37 eligible damaged non-project levees.
- 38 ♦ Continue to fund and implement ~~DWR’s~~ the Delta Levees Maintenance Subventions
39 ~~Maintenance~~ Program to maintain Delta levees.

40 In addition, the Delta Plan proposes creating a regional agency to assist with the planning,
41 implementation, and financing of Delta flood risk reduction activities (see RR R2). Local levee-
42 maintaining agencies have managed the financing and ongoing maintenance, rehabilitation, and repair of
43 Delta levees, and have improved the levels of levee integrity, reducing overall Delta flood risk. Although
44 the State has provided financial assistance ~~by~~ over several decades, these programs have been funded

1 primarily through State general obligation bonds, which face an uncertain future. The unencumbered
2 bond funds that remain available for Delta levee projects total only \$123 million.

3 An alternative funding mechanism could provide a more stable, long-term approach to funding in which
4 local participation by all beneficiaries of flood risk management is more broadly incorporated. A regional
5 flood risk management district with fee assessment authority could address a variety of Delta flood risk-
6 related activities, including levee maintenance and improvements; regional flood management planning;
7 flood facilities inspections; data collection; risk notification; and emergency preparedness planning,
8 response, and mitigation. A regional flood risk management district could complement reclamation
9 district ~~activities~~^{actions at the individual district level}. Because two ballot measures, Propositions 218
10 (1996) and 26 (2010) (discussed in Chapter 8), have raised the approval thresholds for new fees and taxes,
11 the proposed regional assessment district will need to be broadly supported.

12 Planning for Floodplain Land Use

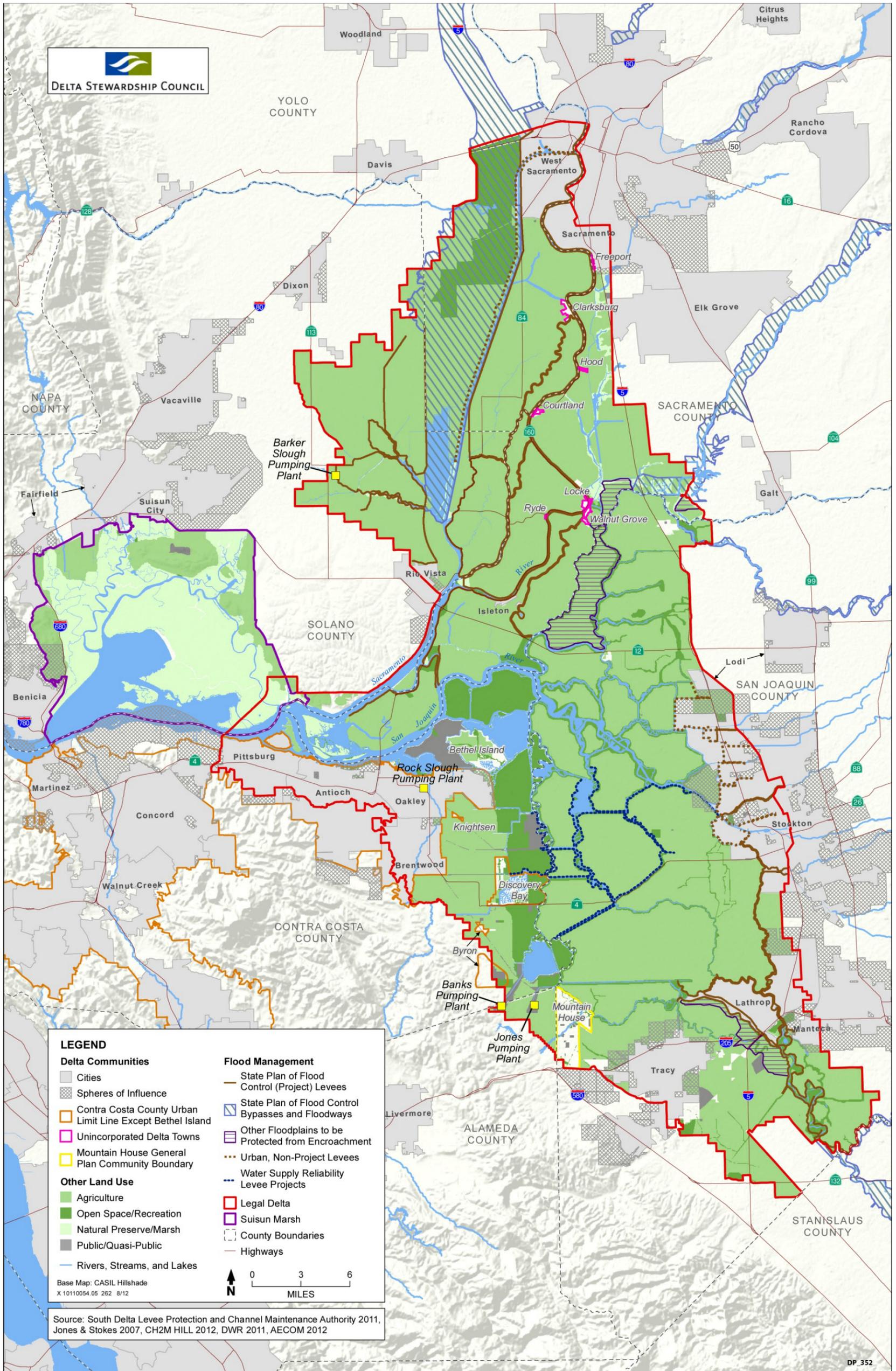
13 The most important step in reducing risk to people in the Delta is to stop putting more people at risk
14 behind levees that do not meet minimum modern standards for flood protection. Actions that increase the
15 demand for higher public spending on flood risk reduction and exacerbate flood risk (for example,
16 urbanizing floodprone areas) should be discouraged.

17 The ~~DPC Delta Protection Commission's~~ *Land Use and Resource Management Plan for the Primary Zone*
18 *of the Delta* also includes important policies to limit development in floodprone areas of the ~~Delta's~~
19 ~~Primary Zone~~:

20 *Local governments shall carefully and prudently carry out their responsibilities to*
21 *regulate new construction within flood hazard areas to protect public health, safety, and*
22 *welfare. These responsibilities shall be carried out consistent with applicable regulations*
23 *concerning the Delta, as well as the statutory language contained in the Delta Protection*
24 *Act of 1992. Increased flood protection shall not result in residential designations or*
25 *densities beyond those allowed under zoning and general plan designations in place on*
26 *January 1, 1992, for lands in the Primary Zone. (DPC 2010b)*

27 As noted in Chapter 5, the ~~Legacy Community~~^{legacy community} of Bethel Island is exposed to unique
28 flood hazards. About 2,100 people reside on the island in about 1,300 residences concentrated on the
29 ~~island's~~^{south central shoreline} and four mobile home parks. The island, which is below sea level, is
30 protected from flooding by 14.9 miles of levees. Because approximately .95-mile of these levees are
31 below the HMP standard, the island is exposed to high flood risks and is ineligible for FEMA assistance
32 in the event of a flood. A single road, Bethel Island Road, links the island to the mainland at the city of
33 Oakley, complicating emergency response or evacuation in the event of flooding. Because developments
34 on Bethel Island are proposed to be served by the Bethel Island Municipal Improvement District or other
35 adjacent public services, the entire island is within the urban limit line adopted by Contra Costa voters in
36 1990. The high flood risks on the island and the restricted evacuation opportunities, however, indicate the
37 island has greater hazards to lives and property than the Delta's other urban or urbanizing areas. For this
38 reason, it is not excluded from the Delta Plan's policy prohibiting new subdivisions unless adequate flood
39 protection is provided. This is consistent with provisions of the Contra Costa County General Plan, which
40 limit residential development on the island to a single home per parcel.

41 As described in Chapter 5, urban residential, commercial, and industrial uses should be located in cities,
42 other urban areas, and their spheres of influence, where strong levees can be provided, rather than in rural
43 lands protected only by non-project levees. Outside of these urban and urbanizing areas and the ~~Legacy~~
44 ~~Community~~^{legacy communities}, the Delta Plan prohibits major subdivisions of five or more parcels where
45 200-year flood protection is not available. Recognizing ~~Legacy Community~~^{legacy communities}' needs
46 for incidental growth to maintain their unique cultural values, development within ~~these community~~^{ies}



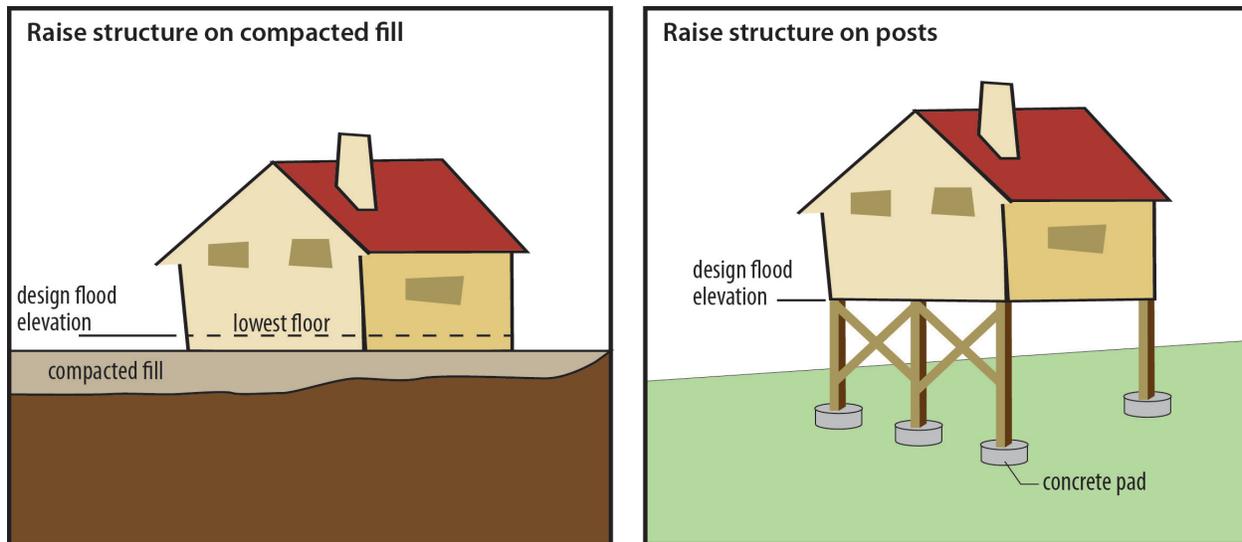
1
2 **Figure 7-56**
3 **Delta Flood Management Facilities**
4 **NOTE: This graphic has been modified from the final staff draft (May 14, 2012) to respond to Delta Stewardship Council direction.**

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1

1 boundaries should continue consistent with existing general plans and federal and local flood protection
 2 laws. Appendix K provides maps of ~~Legacy Community~~ Delta community boundaries. Maintaining most of
 3 the Delta in rural, agricultural land use, as described in Chapter 5, complements policies that reduce the
 4 number of propertyies and the population exposed to high flood risks.

5 Finally, the participation of Delta counties and cities in the National Flood Insurance Program brings with
 6 it a requirement that all residential, commercial, agricultural, and industrial buildings comply with
 7 FEMA's floodproofing standards, including elevating ~~these structures~~ ground floors
 8 above the 100-year flood elevation. Examples of floodproofing are shown in Figure 7-67.



DP_174

Figure 7-67**Examples of Floodproofing**

Floodproofing in accordance with the National Flood Insurance Program can be achieved through several methods. The ~~top~~
 illustration on the left shows an example of floodproofing by constructing the lowest floor within a structure above the design
 flood elevation. The ~~bottom~~ illustration on the right shows floodproofing by raising the bottom of the structure above the design
 flood elevation.

Source: FEMA 1994; FEMA 2001

Emergency Preparedness and Response

Even with the best-engineered levees, channels, and floodways, a residual risk from flooding will always
 remain; flood risk can never be eliminated. Although investment in flood protection infrastructure can
 considerably reduce the likelihood of a catastrophic levee failure, failures are inevitable and will require
 well-coordinated and carefully developed emergency response efforts. To reduce response time and
 optimize effectiveness of response efforts, such plans need to leverage the unique capabilities of each
 agency with a mission in the Delta. This section provides an overview of the agencies and planning
 involved in emergency preparedness and response in the Delta.

Responsibilities for preparing for, declaring, and responding to flood emergencies are distributed among
 local, State, and federal agencies. Federal agencies with authority include USACE and FEMA. In
 California, State and local responsibilities fall to ~~a county's~~ Offices of ~~e~~Emergency ~~s~~Services, local
 reclamation districts, Cal EMA, and DWR. In a Delta flood emergency, the response efforts by local and
 State emergency management professionals are guided by California's Standardized Emergency
 Management System (SEMS). SEMS ~~was is required established~~ by Government Code section 8607(a),
 and ~~was established to~~ provides for effective management of multiagency and multijurisdictional

1 emergencies in California, including flood emergencies. This system consists of five organizational
2 levels, which are activated as necessary: (1) field response, (2) local government, (3) operational area,
3 (4) regional, and (5) State. These levels are activated stepwise as the events warrant additional response
4 and resources, meaning that each level of emergency responder contacts the next level above them should
5 they deem the emergency beyond their capabilities to control. Federal resources are called upon if State
6 resources are exhausted or additional assistance is needed. SEMS incorporates the functions and
7 principles of the Incident Command System, the Master Mutual Aid Agreement, existing mutual aid
8 systems, the operational area concept, and multiagency or interagency coordination. A detailed discussion
9 of SEMS can be found in Cal EMA's SEMS Guidelines (Cal EMA 2009). Local governments must use
10 SEMS to be eligible for funding of their response-related personnel costs under State disaster assistance
11 programs.

12 At the State level, Cal EMA's *California Emergency Plan* is the current guiding plan for all State
13 emergencies. The California Emergency Plan incorporates and complies with the principles and
14 requirements found in federal and State laws, regulations, and guidelines. Cal EMA typically defers to
15 DWR for emergency management during floods. DWR's emergency flood management actions are
16 guided by its 2007 *Interim Flood Emergency Operations Plan*. DWR is in the process of developing its
17 Delta Flood Emergency Preparedness Response and Recovery Program (EPRRP), which will be the
18 overall guiding flood emergency management program for DWR's activities for project and non-project
19 levees in the Delta. The Delta Flood EPRRP consists of three components: (1) the plan for flood
20 emergency preparedness, response, and recovery actions in the Delta, (2) multiagency plan coordination,
21 which coordinates DWR's plan with the plans of other Delta flood response agencies, and (3) response
22 facilities implementation, which includes the development of flood emergency response facilities in
23 the Delta.

24 At the federal level, USACE has a standing All-Hazards Emergency Response Plan and standing
25 contracts for emergency response work in the Delta region, and is ready to assist the State, as requested
26 through PL 84-99. These existing plans and procedures are considered in DWR's flood emergency
27 operations plans and are a critical part of the Delta Flood EPRRP Plan. FEMA ~~has the~~ ~~is~~ ~~primary purpose~~
28 ~~of~~ ~~responsible for~~ coordinating the response of several federal agencies to a large natural disaster that
29 overwhelms the resources of ~~the~~ State and local authorities. The primary duty of FEMA is to ensure
30 services to disaster victims through operational planning and integrated preparedness measures.

31 Following a flood disaster, various federal programs can provide disaster assistance. USACE has specific
32 criteria concerning eligibility for assistance under PL 84-99. FEMA's HMP criteria must be met to be
33 eligible for its assistance (Delta Stewardship Council Staff 2010b).

34 To further address emergency preparedness and response issues in the Delta, the Legislature passed SB 27
35 (Water Code section 12994.5) to develop and implement multi-hazard preparedness and response
36 strategies for the Delta. This legislation required the Office of Emergency Services (now Cal EMA) to
37 establish the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task Force. Led by Cal EMA,
38 the task force consisted of representatives from the Delta Protection Commission, DWR, and
39 representatives of the five Delta counties. The Task Force was directed to do the following:

- 40 ♦ Make recommendations to the Secretary of Cal EMA relating to the creation of an interagency
41 unified command system organizational framework, in accordance with the guidelines of the
42 National Incident Management System and SEMS.
- 43 ♦ Coordinate the development of a draft emergency preparedness and response strategy for the
44 Delta region for submission to the Secretary of Cal EMA. Where possible, the strategy shall use
45 existing interagency plans and planning processes of the involved jurisdictions and agencies that
46 are members of the Delta Protection Commission.

- 1 ♦ Develop and conduct all-hazard emergency response exercises and training in the Delta that are
2 designed to test or facilitate implementation of regional coordination protocols.

3 The recommendations being prepared by the task force will likely play an important role in planning
4 efforts for the Delta, and will be considered in the Delta Plan. As of the writing of this Delta Plan, the task
5 force recommendations had been approved by the Secretary of Cal EMA and forwarded to the Governor.

6 San Joaquin County has developed flood contingency maps and urban evacuation maps as part of its
7 coordinated flood emergency planning efforts. These maps and plans could be used as an example by
8 other Delta counties and State and federal agencies to prepare a Delta-wide emergency response plan.

9 Liability Concerns

10 USACE and other federal agencies are generally afforded some immunity from liability for damages from
11 flood events ~~by~~ under the concept of sovereign immunity and provisions of the Flood Control Act of 1928
12 (33 United States Code section 702c). Congress provided immunity to federal agencies for some but not
13 all tort damages. However, this immunity does not apply to nonfederal agencies.

14 As the risks of levee failure and corresponding damage increase, California's courts have generally
15 exposed public agencies, and the State specifically, to significant financial liability for flood damages
16 (DWR 2005). The most notable recent court decision on flood liability was the California Court of
17 Appeal decision in *Paterno v. State of California* (2003) (113 Cal. App. 4th 998). The court found the
18 State was liable ~~to flooded landowners~~ for damages caused by the failure of a project levee on the Yuba
19 River that the State did not design, build, or even directly maintain. This decision makes it possible that
20 the State will ultimately be held responsible for the structural integrity of much of the federal flood
21 control system in the Delta and Central Valley. The *Paterno v. State of California* decision will ultimately
22 cost State taxpayers approximately \$464 million in awarded damages ~~awarded~~.

23 In *Arreola v. County of Monterey* (2002) (99 Cal. App. 4th 722), the court held local agencies and the
24 California Department of Transportation (Caltrans) liable for 1995 flood damages to property owners that
25 resulted from a failure to properly maintain levees of the Pajaro River project. ~~This case also held~~
26 ~~Caltrans liable for some of the damages.~~

27 The ~~State's~~ California *FloodSAFE Strategic Plan* states, "Local communities are responsible for land use
28 decisions, but generally have not been found liable for failure of the flood protection system. Continued
29 local actions to approve development within floodplains may increase flood risk, even if levees and other
30 flood protection improvements are made. This creates liability issues which the State is concerned about.
31 Legislation passed in 2007 addresses the need to connect land use planning with diligent and factual
32 consideration of flood risks for areas of proposed development" (DWR 2008a).

33 In 2007, the Legislature amended the Water Code to address local community^{ies} liability for approving
34 development in floodprone areas. It provides that "a city or county may be required to contribute its fair
35 and reasonable share of the property damage caused by a flood to the extent that the city or county has
36 increased the state's exposure to liability for property damage by unreasonably approving new
37 development in a previously undeveloped area that is protected by a state flood control project" (Water
38 Code sections 8307(a) and (b)).

39 Ultimately, however, it is important to note that the State does not own, operate, control, or maintain non-
40 project levees and does not have authority to do so. The Delta levee subventions program grants financial
41 assistance to local reclamation districts for their levees. The State conducts evaluations to make sure
42 subventions program funds have been spent appropriately, but not to ensure the quality of the work or the
43 stability or structural integrity of non-project levees. Rather, the non-project levees are the sole
44 responsibility of the reclamation districts, and the State is not liable for damages caused by their failure.

1 Policies and Recommendations

2 These policies and recommendations are based on the Council’s core strategies for reducing flood risks in
3 the Delta, which are:

- 4 ♦ Improve emergency preparedness and response
- 5 ♦ Finance and implement flood management activities
- 6 ♦ Prioritize flood management investment
- 7 ♦ Improve residential flood protection
- 8 ♦ Protect and expand floodways, floodplains, and bypasses
- 9 ♦ Integrate Delta levees and ecosystem function
- 10 ♦ Limit liability

11 Reducing flood risks also relies on locating urban development in the Delta’s cities where levees are
12 stronger, as discussed in Chapter 5, and retaining rural lands for agriculture, so that development in the
13 most floodprone areas is minimized.

14 Improve Emergency Preparedness and Response

15 To effectively and reliably reduce risks to people, property, and State interests in the Delta, a multifaceted
16 strategy of coordinated emergency preparedness, appropriate land use planning, and prioritized
17 investment in flood protection infrastructure is necessary (Water Code sections 85305(a) and 85306).
18 Federal, State, and local governments—and Californians ~~themselves~~—must be prepared for a variety of
19 emergency situations.

20 The recommendations prepared by the Sacramento-San Joaquin Delta Multi-Hazard Coordination Task
21 Force will likely play an important role in planning efforts for the Delta, and will be considered by the
22 Council for incorporation in future updates of the Delta Plan.

23 **Problem Statement**

24 Levee failures and flooding can and will place human life and property in danger, and can have
25 potentially significant implications for the State’s water supply and infrastructure, and the health of the
26 Delta ecosystem. Appropriate emergency preparedness and response planning and implementation
27 activities need to be initiated.

28 **Policies**

29 No policies with regulatory effect are included in this section.

30 **Recommendations**

31 **RR R1 Implement Emergency Preparedness and Response**

32 The following actions should be taken by January 1, 2014, to promote effective emergency
33 preparedness and response in the Delta:

- 34 ♦ Responsible local, State, and federal agencies with emergency response authority should
35 consider and implement the recommendations of the Delta Multi-Hazard Coordination
36 Task Force (Water Code section 12994.5). Such actions should support the development of
37 a regional response system for the Delta.
- 38 ♦ In consultation with local agencies, the Department of Water Resources should expand its
39 emergency stockpiles to make them regional in nature and usable by a larger number of
40 agencies in accordance with Department of Water Resources’ plans and procedures. The

- 1 Department of Water Resources, as a part of this plan, should evaluate the potential of
2 creating stored material sites by “over-reinforcing” west Delta levees.
- 3 ♦ Local levee maintaining agencies should consider developing their own emergency action
4 plans, and stockpiling rock and flood fighting materials.
 - 5 ♦ State and local agencies and regulated utilities that own and/or operate infrastructure in the
6 Delta should prepare coordinated emergency response plans to protect the infrastructure
7 from long-term outages resulting from failures of the Delta levees. The emergency
8 procedures should consider methods that also would protect Delta land use and ecosystem.

9 **Finance and Implement Local Flood Management Activities**

10 The responsibility for securing funding for Delta levee maintenance, repairs, and improvements lies with
11 the numerous local levee maintaining agencies (primarily reclamation districts). Funding is generated
12 through property assessments of local landowners and [also](#) is provided by the State ~~for the~~[under](#) programs
13 administered by DWR (the Delta Levees Special Flood Control Projects ~~Program~~ and Delta Levees
14 Maintenance Subventions ~~p~~[Programs](#)). These programs provide [State](#) matching funds ~~from the State~~
15 ~~because of its interests in~~ [for](#) addressing Delta flood risk; however, many other entities that benefit from
16 flood risk management are not assessed, nor do they contribute to ~~the~~ maintenance and upkeep of Delta
17 levees, including owners of regional infrastructure that crosses the Delta. The duty of providing for Delta
18 flood risk management should be borne by all entities benefitting from these actions, and an equitable
19 methodology of defining and apportioning assessments should be developed and implemented.

20 Local levee-maintaining agencies have managed the financing and ongoing maintenance, rehabilitation,
21 and repair of Delta levees, and have improved the levels of levee integrity, reducing overall Delta flood
22 risk. Although financial assistance has been provided by the State over several decades, these programs
23 have most recently been funded [exclusively](#) through State general obligation bond financing, which faces
24 an uncertain future. The development of an alternative funding mechanism and authority would provide
25 for a more stable, long-term funding approach in which local participation by all beneficiaries of flood
26 risk management is more broadly incorporated. Propositions 218 (1996) and 26 (2010) raised the
27 approval thresholds for new fees and taxes; these thresholds may make it more difficult for a proposed
28 regional assessment district to gain revenue authority.

29 The establishment of a regional flood risk management district with fee assessment authority could
30 address a variety of Delta flood risk-related activities, including levee maintenance and improvements;
31 regional flood management planning; flood facilities inspections; data collection; risk notification; and
32 emergency preparedness planning, response, and mitigation. Establishing a more centralized and
33 responsive entity could provide a mechanism for addressing issues at the individual district level and for
34 the Delta region overall for the long term.

35 ***Problem Statement***

36 No mechanism exists for ensuring that costs of levee maintenance are borne by all beneficiaries. Current
37 financing of levee operations and maintenance is not well coordinated, and future funding sources are
38 uncertain. Financing of local levee operations, maintenance, emergency preparedness and response, and
39 related data collection and reporting efforts would benefit from greater coordination and integration.

40 ***Policies***

41 No policies with regulatory effect are included in this section.

42 ***Recommendations***

43 **RR R2 Finance Local Flood Management Activities**

1 The Legislature should create a Delta Flood Risk Management Assessment District with fee
2 assessment authority (including over State infrastructure) to provide adequate flood control
3 protection and emergency response for the regional benefit of all beneficiaries, including
4 landowners, infrastructure owners, and other entities that benefit from the maintenance and
5 improvement of Delta levees, such as water users who rely on the levees to protect
6 water quality.

7 This district should be authorized to:

- 8 ♦ Identify and assess all beneficiaries of Delta flood protection facilities.
- 9 ♦ Develop, fund, and implement a regional plan of flood management for both ~~p~~Project and
10 non-~~p~~project levees of the Delta, including the maintenance and improvement of levees, in
11 cooperation with the existing reclamation districts, cities, counties, and owners of
12 infrastructure and other interests protected by the levees.
- 13 ♦ Require local levee maintaining agencies to conduct annual levee inspections per the
14 Department of Water Resources' ~~s~~Subventions program guidelines, and update levee
15 improvement plans every 5 years.
- 16 ♦ Participate in the collection of data and information necessary for the prioritization of State
17 investments in Delta levees consistent with RR P1.
- 18 ♦ Notify residents and landowners of flood risk, personal safety information, and available
19 systems for obtaining emergency information before and during a disaster on an
20 annual basis.
- 21 ♦ Potentially implement the recommendations of the Delta Multi-Hazard Coordination Task
22 Force (Water Code section 12994.5) in conjunction with local, State, and federal agencies
23 and maintain the resulting regional response system and components and procedures on
24 behalf of SEMS jurisdictions (reclamation district, city, county, and State) that would
25 jointly implement the regional system in response to a disaster event.
- 26 ♦ Identify and assess critical water supply corridor levee operations, maintenance,
27 and improvements.

28 **RR R3 Fund ~~A~~ctions to ~~protect~~Protect ~~infrastructure~~Infrastructure from ~~flooding~~Flooding**
29 **and ~~other~~Other ~~natural~~Natural ~~disasters~~Disasters:**

- 30 ♦ The Public Utilities Commission should immediately commence formal hearings to impose
31 a reasonable fee for flood and disaster prevention on regulated privately owned utilities
32 with facilities located in the Delta. Publicly owned utilities should also be encouraged to
33 develop similar fees. The Public Utilities Commission, in consultation with the Delta
34 Stewardship Council, the Department of Water Resources, and the Delta Protection
35 Commission, should allocate these funds between State and local emergency response and
36 flood protection entities in the Delta. If a new regional flood management agency is
37 established by law, a portion of the local share would be allocated to that agency.
- 38 ♦ The Public Utilities Commission should direct all regulated public utilities in their
39 jurisdiction to immediately take steps to protect their facilities in the Delta from the
40 consequences of a catastrophic failure of levees in the Delta, in order to minimize the
41 impact on the State's economy.
- 42 ♦ The Governor, by Executive Order, should direct State agencies with projects or
43 infrastructure in the Delta to set aside a reasonable amount of funding to pay for flood

1 protection and disaster prevention. The local share of these funds should be allocated as
2 described above.

3 **Prioritize Flood Management Investment**

4 A method is needed for prioritizing State funds for use in operating, maintaining, and improving Delta
5 levees with a systemwide approach. Although the State has expended millions of dollars since the early
6 1970s on Delta levees, almost half of the Delta's ~~acreage is not protected by levees that today does not~~
7 ~~even~~ meet the HMP guidance today. Efforts by landowners, reclamation districts, and other parties using
8 local resources to perform levee upgrades, beyond ~~these~~ standards that may be funded by the State ~~using~~
9 ~~local resources~~, are encouraged and would be consistent with the ~~State's~~ goal of reducing Delta flood risk.
10 The Delta Reform Act provides that activities of the Council in determining priorities for State
11 investments in Delta levees do not increase the State's liability for flood protection in the Delta or its
12 watershed.

13 **Problem Statement**

14 The Delta Reform Act (Water Code section 85306) requires the Delta Plan to recommend priorities for
15 State investments in Delta levees, including project and non-project levees. Currently, no comprehensive
16 method exists to prioritize State investments in Delta levee operations, maintenance, and improvement
17 projects. Without a prioritization methodology, the apportionment of public resources into levees may not
18 occur in a manner that reflects a broader, long-term approach.

19 **Policies**

20 **RR P1 Prioritization of State Investments in Delta Levees and Risk Reduction**

21 The Delta Stewardship Council, in consultation with the Department of Water Resources, the
22 Central Valley Flood Protection Board, the Delta Protection Commission, local agencies, and
23 the California Water Commission, shall develop funding priorities for State investments in
24 Delta levees by January 1, 2015. These priorities shall be consistent with the provisions of the
25 Delta Reform Act in promoting effective, prioritized strategic State investments in levee
26 operations, maintenance, and improvements in the Delta for both levees that are a part of the
27 State Plan of Flood Control and non-project levees. Upon completion, these priorities shall be
28 considered for incorporation into the Delta Plan.

29 The ~~priorities~~zation shall identify guiding principles, constraints, recommended cost share
30 allocations, and strategic considerations to guide Delta flood risk reduction investments,
31 supported by, at a minimum, the following actions to be conducted by the Department of Water
32 Resources, consistent with available funding:

- 33 ♦ An assessment of existing Delta levee conditions. This shall include the development of a
34 Delta levee conditions map based on sound data inputs, including, but not limited to:
 - 35 • Geometric levee assessment
 - 36 • Flow and updated stage-frequency analysis
- 37 ♦ An island-by-island economics-based risk analysis. This analysis shall consider, but not be
38 limited to, values related to protecting:
 - 39 • Island residents/life safety
 - 40 • Property
 - 41 • Value of Delta islands' economic output, including agriculture

- 1 • State water supply
- 2 • Critical local, State, federal, and private infrastructure, including aqueducts, state
- 3 highways, electricity transmission lines, gas/petroleum pipelines, gas fields, railroads,
- 4 and deepwater shipping channels-
- 5 • Delta water quality
- 6 • Existing ecosystem values and ecosystem restoration opportunities
- 7 • Recreation
- 8 • Systemwide integrity
- 9 ♦ An ongoing assessment of Delta levee conditions. This shall include a process for updating
- 10 Delta levee assessment information on a routine basis.

11 This methodology shall provide the basis for the prioritization of State investments in Delta
12 levees. It shall include, but not be limited to, the public reporting of the following items:

- 13 ♦ [Tiered ranking of Delta islands](#), ~~Island-by-island ranking~~ based on economics-based risk
14 analysis values
- 15 ♦ Delta levee conditions status report, including a levee conditions map
- 16 ♦ Inventory of Delta infrastructure assets

17 Prior to the completion and adoption of these priorities, the interim priorities listed below shall,
18 where applicable and to the extent permitted by law, guide discretionary State investments in
19 Delta flood risk management. [Key priorities for interim funding include emergency
20 preparedness, response, and recovery as well as Delta levee funding.](#)

- 21 ♦ Delta Emergency Preparedness, Response, and Recovery: Develop and implement
22 appropriate emergency preparedness, response, and recovery strategies, including those
23 developed by the Delta Multi-Hazard Task Force (Water Code Section 12994.5).
- 24 ♦ Delta Levee Funding: [The priorities in the following table are meant to guide budget and
25 funding allocation strategies. The Legislature allocates funds for the Delta levee subvention
26 program, which is not a covered action because it funds local agency levee maintenance.
27 The goals for funding levees are all important, and it is expected that over time, the
28 Department of Water Resources must balance these goals. Except on islands planned for
29 ecosystem restoration, improvement of non-project levees to the HMP standard may be
30 funded without justification of the benefits. Improvement to a standard above HMP, such as
31 PL 84-99, may be funded as befits the benefits to be provided, consistent with the
32 Department of Water Resources' current practices and any future adopted
33 investment strategy.](#)

34 This policy covers a proposed action that involves discretionary State investments in Delta
35 flood risk management, including levee operations, maintenance, and improvements.

<u>Goals</u>	Localized Flood Protection	Levee Network	Ecosystem Conservation
<u>First</u> ¹	Protect <u>existing</u> urban and <u>adjacent</u> urbanizing areas by providing 200 year flood protection.	Protect water quality and water supply conveyance in the Delta, especially levees that protect freshwater aqueducts and the primary channels that carry fresh water through the Delta.	Protect existing and provide for a net increase in channel-margin habitat
<u>Second</u> ²	Protect small communities and critical infrastructure of Statewide importance (located outside of urban areas) to a level consistent with HMP at a minimum	Protect flood water conveyance in and through the Delta to a level consistent with the State Plan of Flood Control for project levees or, HMP for non-project levees	Protect existing and provide for net enhancement of floodplain habitat
<u>Third</u> ³	Protect agriculture and local working landscapes, including achieving HMP for non-project levees not specifically planned for ecosystem restoration activities, and continuing the Delta Levees Subventions Program	Protect cultural, historic, aesthetic, and recreational resources to a level consistent with HMP (Delta as Place)	Protect existing and provide for net enhancement of wetlands

1 Improve Residential Flood Protection

2 To reduce the risk to lives, property, and State interests in the Delta, additional standards are needed to
 3 address new residential development. Sea-level rise, subsidence, and new residential development
 4 combine to potentially put many more lives at risk. The policies in this section are designed to reduce risk
 5 while preserving the Delta’s unique character and agricultural way of life. These policies should be
 6 construed as those required to provide the minimum level of flood protection, and should not be viewed
 7 as encouraging development in floodprone Delta areas, even after they achieve 200-year flood protection.
 8 Flood insurance and awareness of local emergency preparedness and response policies is strongly
 9 encouraged for all who live in floodprone areas of the Delta.

10 Consistent with existing law, urban development in the Primary Zone should remain prohibited. Urban
 11 development in the Secondary Zone should be confined to existing urban spheres of influence where the
 12 200-year design standard will be fully implemented by 2025. The 2007 flood risk management legislation
 13 (SB 5) contained provisions affecting ~~city~~^{ies} and ~~county~~^{ies} responsibilities relating to local planning
 14 requirements, such as general plans, development agreements, zoning ordinances, tentative maps, and
 15 other actions (Government Code sections 65865.5, 65962, and 66474.5). Future land use decisions should
 16 not permit or encourage construction of significant numbers of new residences in the nonurban Delta. For
 17 the ~~Legacy Community~~^{legacy communities} in the Delta, structures developed in these areas are required to
 18 meet the legal standard of a 100-year minimum level of flood protection. However, developing and
 19 maintaining adequate flood protection remains difficult.

20 **Problem Statement**

21 Continued residential development without adequate flood protection increases risk to lives, property, and
 22 State interests in the Delta. Flood risks are expected to grow in light of anticipated climate change effects
 23 related to peak flows and sea level rise.

1 **Policies**

2 **RR P2 Require Flood Protection for Residential Development in Rural Areas**

3 New residential development of five or more parcels shall provide for a minimum of 200-year
4 flood protection, such as through the use of adequate levees or floodproofing, if it is located
5 outside of: ~~defined~~

- 6 1. Areas that city or county general plans, as of the date of the Delta Plan's adoption,
7 designate for development in cities or their spheres of influence; or;
- 8 2. Areas within Contra Costa County's 2006 voter-approved urban limit line, except Bethel
9 Island; areas within the Mountain House General Plan Community Boundary in San
10 Joaquin County; or the unincorporated Delta towns of Clarksburg, Courtland, Hood, Locke,
11 Ryde, and Walnut Grove. ~~urban and urbanizing areas and Legacy Communities as shown in~~
12 Appendix K ~~shall provide for a minimum of 200-year flood protection, such as through the~~
13 ~~use of adequate levees or flood proofing.~~

14 This policy covers a proposed action that involves new residential development of five or more parcels
15 that is not located within the areas described in the previous paragraph. ~~outside of defined urban and~~
16 ~~urbanizing areas and outside of Legacy Communities. In addition, this policy covers any such action~~
17 ~~anywhere on Bethel Island outside of its Legacy Community.~~

18 **Protect and Expand Floodways, Floodplains, and Bypasses**

19 Local land use policies guiding development in floodways are not consistent across Delta counties.
20 Floodways have not been established for many of the channels in the Delta by FEMA or by the Flood
21 Protection Board. In light of these inconsistencies, the Delta Plan addresses these issues and highlights the
22 need for the protection of floodplains and floodways consistent with improved flood protection. Over the
23 next 100 years, Delta floodways may expand and deepen because of sea level rise and changing
24 precipitation patterns. Development in existing or potential future designated floodplain or bypass
25 locations in the Delta or upstream of the Delta can permanently eliminate the availability of these areas
26 for future floodplain usage. It is important to identify floodplain areas now for immediate protection and
27 eventual integration into the flood protection system.

28 **Problem Statement**

29 The carrying capacity of the existing flood control system is diminished by encroachments into
30 floodways, critical floodplains, and existing floodplain or bypass locations in the Delta. Local land use
31 policies guiding development in floodways are not consistent across Delta counties. The existing system
32 is already at suboptimal capacity. Expected changes in sea ~~-~~level rise and runoff patterns due to climate
33 change are expected to exacerbate the problem.

34 **Policies**

35 ~~The following are policies as to the lands in the Delta, and recommendations as to the lands outside the~~
36 ~~Delta:~~

37 **RR P3 Protect Floodways**

38 No encroachment shall be permitted in a floodways unless it can be demonstrated by
39 appropriate analysis that the encroachment will not unduly impede the free flow of water in the

~~floodway or jeopardize public safety. shall not be encroached⁴ upon nor diminished without mitigating for future flood flows.~~

This policy covers a proposed action that would encroach upon a floodway.

RR P4 Protect Floodplains

~~No encroachment shall be permitted in any of the following areas floodplains unless it can be demonstrated by appropriate analysis that the encroachment will not have a significant effect on floodplain values and functions, as defined in 33CFR 320.4(1)(1) shall not be encroached upon without mitigating for future flood flows because they are critical floodplains² and may provide ecosystem benefits.~~ This does not exempt these ~~activities~~ potential encroachments from the regulations and requirements of the Central Valley Flood Protection Board.

- ◆ Areas located in the Yolo Bypass from Fremont Weir through Cache Slough to the Sacramento River including the confluence of Putah Creek into the bypass
- ◆ The Cosumnes River-Mokelumne River Confluence, as defined by the North Delta Flood Control and Ecosystem Restoration Project (McCormack-Williamson), or as modified in the future by the Department of Water Resources or the U.S. Army Corps of Engineers (DWR 2010a).
- ◆ The Lower San Joaquin River Floodplain Bypass area, located on the Lower San Joaquin River upstream of Stockton immediately southwest of Paradise Cut on lands both upstream and downstream of the Interstate 5 crossing. This area is described in the Lower San Joaquin River Floodplain Bypass Proposal, submitted to the Department of Water Resources by the partnership of the South Delta Water Agency, the River Islands Development Company, RD 2062, San Joaquin Resource Conservation District, American Rivers, the American Lands Conservancy, and the Natural Resources Defense Council, March 2011. This area may be modified in the future through the completion of this project.

This policy covers a proposed action that involves projects located in the Yolo Bypass, Cosumnes River-Mokelumne River Confluence, and Lower San Joaquin River Floodplain Bypass areas. ~~as described in ER R1.~~

Recommendations

RR R4 Fund and Implement San Joaquin River Flood Bypass

The Legislature should fund the Department of Water Resources and the Central Valley Flood Protection Board to evaluate and implement a bypass and floodway on the San Joaquin River near Paradise Cut that would reduce flood stage on the mainstem San Joaquin River adjacent to the urban and urbanizing communities of Stockton, Lathrop, and Manteca in accordance with Water Code section 9613(c).

RR R5 Continue Delta Dredging Studies

The current efforts to maintain navigable waters in the Sacramento River Deep Water Ship Channel and Stockton Deep Water Ship Channel, led by the U.S. Army Corps of Engineers and described in the Delta Dredged Sediment Long-Term Management Strategy (USACE 2007,

¹As described in the Department of Water Resources' "Urban Levee Design" (DWR 2011).

²As defined by the FEMA National Flood Insurance Program: Floodplain: Any land area susceptible to being inundated by flood waters from any source. <http://www.fema.gov/business/nfip/19def2.shtml>.

1 Appendix L), should be continued in a manner that supports the Delta Plan and the coequal
2 goals. Appropriate dredging throughout other areas in the Delta for maintenance purposes, or
3 that would increase flood conveyance and provide potential material for levee maintenance or
4 subsidence reversal should be implemented in a manner that supports the Delta Plan and
5 coequal goals. [Coordinated use of dredged material in levee improvement, subsidence reversal,
6 or wetland restoration is encouraged.](#)

7 **RR R6 Designate Additional Floodways**

8 The Central Valley Flood Protection Board should evaluate whether additional areas both
9 within and upstream of the Delta should be designated as floodways. These efforts should
10 consider the anticipated effects of climate change in its evaluation of these areas.

11 **Integrate Delta Levees and Ecosystem Function**

12 Setback levees can provide additional levee system stability, more complex land-water interface structure,
13 and shaded riverine aquatic habitat that ~~can~~ benefit ecosystem function in appropriate settings. They can
14 also provide flood control benefits in those areas of the Delta not subject to strong tidal influences where
15 channel capacity improvements can actually increase flood-carrying capacity. Not all locations are
16 amenable or useful for setback levee placement. Each site should be investigated for its potential to
17 provide ecological benefits consistent with levee integrity.

18 **Problem Statement**

19 Criteria for the development and implementation of setback levees in the Delta have not yet been
20 developed by relevant agencies. ~~Such~~ [These](#) criteria are needed to provide appropriate guidance when
21 considering setback levee siting and design. Currently, agencies have no consistent method for
22 determining the appropriateness of setback levee incorporation as they relate to habitat enhancement and
23 flood control benefit.

24 **Policies**

25 No policies with regulatory effect are included in this section.

26 **Recommendations**

27 **RR R7 Develop Setback Levee Criteria**

28 The Department of Water Resources, in conjunction with the Central Valley Flood Protection
29 Board, the Department of Fish and Game, and the Delta Conservancy, should develop criteria
30 to define locations for future setback levees in the Delta and Delta watershed.

31 **Limit [State Liability](#)**

32 The Delta Reform Act requires that the Delta Plan attempt to reduce risks to people, property, and State
33 interests in the Delta by, among other things, recommending priorities for State investments in levee
34 operation, maintenance, and improvements in the Delta, including project and non-project levees (Water
35 Code sections 85305, 85306, and 85307). The law expressly states that ~~its~~ [these](#) provisions do not affect
36 the liability of the State for flood protection in the Delta or its watershed (Water Code section 85032(j)).
37 Consequently, no action taken by a State agency as required or recommended by, or otherwise in
38 furtherance of this Delta Plan, shall affect ~~the State's~~ flood protection liability in the Delta or its
39 watershed. Therefore, the ~~State~~-Legislature should consider requiring an adequate level of flood insurance
40 for residences, businesses, and industries in floodprone areas.

1 **Problem Statement**

2 As the risks of levee failure and corresponding damage increase, California's courts have generally
3 exposed public agencies and the State, specifically, to significant financial liability for flood damages.
4 [DWR's 2005 white paper recommends one way that the State should reduce its liability is to require](#)
5 [houses and businesses have flood insurance.](#) (DWR 2005).

6 **Policies**

7 No policies with regulatory effect are included in this section.

8 **Recommendations**

9 **RR R8 Require Flood Insurance**

10 The Legislature should require an adequate level of flood insurance for residences, businesses,
11 and industries in floodprone areas.

12 **RR R9 Limit State Liability**

13 The Legislature should consider ~~making changes to State law~~ [statutory and/or constitutional](#)
14 [changes](#) that would [address the State's potential flood liability, including giving](#) ~~give~~ State
15 agencies the same level of immunity with regard to flood liability as federal agencies have
16 under federal law.

17 **Timeline for Implementing Policies and Recommendations**

18 Figure 7-78 lays out a ~~preliminary~~ timeline for implementing the policies and recommendations described
19 in the previous section. The timeline emphasizes near-term and intermediate-term actions.

TIMELINE | **CHAPTER 7: Risk Reduction**

ACTION (REFERENCE #)	LEAD AGENCY(IES)	NEAR TERM 2012-2017	INTERMEDIATE TERM 2017-2025
POLICIES	Prioritization of State investments in Delta Levees and risk reduction (RR P1)	Council, DWR, CVFPB	●
	Require flood protection for residential development in rural areas (RR P2)	Local agencies	●
	Protect floodways (RR P3)	CVFPB	●
	Protect floodplains (RR P4)	CVFPB	●
RECOMMENDATIONS	Implement emergency preparedness and response (RR R1)	Local, State, and federal agencies	●
	Finance local flood management activities (RR R2)	Legislature, DPC	●
	Fund actions to protect infrastructure from flooding and other natural disasters (RR R3)	PUC	●
	Fund and implement San Joaquin River Flood Bypass (RR R4)	Legislature, DWR, CVFPB	●
	Continue Delta dredging studies (RR R5)	USACE	●
	Designate additional floodways (RR R6)	CVFPB	●
	Develop setback levee criteria (RR R7)	DWR	●
	Require flood insurance (RR R8)	Legislature	●
	Limit State liability (RR R9)	Legislature	●

Agency Key: DP_346
 Council: Delta Stewardship Council DPC: Delta Protection [Commission](#) PUC: California Public Utilities Commission
 CVFPB: Central Valley Flood Protection Board DWR: Department of Water Resources USACE: U.S. Army Corps of Engineers

1 **Figure 7-78**
 2 **Timeline for Implementing Policies and Recommendations**
 3 **NOTE:** This graphic has been modified from the final staff draft (May 14, 2012) to respond to Delta Stewardship Council
 4 [direction, or to make a stylistic correction.](#)

5 Issues for Future Evaluation and Coordination

6 The following list of issues should be considered in future updates of the Delta Plan. These and other
 7 issues will need to be considered as additional information and materials become available. The various
 8 activities called for in this Delta Plan, as well as issues that arise from other planning efforts, such as the
 9 *Central Valley Flood Protection Plan*, will be considered. Additional areas of interest and concern related
 10 to flood risk in the Delta may deserve consideration in the development of future Delta Plan
 11 updates, including:

- 12 ♦ Reoperation of Upstream Reservoirs and Peak Flow Attenuation: Reservoir operations
 13 upstream of the Delta can have substantial impacts on flood flows through the Delta; therefore,
 14 operation procedures among government agencies should be well coordinated, and where
 15 possible, focused more on flexibility to prevent flooding in the Delta. Water Code
 16 section 85309 directs DWR to develop a proposal to coordinate flood and water supply

- 1 operations with appropriate State and federal agencies, and this shall be considered by the
2 Council for future inclusion ~~within~~in the Delta Plan.
- 3 ♦ Utility Corridor Consolidation: An attempt to consolidate infrastructure into “utility corridors”
4 as facilities are added and upgraded over time should be further investigated to determine
5 whether this can allow for better management of flood risk consequences to these
6 critical assets.
 - 7 ♦ State Highways and Sea Level Rise: The Council will consult with Caltrans regarding the
8 potential effects of climate change and sea level rise on the three State highways that cross the
9 Delta (Water Code section 85307 (c)).

10 Science and Information Needs

11 The Delta system and its influencing factors are not static; therefore, ~~efforts are~~research is needed to
12 better understand dynamic issues such as climate change, seismicity, sea level rise, subsidence, and other
13 areas. ~~A e~~Continuing, robust investigations into the science, engineering, and economic aspects of the
14 Delta ~~is are~~ critical to adaptively managing for expected and unexpected changes, and can provide
15 decision makers and stakeholders with key information for future planning and decision making.
16 Specifically, additional information will be needed in the following areas:

- 17 ♦ The interaction between Delta levees and ecosystem function
- 18 ♦ Sea level rise: impacts on, and incorporation into, flood risk reduction standards
- 19 ♦ Climate change: effects of altered hydrology on levee system integrity
- 20 ♦ Effects of seismicity on levee integrity
- 21 ♦ Updated flood stage-probability functions
- 22 ♦ Potential for subsidence reversal and carbon sequestration from growing native marsh plants
- 23 ♦ Understanding the impacts on Delta flood management from upstream flood management
24 infrastructure operations, including reservoir operations
- 25 ♦ Technologies for assessing levee integrity

26 Efforts to address these needs and others that arise during Delta Plan implementation should be
27 undertaken in a systematic, ~~transparent~~ fashion so that information developed and lessons learned can be
28 incorporated into future Delta Plan updates.

29 Performance Measures

30 Development of informative and meaningful performance measures is a challenging task that will
31 continue after the adoption of the Delta Plan. Performance measures need to be designed to capture
32 important trends and to address whether specific actions are producing expected results. Efforts to
33 develop and track performance measures in complex and large-scale systems like the Delta are commonly
34 multiyear endeavors. The recommended output and outcome performance measures listed below are
35 provided as examples and subject to refinement as time and resources allow. Final administrative
36 performance measures are listed in Appendix C and will be tracked as soon as the Delta Plan is
37 completed. ~~Development of informative and sensitive performance measures is a challenging task that will~~
38 ~~continue after the adoption of the Delta Plan. Performance measures need to be designed to capture~~
39 ~~important trends and to address whether specific actions are producing expected results. Efforts to~~

~~develop performance measures in complex and large-scale systems like the Delta are commonly multiyear endeavors. The recommended performance measures are provisional and subject to refinement as time and resources allow.~~

Output Performance Measures

- ◆ New residential development provides 200-year flood protection. (RR P2)
- ◆ ~~Acreage of~~ Delta land [acreage](#) and [the](#) number of reclamation districts with levees below HMP ~~is are~~ reduced. (RR P1)
- ◆ Freshwater aqueducts passing through the Delta and the primary freshwater channel pathways through the Delta are protected by levees that provide adequate protection against floods and other risks of failure. (RR P1)
- ◆ Responsible local, State, and federal agencies with emergency response authority implement the recommendations of the Delta Multi-Hazard Coordination Task Force (Water Code section 12994.5). (RR ~~R1~~4)
- ◆ DWR and the Central Valley Flood Protection Board ~~implement~~ [construct](#) a bypass and floodways on the San Joaquin River near Paradise Cut. (RR R4)

Outcome Performance Measures

- ◆ No lives are lost in the Delta as a result of flood emergencies and economic damages associated with Delta flood emergencies decrease. (RR R1)
- ◆ Emergency response and recovery costs are eligible for FEMA reimbursement. (RR P1)
- ◆ Water deliveries to East Bay Municipal Utilities District, Contra Costa Water District, the CVP, and the SWP are not interrupted by floods or earthquakes. (RR P1)

References

- California Climate Action Team. 2010. State of California Sea-Level Rise Interim Guidance Document. Developed by the Sea-Level Rise Task Force of the Coastal and Ocean Working Group, with science support provided by the Ocean Protection Council's Science Advisory Team and the California Ocean Science Trust. October.
- Cal EMA (California Emergency Management Agency). 2009. *SEMS Guidelines: Standard Emergency Management System*. November.
- Cal EMA and FEMA (California Emergency Management Agency and Federal Emergency Management Agency). 2010. Memorandum of Understanding Regarding Criteria for Public Assistance Eligibility for Reclamation Districts in the Sacramento/San Joaquin Legal Delta. February.
- California Ocean Protection Council. 2011. Resolution of the California Ocean Protection Council on Sea Level Rise. Adopted March 11.
- Delta Stewardship Council Staff. 2010a. Flood Risk White Paper. October 18.
<http://deltacouncil.ca.gov/docs/delta-plan/2010-10-18/flood-risk-white-paper>.
- Delta Stewardship Council Staff. 2010b. Emergency Preparedness and Response White Paper. November 10. http://deltacouncil.ca.gov/sites/default/files/documents/files/Delta_Emergency_Management_White_Paper_2011_11_08.pdf.

- 1 Delta Vision Blue Ribbon Task Force. 2008. *Delta Vision Strategic Plan*. Sacramento, CA. October.
- 2 Deverel, S. and D. Leighton. 2010. Historic, Recent, and Future Subsidence, Sacramento–San Joaquin
3 Delta, California, USA. *San Francisco Estuary & ~~and~~ Watershed Science*. August.
- 4 [DPC \(Delta Protection Commission\). 2012a. *Economic Sustainability Plan for the Sacramento-*](#)
5 [*San Joaquin Delta*. Public Draft. October 10.](#)
- 6 DPC (Delta Protection Commission). 2010**b**. *Land Use and Resource Management Plan for the Primary*
7 *Zone of the Delta*. Adopted February 25.
- 8 [DWR \(California Department of Water Resources\). 1973. Bulletin 69-72. California High Water 1971-72.](#)
- 9 DWR (California Department of Water Resources). 2005. Flood Warnings: Responding to California’s
10 Flood Crisis. White paper. [http://www.water.ca.gov/pubs/flood/
11 flood_warnings___responding_to_california's_flood_crisis/011005floodwarnings.pdf](http://www.water.ca.gov/pubs/flood/flood_warnings___responding_to_california's_flood_crisis/011005floodwarnings.pdf).
- 12 DWR (California Department of Water Resources). 2008a. *Draft FloodSAFE Strategic Plan*. May 28.
- 13 DWR (California Department of Water Resources). 2008b. *Delta Risk Management Strategy (DRMS) 30*
14 *Phase I, Risk Analysis Report, Final*. Prepared by URS Corporation/Jack R. Benjamin & 31
15 Associates, Inc. Prepared for DWR, USACE, and DFG. December.
16 http://www.water.ca.gov/floodmgmt/dsmo/sab/drmisp/phase1_information.cfm.
- 17 DWR (California Department of Water Resources). 2008c. *Managing an Uncertain Future: Climate*
18 *Change Adaptation 13 Strategies for California’s Water*. Sacramento, California.
- 19 DWR (California Department of Water Resources). 2009a. *Delta Risk Management Strategy Final*
20 *Phase I Report*. March.
- 21 DWR (California Department of Water Resources). 2009b. Locations and Attributes of Levees in
22 California as Maintained by the DWR California Levee Database. December.
- 23 DWR (California Department of Water Resources). 2010a. *North Delta Flood Control and Ecosystem*
24 *Restoration Project Final Environmental Impact Report*. Sacramento, California. October.
- 25 DWR (California Department of Water Resources). 2011a. *Delta Risk Management Strategy Phase II*
26 *Report*. June.
- 27 DWR (California Department of Water Resources). 2011b. *Draft “Urban Levee Design Criteria.”*
28 November 15.
- 29 DWR (California Department of Water Resources). 2011c. *Central Valley Flood Protection Plan (Public*
30 *Draft)*. December.
- 31 DWR (California Department of Water Resources). 2012. *Report to Delta Stewardship Council on the*
32 *Department of Water Resources’ Delta Levees Program*. March 15.
- 33 DWR and DFG (California Department of Water Resources and California Department of Fish and
34 Game). 2008. *A Report Pursuant to Requirements of Assembly Bill 1200, Laird, Risks and*
35 *Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta*.
36 January.
- 37 FEMA (Federal Emergency Management Agency). 1994. *Mitigation of Flood and Erosion Damage to*
38 *Residential Buildings in Coastal Areas*. FEMA 257. October.

- 1 FEMA (Federal Emergency Management Agency). 2001. Ensuring That Structures Built on Fill In or
2 Near Special Flood Hazard Areas Are Reasonably Safe from Flooding in accordance with the
3 National Flood Insurance Program. FIA-TB-10. May.
- 4 FEMA (Federal Emergency Management Agency). 2006. *National Flood Insurance Program (NFIP)*
5 *Floodplain Management Requirements: A Study Guide and Desk Reference for Local Officials.*
6 Unit 3: NFIP Flood Studies and Maps. Figure 3-6. Accessed July 7, 2011.
7 <http://www.fema.gov/library/viewRecord.do?id=2165>.
- 8 Healey, M. and J. Mount. 2007. Delta Levees and Ecosystem Function. CALFED Bay-Delta Program.
- 9 Miller, Robin. 2008. Subsidence Reversal in a Re-established Wetland in the Sacramento-San Joaquin
10 Delta, California, USA. U.S. Geological Survey.
- 11 Mount, J., and R. Twiss. 2005. Subsidence, Sea Level Rise, Seismicity in the Sacramento–San Joaquin
12 Delta.
- 13 MWD (Metropolitan Water District of Southern California). 2010. 6.5 Magnitude Earthquake Causing
14 20-Island Failure. Modeling and graphics developed by Resource Management Associates and
15 34 North for the Metropolitan Water District of Southern California.
- 16 National Committee on Levee Safety. 2009. Draft: Recommendations for a National Levee Safety
17 Program. January 15. [http://www.nfrmp.us/ncls/docs/NCLS-Recommendation-](http://www.nfrmp.us/ncls/docs/NCLS-Recommendation-Report_012009_DRAFT.pdf)
18 [Report_012009_DRAFT.pdf](http://www.nfrmp.us/ncls/docs/NCLS-Recommendation-Report_012009_DRAFT.pdf).
- 19 [Sacramento River Delta Historical Society. 1996. Andrus Island. Sacramento River Delta Historical](#)
20 [Society Newsletter. Vol. 16, No. 2. December.](#)
- 21 Shields, F.D. and D.H. Gray. 1992. “Effects of Woody Vegetation on Sandy Levee Integrity.” *Journal of*
22 *the American Water Resources Association* 28:917–931.
- 23 USACE (U.S. Army Corps of Engineers). 1996. EM 1110-2-1619, Risk-based Analysis for Flood
24 Damage Reduction Studies. August 1.
- 25 USACE (U.S. Army Corps of Engineers). 2002. *Sacramento and San Joaquin River Basins California*
26 *Comprehensive Study, Interim Report*. Sacramento District.
- 27 USACE (U.S. Army Corps of Engineers). 2006. ER 1105-2-101, Risk Analysis for Flood Damage
28 Reduction Studies. January 3.
- 29 USACE (U.S. Army Corps of Engineers). 2007. *Delta Dredged Sediment Long-Term Management*
30 *Strategy (Pinole Shoal Management Area). Study Work Plan*. Management Committee Review
31 Draft. San Francisco District. May 9.
- 32 USGS (U.S. Geological Survey). 2011. “Atmospheric Rivers, Floods and the Water Resources of
33 California.” *Water* 3(2):445-478. <http://www.mdpi.com/2073-4441/3/2/445>.