A Report Pursuant to Requirements of Assembly Bill 1200, Laird

Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento/San Joaquin Delta

Department of Water Resources &
Department of Fish and Game

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SUMMARY

The Sacramento-San Joaquin Delta is vitally important to California's economy and ecosystem. The estuary is a maze of tributaries, sloughs, wetlands and islands, which drain two of the largest rivers in the State. The system of islands that comprise most of the Delta is protected by an antiquated levee system. The Delta is the hub of the State's water system, providing water to 25 million people in the Bay Area, Central Valley and Southern California and water to millions of acres of farm land. About $400 billion of California's $1.5 trillion economy is supported by water from the Delta. The potential for catastrophic disruption of this system from levee failures could have staggering effects on the Delta and the state.

Most Delta levees hold back water year-round

Assembly Bill (AB) 1200 (Laird, Chapter 573, Statutes of 2005) highlighted the complex Delta water issues, and directed the Department of Water Resources (DWR) and the Department of Fish and Game (DFG) to report to the Legislature and Governor on the following:

- Potential impacts of levee failures on water supplies derived from the Sacramento-San Joaquin Delta due to future subsidence, earthquakes, floods, and effects of climate change
- Options to reduce the impacts of these factors
- Options to restore salmon and other fisheries that use the Delta estuary

The State is currently involved in four major planning efforts to evaluate ecosystem and water supply issues and consider options for improvements:

1. The Delta Risk Management Strategy (DRMS) is evaluating Delta issues primarily from the perspective of the risks from levee failures and ways to reduce those risks

2. The CALFED Ecosystem Restoration Program (ERP) Conservation Strategy is identifying restoration opportunities within the Delta and Suisun Marsh ecological restoration zones based on existing elevations, soil types, habitats and natural process requirements of pelagic organisms and other native fish species

3. The Delta Vision will develop a durable vision for sustainable management of the Delta with the goal of managing the Delta over the long term to restore and maintain identified functions and values that are determined to be important to the environmental quality of the Delta and the economic and social well being of the people of the state

4. The Bay Delta Conservation Plan (BDCP) is evaluating Delta issues primarily for the goal of obtaining permits for water supply operations through a comprehensive conservation plan for the Delta designed to protect and restore at-risk species

Since these efforts are occurring concurrently, the processes will provide robust options that build upon each other to improve the Delta ecosystem and water supply reliability. DRMS is the primary process to provide technical information requested by AB 1200. Preliminary evaluations by DRMS show that the risks from earthquakes and floods are substantial and are expected to increase in the future.

The preliminary information obtained from each planning process includes consideration of an improved water conveyance system for the Delta. For DRMS, water conveyance improvement is a primary way to improve water conveyance reliability and to reduce economic risks. For Delta Vision, a comprehensive vision and twelve integrated and linked recommendations is the key to success. One of those recommendations calls for new facilities for conveyance and storage, and better linkage between the two. Dual conveyance is identified as the preferred direction for further assessment against a list of performance standards. For BDCP, an isolated conveyance facility can aid the ecosystem by reducing entrainment and enlarging the area available for species and habitat restoration. New dual water conveyance systems can also aid water supply by adding operational flexibility and improving water quality (i.e., reducing salt loads). The processes have reached important conclusions at the end of 2007. Each will influence one another during 2008 as further refinement continues.

Since each process has only prepared initial findings at this point in time, this document reports on progress made to define the risks and options to reduce risks for the Delta as requested by the Legislature.

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SECTION I - PURPOSE OF REPORT

The Sacramento-San Joaquin Delta (Delta) is the hub of the State's water supply system, provides critical fish and wildlife habitat, and houses critical infrastructure for the State's economy. But the Delta is also at extraordinary risk of disaster. Much of the land is below sea level, protected by an aging system of public and private levees. Earthquakes, floods, and climate change pose threats to these levees and the state's supply of drinking and irrigation water. A mass failure of the levee system could have staggering effects upon California's economy, beginning with the 25 million urban water users and over 3 million acres of irrigated farmland that depend on water obtained from the Delta.

Assembly Bill 1200 (Laird, Chapter 573, Statutes of 2005) highlighted these important factors and directed the Department of Water Resources (DWR) and the Department of Fish and Game (DFG) to prepare a report on potential impacts, improvements, and options for the Delta's future (http://www.leginfo.ca.gov/pub/05-06/bill/asm/ab_1151-1200/ab_1200_bill_20051006_chaptered.pdf). The purpose of the following report is to summarize progress on evaluations that have been initiated since passage of AB 1200 and the need to continue evaluations into 2008.

ASSEMBLY BILL 1200

AB 1200 outlined two assignments:

1. Directed DWR to evaluate the potential impacts on water supplies derived from the Delta due to continued land subsidence, earthquakes, floods, and climate change. Since these factors are expected to change in the future, AB 1200 directed that the evaluations consider 50, 100, and 200—year projections when determining impacts on the Delta. This requirement was written into *Section 139.2* of the Water Code.

2. Directed DWR and DFG to determine the principal options to solve a number of water related issues in the Delta. The bill asked for a comparative ranking of the options, not a recommendation on a preferred option. This requirement was written into *Section 139.4* of the Water Code.

EVALUATING DELTA RISKS AND OPTIONS

DRMS project is the primary source of findings in this report (see Sections 3 and 4). DRMS was an action envisioned by the CALFED Record of Decision in 2000, initiated by DWR, and provides data to meet the requirements of AB 1200. A team of consultants started work in March 2006. Phase 1 assessed the risks of levee failures in the Delta. Phase 2 was aimed at developing strategies (options) for reducing the risks of levee failure (*see sections 1392* and *139.4* of the Water Code.)

Other planning efforts will help provide additional information on Delta options. The Delta Vision Blue Ribbon Task Force (Governor Schwarzenegger Executive Order S-17-06) was charged with developing a vision and a strategy for managing the Delta as a sustainable system for all environmental and economic services provided by the Delta. The ERP Conservation Strategy is focused on actions to restore and recover the Bay-Delta ecosystem. BDCP is being developed under State and federal laws that provide for the conservation of habitat while providing water supply assurances. Delta Vision, ERP, and BDCP provide additional information on potential options for the Delta that need to be considered in selecting a preferred strategy for the Delta's future. These processes are discussed in Section 5.

DWR And DFG Shall Evaluate And Compare Delta Options To:

1. Prevent the disruption of water supplies
2. Improve the quality of drinking water supplies
3. Reduce the amount of salts contained in Delta water serving agricultural areas
4. Maintain water quality for Delta users
5. Assist in preserving Delta lands
6. Protect water rights of the "area of origin" and the environment of the Sacramento-San Joaquin river systems
7. Protect highways, utility facilities, and other infrastructure
8. Preserve, protect, and improve levees
9. Restore salmon and other fisheries

SECTION II - INTRODUCTION TO THE DELTA

SETTING

The Delta and Suisun Marsh (see Figure 1) are located at the confluence of the Sacramento and San Joaquin rivers, which drain about 40 percent of California's water. Unlike other deltas that form where rivers deposit sediments at the ocean, the Sacramento -San Joaquin Delta is located inland. Before the California Gold Rush in 1849, the Delta and Suisun Marsh consisted of hundreds of miles of tidally influenced sloughs, channels, and hundreds of thousands of acres of marsh and overflow land. Today, more than 1,100 miles of Delta levees and about 230 miles of Suisun Marsh levees line these channels.

SERVICES

The Delta and Suisun Marsh include more than 1,315 square miles (about 840,000 acres): 67 percent agriculture, 9 percent urban, 14 percent conservation and other lands, and 10 percent water.

The Delta and Suisun Marsh provide many services to the region and to California. The report, *Status and Trends of Delta-Suisun Services* (2007), provides a briefing on nine services:

• **Land Uses** (agricultural, urban, and conservation). The region has 165,000 dwellings and a population of about 470,000 (2000 Census). The region contains about 500,000 acres of highly productive farmland.

• **Flood Management.** The levees are intended to protect the adjacent lands from floods originating from Central Valley rivers, high ocean tides, and storm-generated waves within Delta waterways.

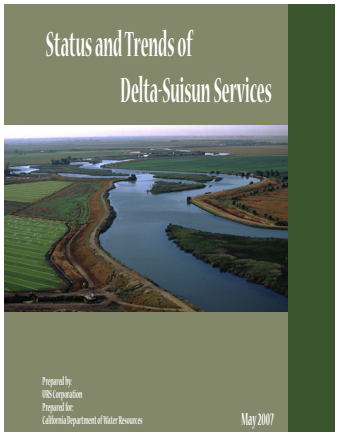
• **Ecosystem.** The region provides a unique estuarine habitat for many resident and migratory fish and birds, some listed as threatened or endangered species.

• **Water Supply.** About one-quarter of California's drinking water comes from the Delta (two thirds of Californians get some portion of their drinking water from the Delta). About three million acres of farm land receive irrigation water from the Delta.

• **Water Quality Management And Discharges.** Both the Delta and Suisun Marsh are managed to control salinity. Discharge of other pollutants are restricted.

• **Transportation.** Most rail and highway corridors serve other areas of the State, and navigable ship channels connect inland ports to international destinations.

• **Utilities.** A wide variety of utilities (electrical transmission, natural gas pipelines, petroleum pipelines, and water pipelines) and other infrastructure serving large areas of the State traverse the Delta and Suisun Marsh.



More information on the Delta and Suisun Marsh can be found in the report, *Status and Trends of Delta-Suisun Services* (2007), on the DWR Delta Vision web portal:
http://www.deltavision.ca.gov/DeltaVisionReports.shtml

Other informative maps can be found in the report, *Delta Overview* (2007), on the DWR Bay Delta Office web portal:
http://baydeltaoffice.water.ca.gov/sdb/tbp/deltaoverview/delta_overview.pdf

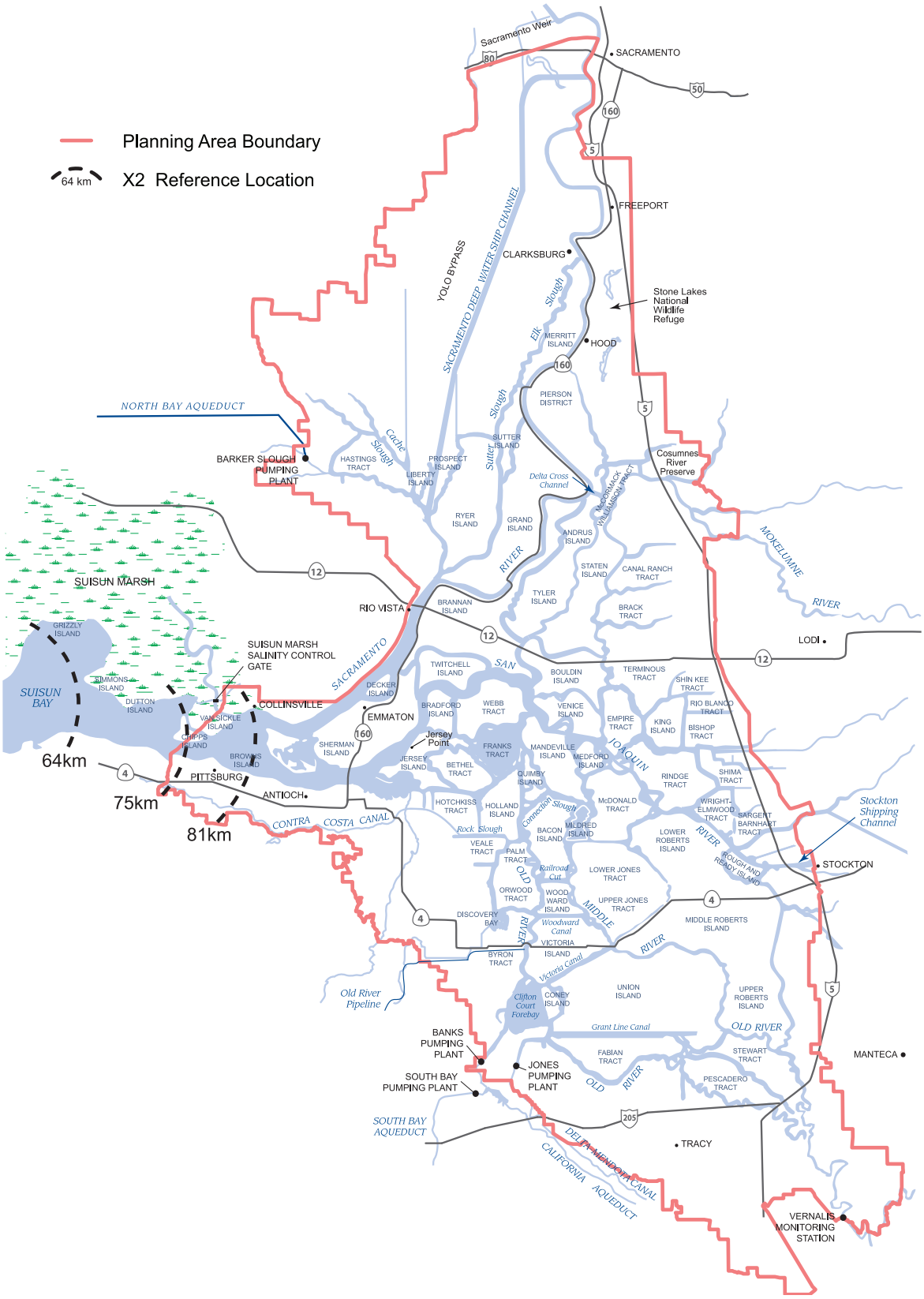


FIGURE 1. Location Map for Delta and Suisun Marsh

• **Recreation/Tourism.** The Delta and Suisun Marsh offer a wide range of activities including boating, fishing, waterfowl and upland game bird hunting, wildlife viewing, bird watching, sightseeing, and photography.

• **Local And State Economics.** The Delta and Suisun Marsh contribute to the local and statewide economies, especially through water withdrawals and exports.

ENVIRONMENTAL DECLINE AND WATER SUPPLY

The water exports and the ecosystem are the two largest needs that are often in conflict. Water diversions and exports to other regions remove water from the ecosystem. Species decline from a variety of causes have increased environmental protections that negatively impact water supply. Pelagic or open water fish have been declining in abundance for several decades. Four species (Delta smelt (listed as threatened), longfin smelt, threadfin shad, striped bass) have experienced precipitous decline beginning about 2002. By 2004, the decline was widely recognized as a serious issue and became known as the Pelagic Organism Decline (http://iep.water.ca.gov/AES/POD.pdf). The 2005 Delta Smelt Action Plan (http://www.publicaffairs.water.ca.gov/newsreleases/2005/10-19-05DeltaSmeltActionPlan.pdf) and the 2007 Pelagic Fish Action Plan (http://www.water.ca.gov/deltainit/030507pod.pdf) define the problems and proposed actions to improve conditions. Judge Wanger's 2007 ruling was made to protect the threatened Delta smelt from export pumping operations until new federal biological permits are obtained in about the end of 2008 (http://www.earthjustice.org/library/legal_docs/delta-smelt-final-remedy-order.pdf). Water exports could be reduced by up to 35 percent.

HAZARDS TO LEVEES

The region's levees define the configuration of the channels and land areas of the Delta and Suisun Marsh. Land subsidence, primarily through microbial oxidation of organic peat soils, has resulted in most of the Delta islands sitting below sea level – some as much as 25 feet (see Figure 2). The lower land surface makes levees more susceptible to failure and provides more room for inflowing salt water from Suisun Bay when a levee failure occurs. During levee failure events, a sudden rise in Delta salinity can cause the cessation or reduction of in-Delta water diversions and exports until the salty water is flushed out of the area.

Most Delta levees were built before modern engineering techniques were common and do not meet today's standards for stability during earthquakes or large floods. Many levees rest on organic peat soil foundations that have settled because of the added weight. Unlike levees along upstream rivers that only hold back water during high flows, Delta levees hold back water year round. Levee failures have flooded Delta islands and tracts on 166 occasions since 1900, and most land has flooded at least once from levee failures (see Figure 3).

All of the existing services of this region are dependent on the levees. Levee failures flood crops, homes, businesses, roads and railroads, utilities, and other infrastructure. Levee failures can interrupt water supply and significantly change the ecosystem. The region's levees face hazards from several events:

• Earthquakes (seismic events). There are several major faults that influence the Delta region (see Figure 4). Delta and Suisun Marsh levees are composed of a wide variety of materials including silt, sand, clay, and organic peat. Saturated sandy areas within the levees can loosen and move (liquefy) during ground shaking, causing the levee to slump. Ground movement during an earthquake can cause a levee to move and deform without liquefaction.

• Floods (high storm runoff into the Delta). Large flows into the Delta can raise the water surface above the tops of the levees and increase pressure for seepage through and under the levees, which can cause them to fail (see Figure 5).

• Sunny—day events. Undetected problems, such as burrowing animal activity, can cause levees to fail during normal, non-flood flow periods ("sunny—day events"). The 2004 Jones Tract levee failure is an example.

• High wind waves and erosion. Water in Delta channels whipped by high winds can weaken levees by erosion. Wind-driven waves are especially damaging to the unprotected land side of the levees when islands are flooded.

These hazards are expected to increase in the future as natural factors such as sea level rise, subsidence, climate change, and increasing seismic risk put more pressure on the levees.

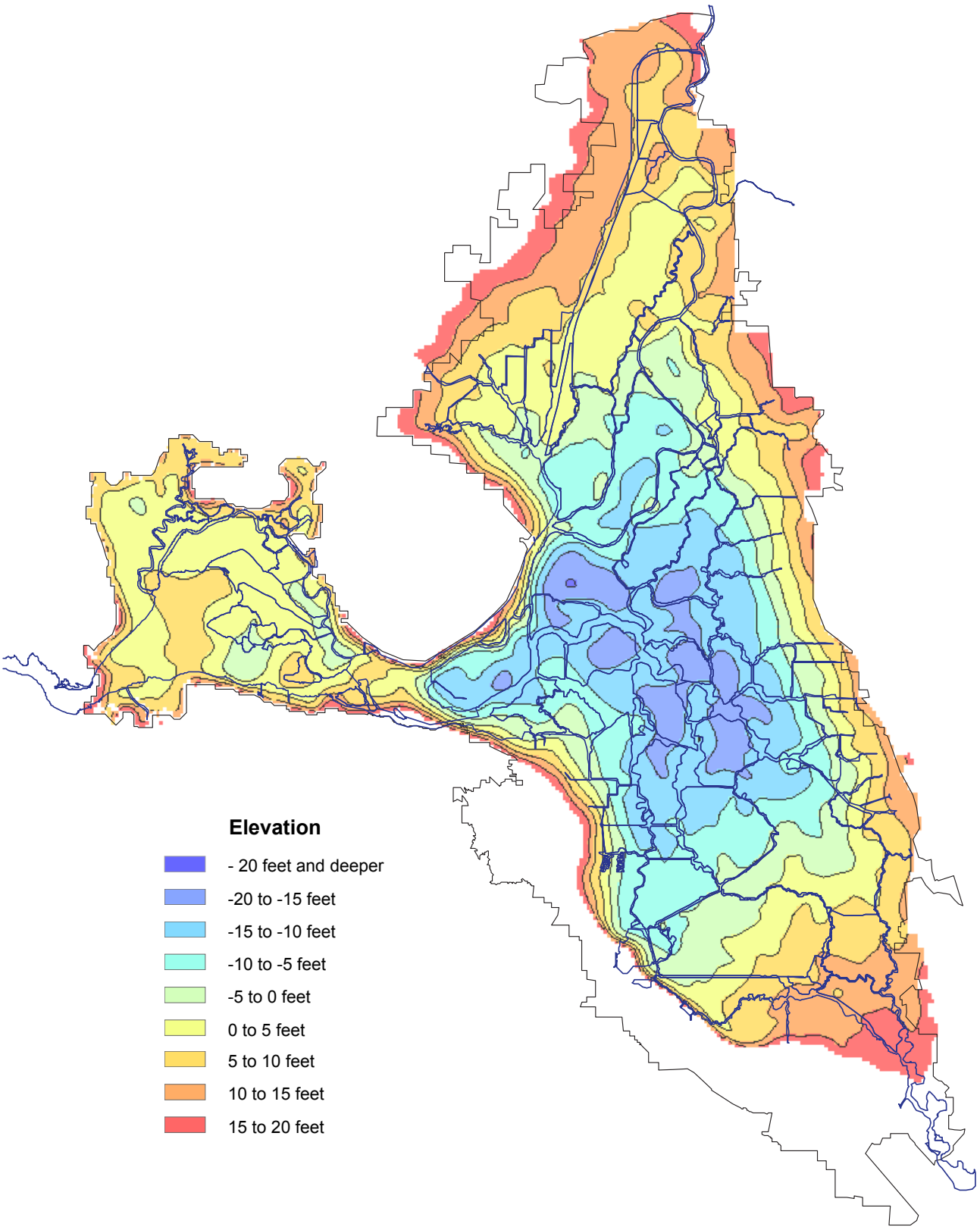


FIGURE 2. Surface Elevation Map.
Most of the islands in the Delta are below sea level.

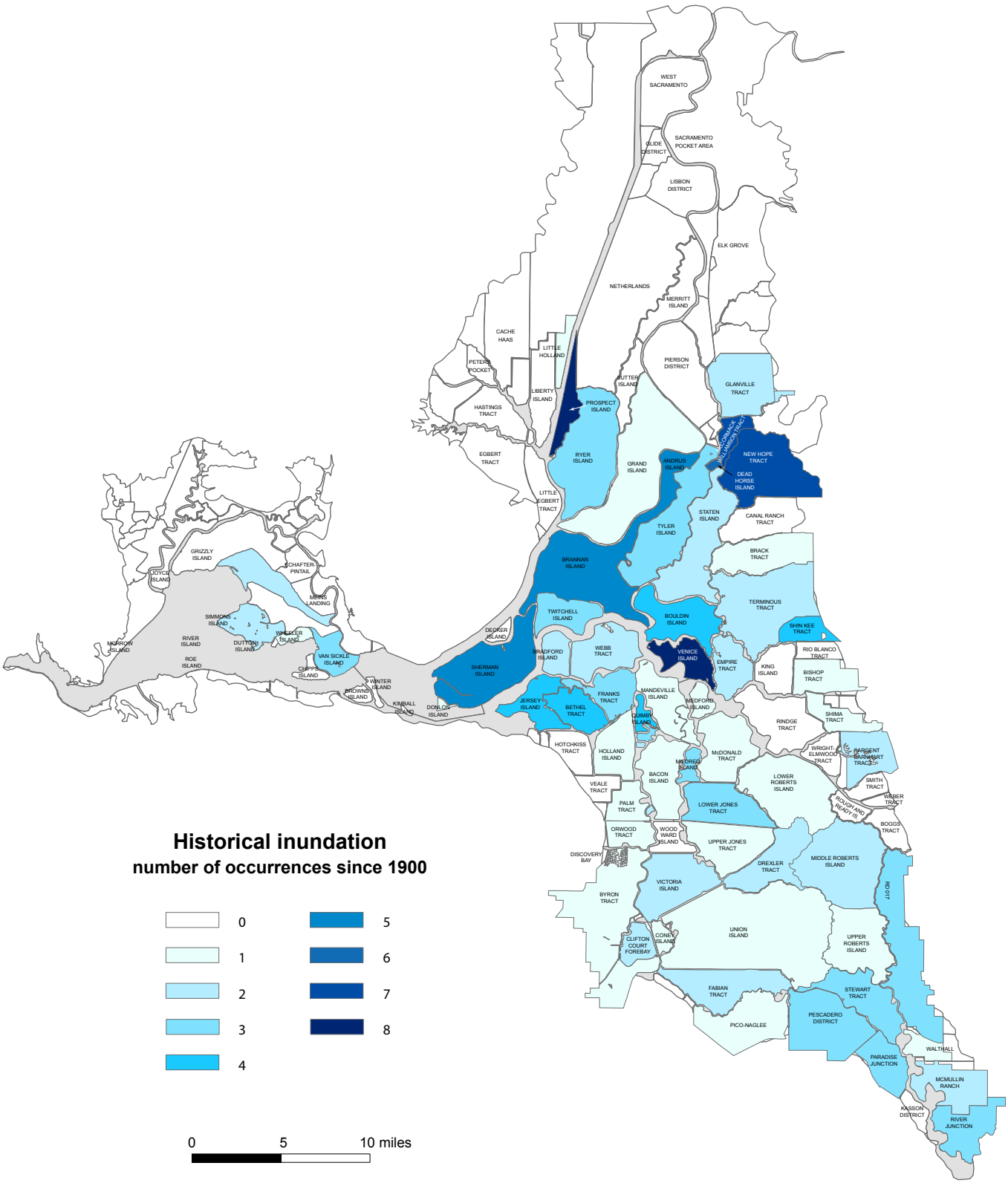


FIGURE 3. Historical Island Flooding Since 1900.
Most Delta islands and tracts have flooded at least once since 1900.

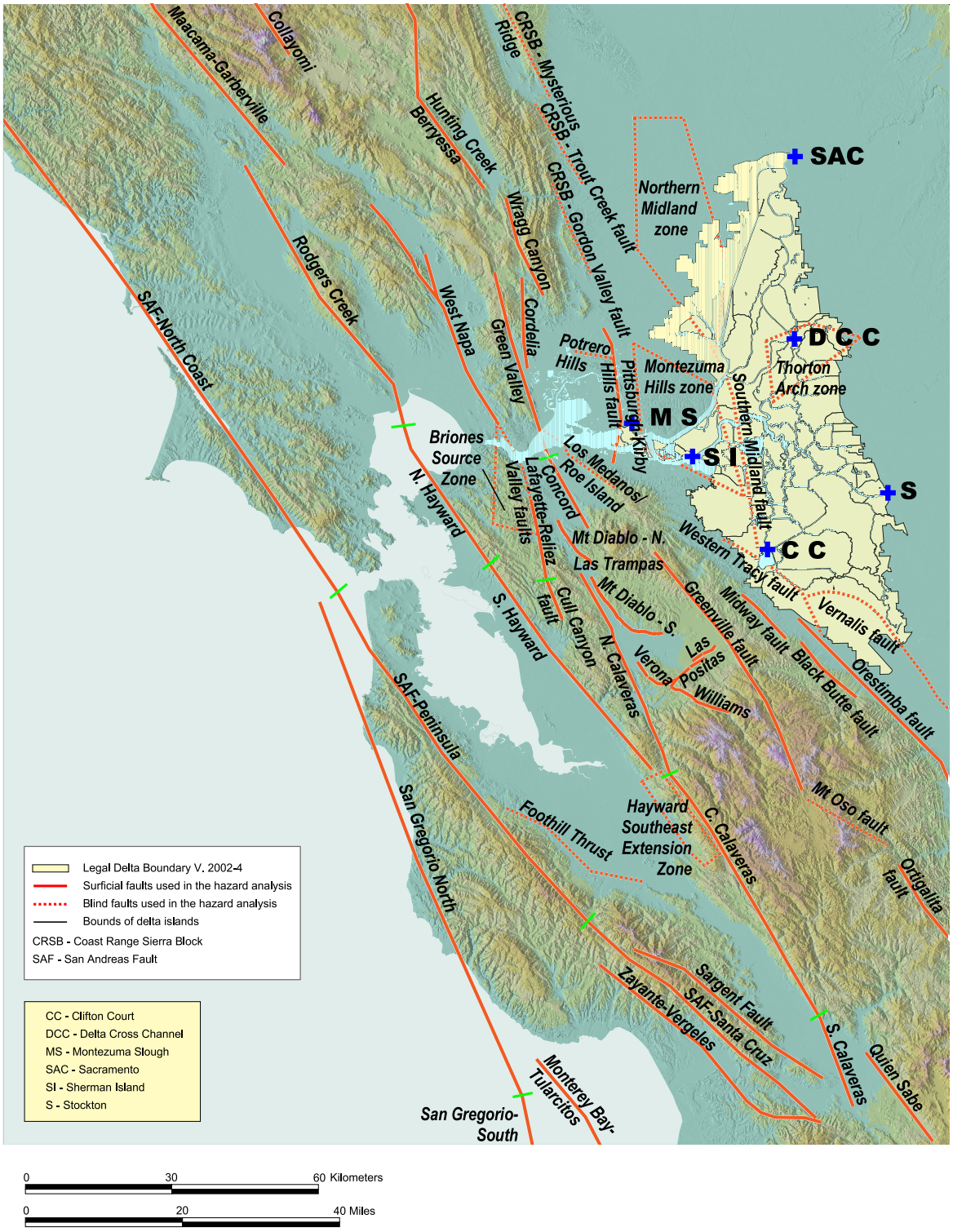


FIGURE 4. Faults In The San Francisco Bay Region.
Each fault in the region can produce earthquakes.

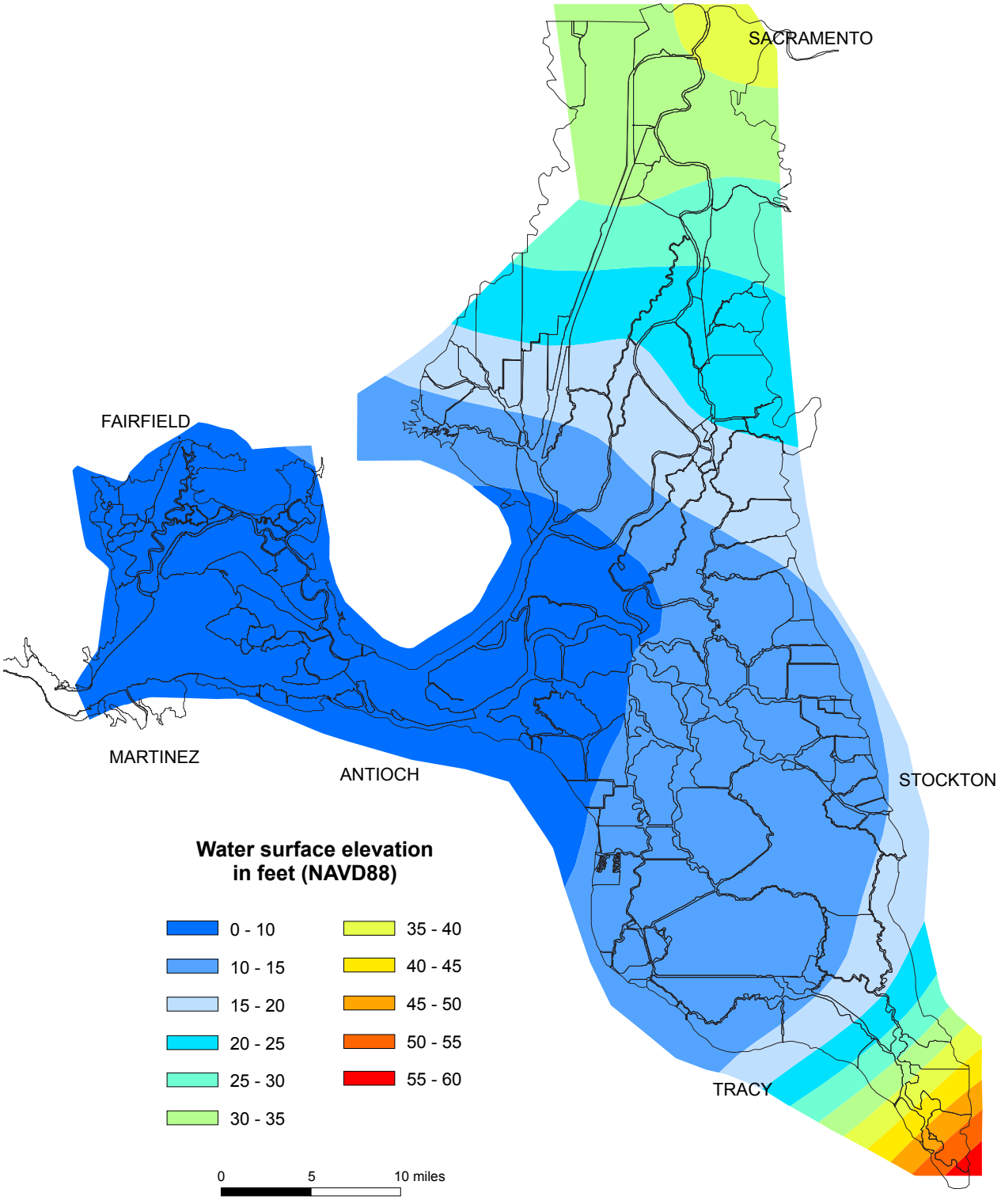


FIGURE 5. Example Water Surface Elevations During Extreme Flood Events In The Delta.
Levees near the periphery of the Delta must be higher than at the western side due to large inflows to the Delta.

CHANGING DELTA

The Delta is constantly changing. Figure 6 demonstrates one dimension of that change, loss of tidal wetlands, which is primarily from the construction of levees. The Delta is facing more changes in the future that will further stress Delta levees, water supply, and the ecosystem.

Sea Level Rise. Over the last 100 years sea level has risen about 0.6 feet at the Golden Gate Bridge (Figure 7). The CALFED Independent Science Board suggests that sea level is likely to rise at least 2.3 to 3.2 feet by 2100, and even greater rise (by 6.5 feet or more) is possible if ice cap (e.g. Greenland) melting accelerates. The existing Delta levees were not built to withstand the forces of rising sea level. The higher sea level will also increase tidal mixing, increasing salinity levels in the Delta. More of the State's fresh water supply will be required for salinity control and more salt water will intrude from Suisun Bay when levees fail.

Floods. Storm runoff and peak flood events are likely to become more intense as warmer temperatures cause higher snow lines. More winter precipitation is expected to fall in the mountains as rain rather than snow. Larger and more frequent flood flows to the Delta will further stress levees.

Snowmelt. Warmer temperatures will result in a smaller snowpack in the mountains. Based on long-term records, DWR estimates that average April 1 snowpack stores about 15 million acre-feet of water, an amount that is 1.5 million acre-feet less than a century ago. An additional 2 million acre-feet is expected to be lost by 2050. The smaller snowpack will result in less snowmelt and runoff in the spring and summer, directly reducing water supply.

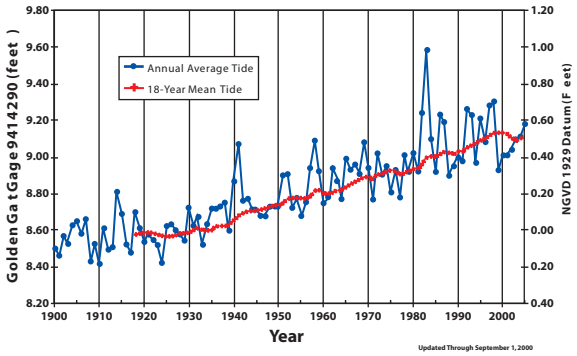


FIGURE 7. Golden Gate Annual Average And 19-Year Mean.
Tide Levels Records show a 0.6 foot rise in sea level since 1920

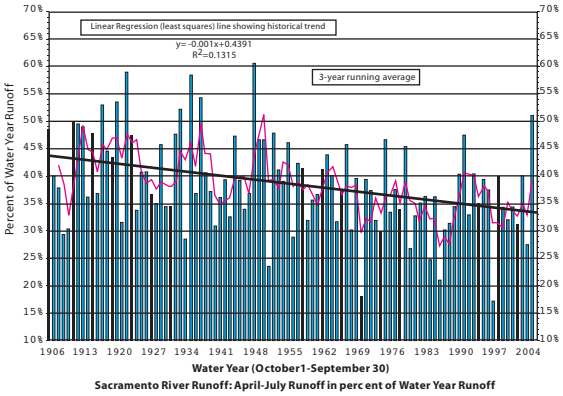
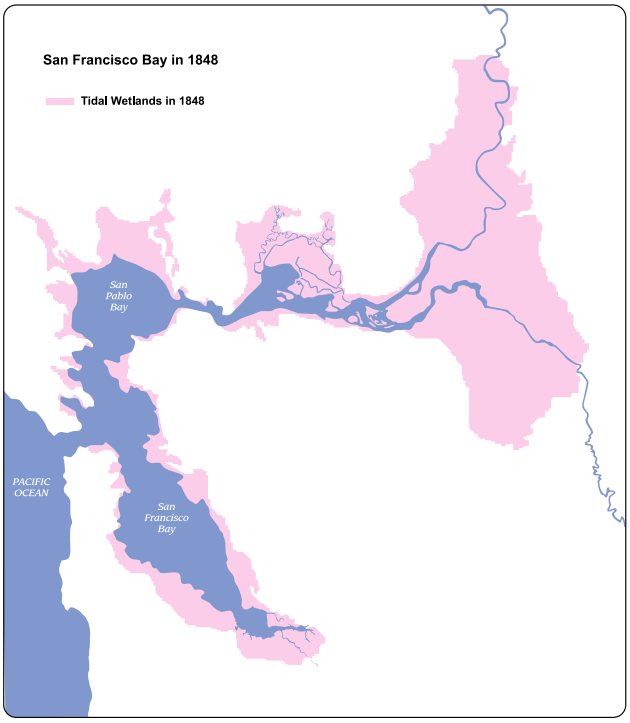


FIGURE 8. Sacramento River April – July Runoff.
Spring runoff, an indication of snowmelt, has been decreasing for years



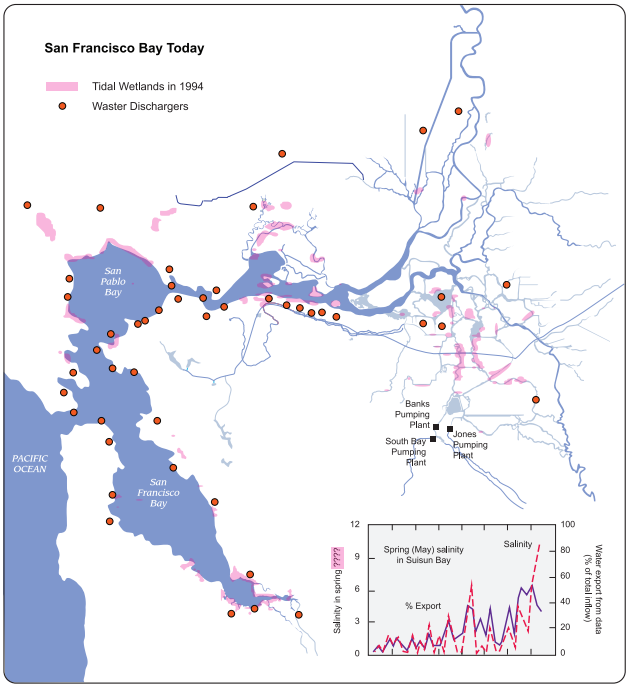


FIGURE 6. Tidal Wetland Change.
Tidal wetlands. in the San Francisco estuary and Delta are one example of the major changes the area has seen since the Gold Rush
http://sfbay.wr.usgs.gov/general_factsheets/change.html

Subsidence. Over the next 200 years, some areas, especially in the central Delta, could subside by another 18 feet below existing land levels, or until peat soils are depleted if current land use practices continue to further stress the levees.

Decline Of Native Species. Since the early 2000s there has been an unexpected decline in the abundance of many pelagic (open water) fish species. The causes are complex, and not well understood, but potentially include invasive species, toxins and water operations.

Introduced Species. Introduced species often have an adverse effect on the ecosystem as they compete with native species for space and food. Currently, several introduced exotic invasive species are suspected of negatively impacting primary productivity and native fish abundance.

Warmer Temperatures (Global Warming). Warmer water temperatures in the rivers can adversely affect fish in the Delta and could result in changes in upstream reservoir operations to include more frequent releases, ensuring colder sustained water temperatures.

Urbanization. Development occupies Delta land that is no longer available for habitat and other management activities such as water conveyance facilities. Increased waste discharges and storm runoff affect water quality. In addition, urbanization of lowlands can pose a major threat to public safety and the ability to improve the ecosystems and flood performance of the Delta.

Earthquakes. No Delta levee is known to have failed from an earthquake. However, the current network of levees has not experienced a large earthquake. The 7.8 magnitude 1906 San Francisco earthquake was a significant event, but relative levee heights were much lower then. The last 100 years of land subsidence has made the Delta islands deeper and resulted in building levees higher. These levees are more susceptible now to failure during an earthquake than they were in 1906. In addition, seismic activity since the 1906 earthquake has been reduced from the historical events preceding that earthquake (see Figure 9 by USGS). Due to the lower number of significant earthquakes, stress is building, increasing the chance of a large earthquake. On the basis of research conducted since the 1989 Loma Prieta earthquake, the U.S. Geological Survey and other scientists conclude that there is a 62 percent probability of at least one magnitude 6.7 or greater quake, capable of causing widespread damage, striking the San Francisco Bay region by 2032.

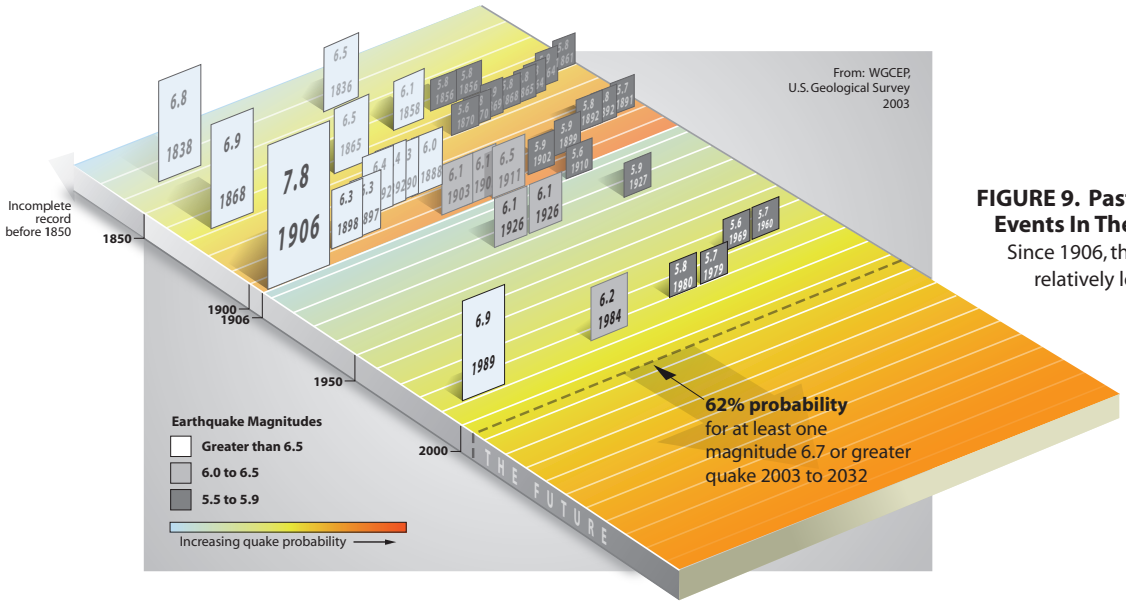


FIGURE 9. Past And Future Seismic Events In The Bay-delta Region. Since 1906, the Delta has been in a relatively low seismic period.

SECTION III - QUANTIFICATION OF RISKS

Although concern over potential catastrophic failure of Delta levees has been growing for years, a comprehensive assessment has not been previously attempted to quantify the potential susceptibility to failure from the broad range of threats that levees face.

AB 1200 provided the impetus for DRMS assessment of the Delta levee system. DRMS provides a framework for evaluating major threats to the Delta levee system and the impacts that levee failure can have on the Delta ecosystem and economy, the State's water delivery system and other infrastructure, and those who rely on the exports of fresh water from the Delta.

CONTEXT AND STATUS

• Prior to the initiation of DRMS study, no other levee risk assessment has been as comprehensive and complex.

• Due to the relatively short time for the assessment, DRMS made the best estimates possible based on existing available data and models.

• While data gaps exist, there were no opportunities to gather new data in the course of the DRMS effort.

• Results should be considered on a regional basis rather than for any individual island or levee reach.

• The results should be used for a broad understanding of the condition in the entire Delta, and should not be used as a basis for design for any specific location.

A preliminary Summary Report (http://www.drms.water.ca.gov/docs/RiskAnalysis_Summary_Report3-Draft062807.pdf) and more detailed Phase 1 information can be found on DWR's DRMS web page (http://www.drms.water.ca.gov/Phase1Information/). The DRMS preliminary findings have been reviewed by a CALFED scientific panel. The review has lead to a re-evaluation of some of the initial DRMS analyses. The results of the re-evaluation will be incorporated into the final report and will be completed in April 2008. Delta Vision, ERP and BDCP all depend on the best available information from DRMS to support their own processes. Therefore, the following findings should be viewed as a progress report that is subject to refinement. While specific numbers may change, the essence of the findings is expected to remain the same.

The DRMS Risk Analysis Considers:

- The frequency that different sizes of earthquakes and floods occur.
- How land subsidence can affect a levee.
- The condition and vulnerability of different Delta levee reaches to earthquakes and floods.
- How hazards and levee vulnerability combine to cause levee failures, including how many levees are likely to fail during the same earthquake or flood.
- The water supply, economic, and ecosystem consequences of levee failure.
- How these factors are likely to change in the future.

Note: The level of risk is determined by considering the combinations of these factors.

"Business-As-Usual"

All assessments for seismic and flood conditions assume that today's management practices (facilities, policies, funding, maintenance, etc.) continue in the future. This "business -as-usual" approach measures the risk that the state faces today and provides the basis for considering options to reduce the risk (see next section).

PRELIMINARY DRMS SEISMIC FINDINGS

A moderate to large earthquake in the San Francisco Bay region could cause major damage to Delta and Suisun Marsh levees, and could cause many of them to fail. Levee foundations could fail due to liquefaction or the levees themselves could deform and fail. Seismically induced levee failures would be expected to extend for thousands of feet if not miles and impact many locations simultaneously.

Probability Of Multiple Levee Failures

The DRMS assessment provides preliminary estimates of the probability that multiple islands will flood simultaneously during a 25-year exposure period due to a seismic event as shown below in Figure 10. The vertical scale goes from 0 (little chance of 70 or more simultaneous island failures) to 1 (a very high chance of at least a few failures). For example, there is about a 40 percent chance that 20 or more islands will flood simultaneously as a result of an earthquake sometime over 25 years of exposure.

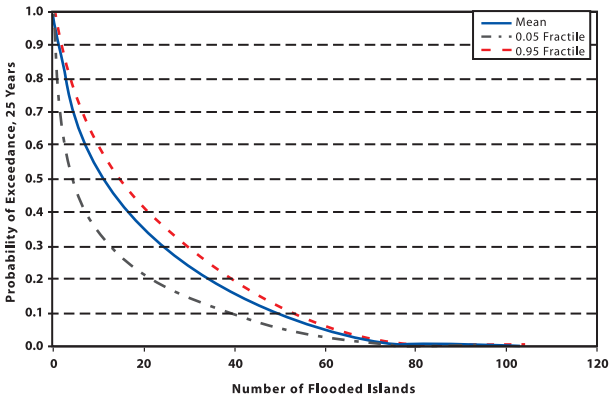


FIGURE 10. Probability In A 25 Year Exposure Period Of A Number Of Simultaneous Levee Failures From A Seismic Event

Export Disruption

Levee breaches during the late spring, summer or early fall can draw saline water into the Delta from Suisun Bay and render water unusable for State and federal water exports, Contra Costa Water District, and in-Delta uses. DRMS estimated that seismic levee failures that flood 30 islands could disrupt water exports for 16 to 23 months due to salt intrusion. This could reduce water exports by 6.5 million acre-feet to 9.3 million acre-feet.

Ecosystem Consequences

Ecosystem conditions during levee failures and island flooding can vary widely depending on the time of year that failures occur, the number and location of flooded islands, and the location of species. DRMS is still working on developing metrics to describe and display the ecosystem consequences such as potential losses due to fish entrainment. It is expected that the conservation strategies provided in the ERP Phase 2 Conservation Strategy, as well as BDCP, will guide the design for creating a more robust Delta ecosystem better able to withstand catastrophic events.

Economic Consequences

Economic costs are the net costs to the State economy without any consideration of who within the State bears the cost. These include repair and recovery costs, direct flooding damage to infrastructure (buildings, contents, utilities, transportation corridors, etc.), in-Delta lost use economic costs, in-Delta and water export lost use economic costs, and other statewide economic costs. All economic costs are generally additive.

Economists are also often interested in economic impacts that include a variety of other economic measures such as lost output, lost jobs, lost labor income, and lost value added. (Value added is labor income plus property income plus certain business taxes.) Estimation of the local impacts does not attempt to account for benefits that may accrue to other areas.

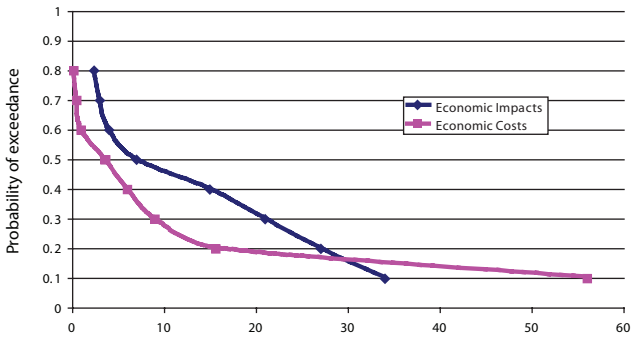


FIGURE 11. Economic Costs And Impacts

For example, if Delta flooding were to prevent harvest of a local asparagus crop, that would have impact on local output, employment, labor income and value added. However, if this shortage of asparagus caused prices to rise and Imperial Valley farm income to increase substantially, the adverse impact might be counterbalanced by a benefit when considering the state as a whole.

Economic costs and economic impacts are separate measures and should not be added together. Figure 11 shows the probability of incurring economic costs and impacts from a seismic event during a 25-year exposure period. The majority of these economic consequences are associated with disruption of water supplies.

Public Health And Safety Consequences

The primary public safety concern is for the population on flooded islands. Table 2 shows estimates of the population-at-risk. The area that is considered potentially vulnerable to levee failure during seismic events is the area below the mean higher high water elevation (MHHW). This is the average elevation of the highest of the two tides each day over a 19-year period. The estimates should assist future management decisions regarding appropriate levee protection standards. DRMS is developing metrics to show the probability of loss of life for the various combinations of flooded islands in Phase 2 of the program.

Chance Of Individual Island Failures

Preliminary estimates of the frequency of individual island failures due to seismic events are shown in the adjacent map. The map is color coded into five bands of expected frequencies of failure. These should be viewed collectively as patterns rather than individually. For example, areas of lower seismic island failure tend to be in the Suisun Marsh and the eastern portion of the Delta. A relatively higher frequency of failure is expected to occur in the central and western Delta, areas that are closer to potentially active faults, and where the differences between the island land surfaces are 15-20 feet or more below the adjacent water surface.

Considering the probability of all seismic levee failures under 2005 conditions, about 115 failures can be expected during 100 years of exposure. With sea level rise, continued subsidence, and an expected increase in seismic hazard, the rate of island failure will increase in the future. Compared to 2005 conditions, the frequency of failure is expected to increase by about 12 percent by 2050 and by about 27 percent by 2100.

TABLE 2. POPULATION AT RISK FROM SEISMIC EVEN T

Number of Flooded Islands	Population of Flooded Islands
1	1,800
3	2,200
10	5,400
20	6,000
30	10,000

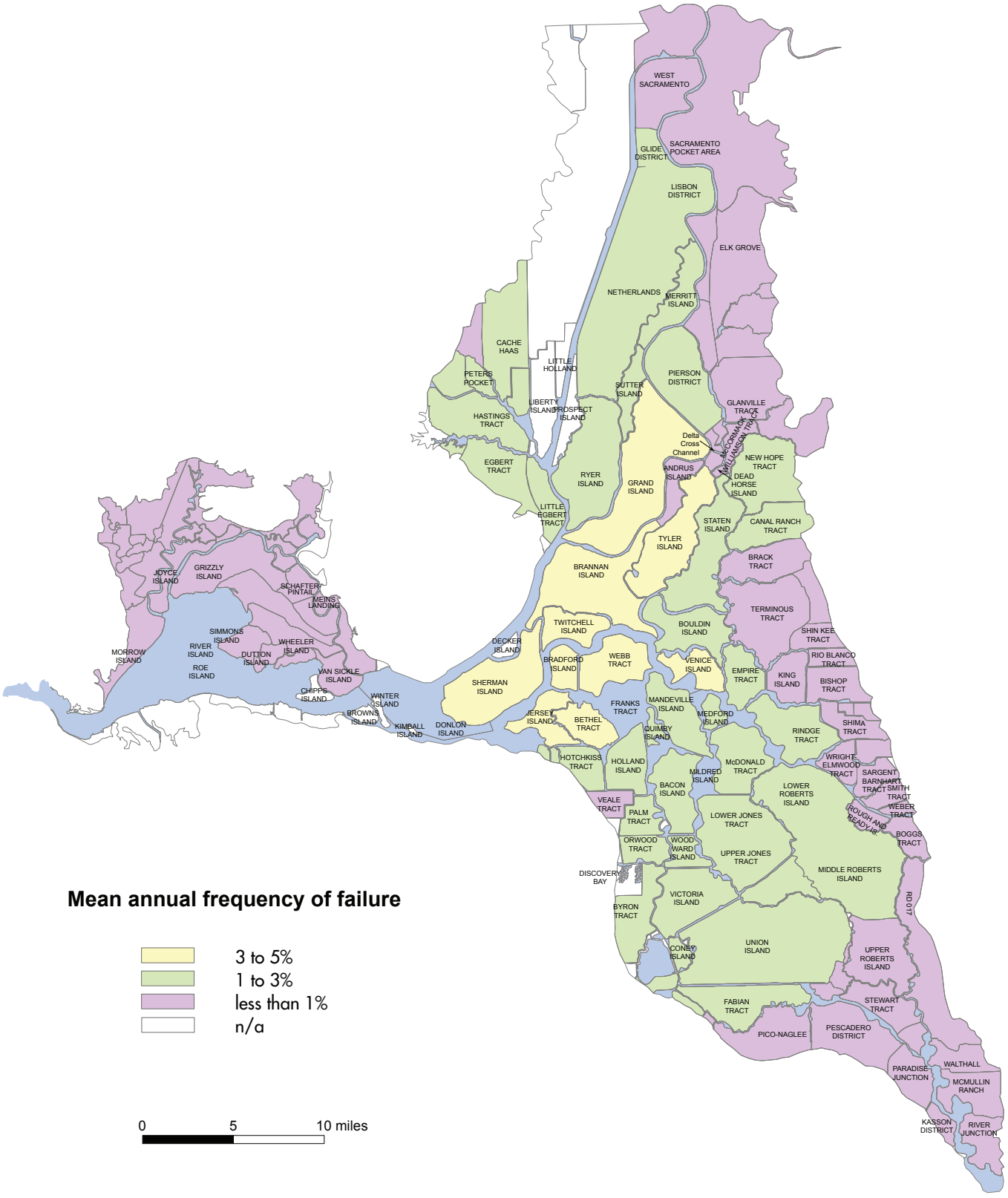


FIGURE 12. Annual Frequency Of Failure Of Individual Islands Under Seismic Events

PRELIMINARY DRMS FLOOD FINDINGS

High water during large flood flows into the Delta can overtop levees or increase seepage pressures through the levee embankment or its foundation. Most of the historic levee failures in the Delta and Suisun Marsh have been during flood flows, often in conjunction with high tides, storm surges or other storm-related phenomena.

Probability Of Multiple Levee Failures

DRMS provides preliminary estimates of the probability that multiple islands will flood simultaneously during 25 years of exposure due to a flood event as shown in Figure 13. There is about a 20 percent chance that 20 or more islands will flood during a single flood during a 25-year period.

Export Disruption

When a levee failure occurs during high flows or a flood event, fresh water tends to fill the flooded islands. This is in contrast to levee failures during low river flow when salt water from the Suisun Bay is drawn into the Delta to fill the flooded islands. The export disruptions were found to be negligible for failures under flood conditions, assuming that the levees are repaired as quickly as possible under a sensible priority system. However, there may be lasting impacts on Delta hydrodynamics if levee failures are not repaired, and post-failure exports may be impaired during the lower flow periods common during most of the year.

Ecosystem Consequences

As mentioned under the section on seismic failures, DRMS is still working on developing metrics to describe and display the ecosystem consequences. It is expected that the conservation strategies provided in the ERP Phase 2 Conservation Strategy, as well as BDCP will guide the design for creating a more resilient Delta ecosystem better able to adjust to catastrophic events.

Economic Consequences

DRMS estimates that levee failures on 30 islands due to flood flows to the Delta would result in economic costs of about $22 billion and economic impacts of about $8 billion. About 98 percent of the economic cost is expected to be in-Delta costs with the remaining two percent from lost use of infrastructure of statewide importance. See the definition of economic costs and economic benefits in the *Preliminary DRMS Seismic Findings* section of this report.

Health And Safety Consequences

The primary public safety concern is for the population on flooded islands. DRMS estimates that flooding of 30 islands could displace up to 35,000 people. This number is larger than the 30 island failure with a seismic event because the water levels during a flood event are much higher and cover a larger area than the MHHW tide level. DRMS is working on metrics to show the probability of loss of life for the various combinations of flooded islands.

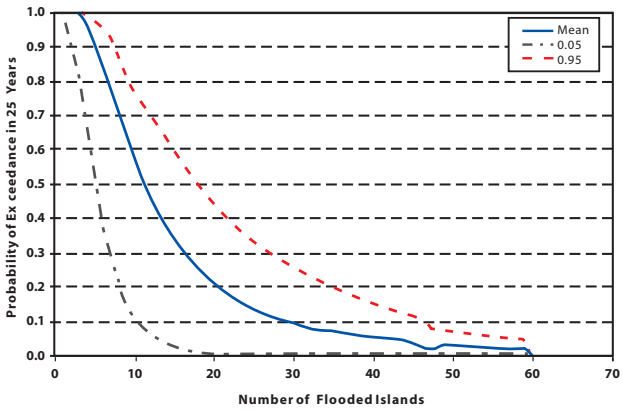


FIGURE 13. Probability In 25 Years Of Exposure For The Indicated Number Of Simultaneous Island Failures (Or More) From A Flood Event

Chance of Individual Island Failures

Preliminary estimates of the frequency of individual island failures due to flood events are shown in the adjacent map. These should be viewed regionally rather than for a specific island. The areas of higher frequency of failures tend to be in the Suisun Marsh and throughout the central Delta.

With sea level rise, continued subsidence, and an increase in expected storm runoff and peak flood events, the rate of island failures is expected to increase in the future. Compared to 2005 conditions, the frequency of failure is expected to increase by about 230 percent by 2050 and by about 620 percent by 2100.

PRELIMINARY "SUNNY—DAY" FAILURE RESULTS

Levees in the Delta occasionally fail during non-flood times from undetected problems such as burrowing animals. A levee on Upper Jones Tract failed from unknown reasons during the summer of 2004. Repair costs and flooding damages on the island totaled nearly $100 million.

DRMS used the historic rate of sunny-day levee failures to model the potential for future occurrences. Based on this information and current conditions, the Delta would experience a sunny-day failure every nine years on the average. With sea level rise and continued subsidence and no increases in levee improvements or maintenance, the rate of failures will increase in the future. Compared to 2005 conditions, the frequency of failure is expected to increase by about 10 percent by 2050 and by about 20 percent by 2100.

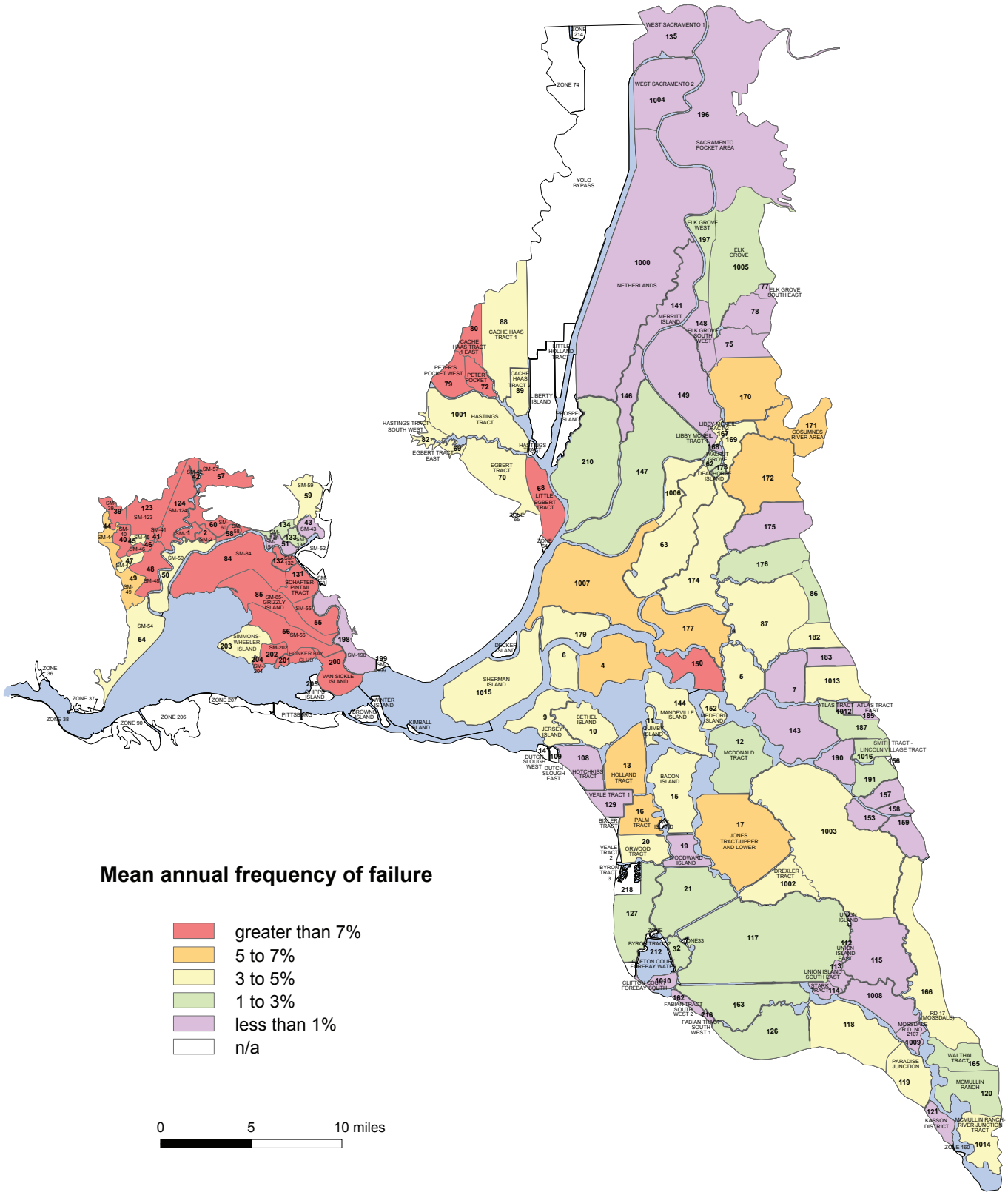


FIGURE 14. Annual Frequency Of Failures Of Individual Islands Under Flooding Events

SECTION IV - OPTIONS FOR THE DELTA

DRMS Phase 2 work focused on the evaluation of alternative strategies to reduce the risks summarized in the previous section. In addition, the Delta Vision, ERP Conservation Strategy and BDCP are developing additional options for the future of the Delta (see Section 5).

PRELIMINARY BUILDING BLOCKS

DRMS developed 31"building blocks" as potential individual efforts that would provide improvement to some aspect of the Delta. No single building block is considered a complete option under AB 1200. However, several building blocks could be packaged into scenarios for managing the Delta. The building blocks can be grouped into three main categories: 1) conveyance and flood risk reduction, 2) infrastructure impact reduction, and 3) environmental risk reduction. As with the assessment of risks in the previous section, the building blocks and scenarios will be refined during 2008.

DRMS evaluated the preliminary building blocks for their ability to reduce risks due to levee failure and based on the best judgment, combined them into scenarios. The results suggest that three building blocks have the highest risk reduction potential, but also have very high implementation costs. These building blocks are:

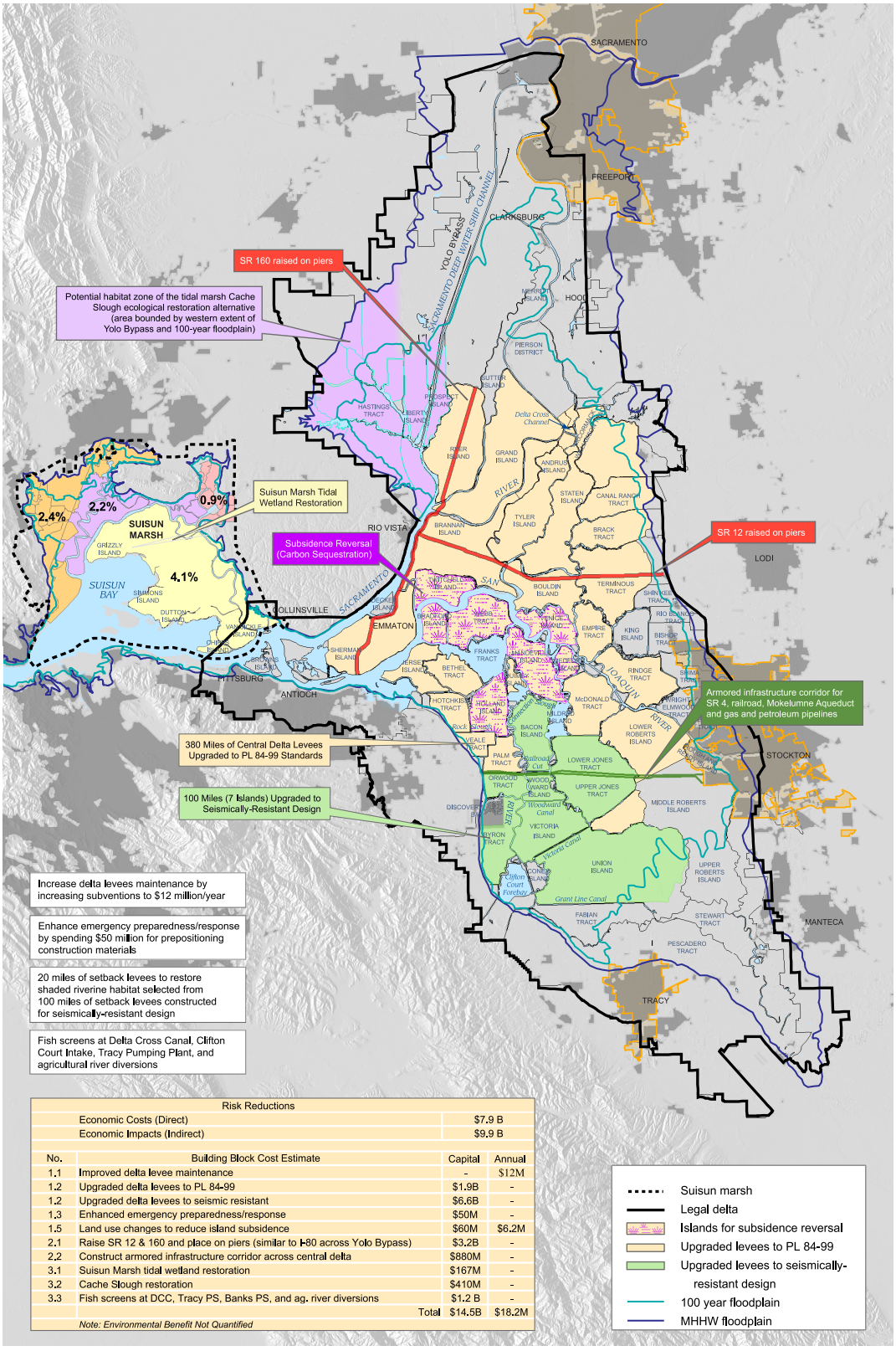
• **Armored Pathway Through Delta Conveyance.** This building block provides an inlet facility on the Sacramento River at Hood, channel dredging, setback levees, barrier gates to control the flow in the Delta channels, and other facilities and habitat improvements. It provides an improved method to move water from the Sacramento River that is less vulnerable to levee failures.

• **Seismically Improved Levees.** This building block reduces the chance of salt water intrusion into the southern Delta from levee failures during an earthquake by upgrading and replacing levees in the southern Delta to withstand a 300-year earthquake.

• **Isolated Conveyance Facility.** This building block provides a north to south freshwater corridor by construction of a canal around the eastern periphery of the Delta that is separated from other Delta channels.

PRELIMINARY SCENARIOS

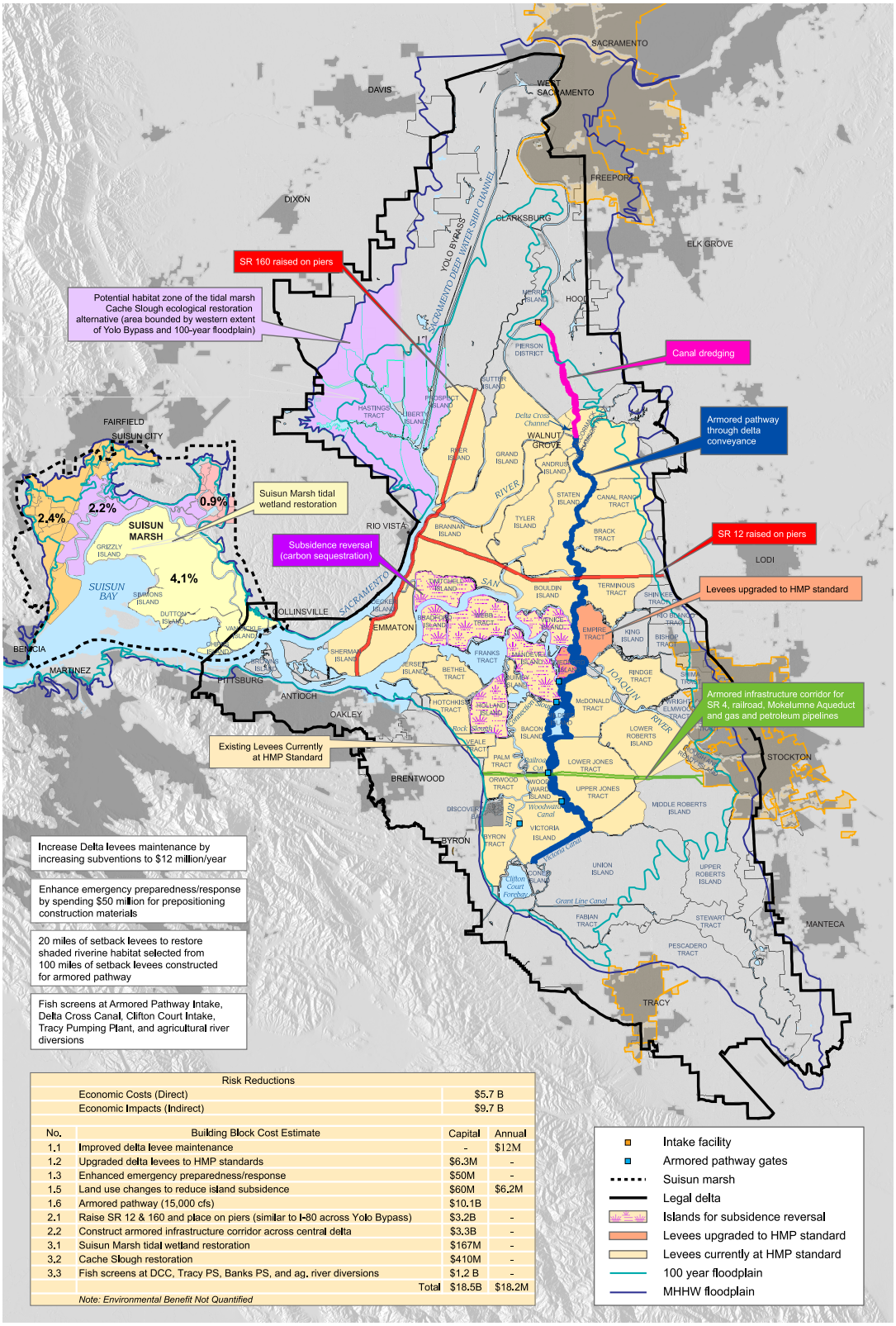
These three high-ranking building blocks were combined with other building blocks to form more complete scenarios for the Delta. Although there are many other ways to combine building blocks into scenarios, these three provide a preliminary view of how combinations of building blocks can function together. Each scenario is shown on a map on the following pages.



Risk Reductions		
	Economic Costs (Direct)	$7.9 B
	Economic Impacts (Indirect)	$9.9 B

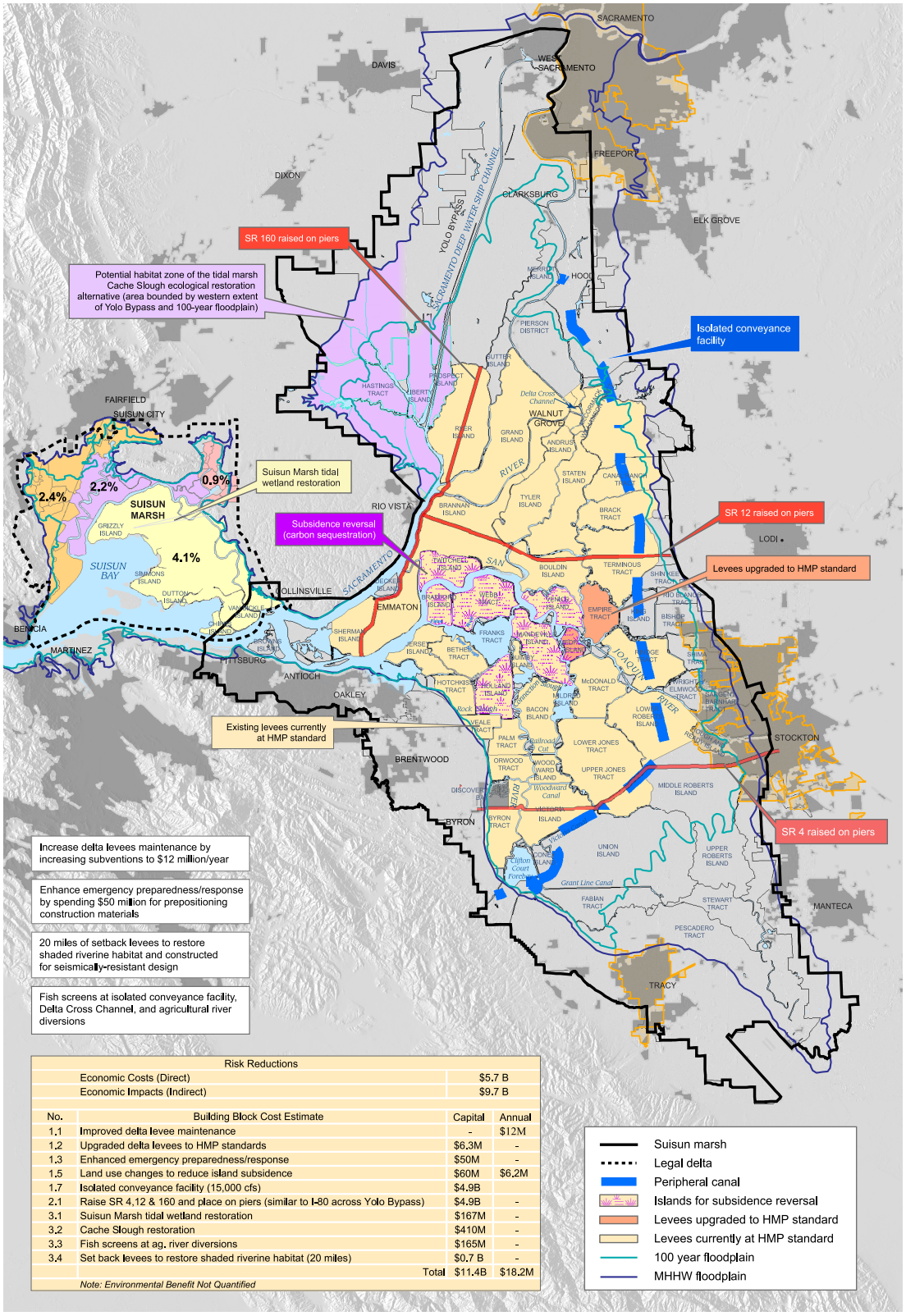
No.	Building Block Cost Estimate	Capital	Annual
1.1	Improved delta levee maintenance	-	$12M
1.2	Upgraded delta levees to PL 84-99	$1.9B	-
1.2	Upgraded delta levees to seismic resistant	$6.6B	-
1.3	Enhanced emergency preparedness/response	$50M	-
1.5	Land use changes to reduce island subsidence	$60M	$6.2M
2.1	Raise SR 12 & 160 and place on piers (similar to I-80 across Yolo Bypass)	$3.2B	-
2.2	Construct armored infrastructure corridor across central delta	$880M	-
3.1	Suisun Marsh tidal wetland restoration	$167M	-
3.2	Cache Slough restoration	$410M	-
3.3	Fish screens at DCC, Tracy PS, Banks PS, and ag. river diversions	$1.2 B	-
	Total	$14.5B	$18.2M
	Note: Environmental Benefit Not Quantified		

FIGURE 15. DRMS Scenario 1: Improved Levees



Risk Reductions			
	Economic Costs (Direct)	$5.7 B	
	Economic Impacts (Indirect)	$9.7 B	
No.	Building Block Cost Estimate	Capital	Annual
1.1	Improved delta levee maintenance	-	$12M
1.2	Upgraded delta levees to HMP standards	$6.3M	-
1.3	Enhanced emergency preparedness/response	$50M	-
1.5	Land use changes to reduce island subsidence	$60M	$6.2M
1.6	Armored pathway (15,000 cfs)	$10.1B	
2.1	Raise SR 12 & 160 and place on piers (similar to I-80 across Yolo Bypass)	$3.2B	-
2.2	Construct armored infrastructure corridor across central delta	$3.3B	-
3.1	Suisun Marsh tidal wetland restoration	$167M	-
3.2	Cache Slough restoration	$410M	-
3.3	Fish screens at DCC, Tracy PS, Banks PS, and ag. river diversions	$1.2 B	-
		Total $18.5B	$18.2M
	Note: Environmental Benefit Not Quantified		

FIGURE 16. DRMS Scenario 2: Armored Pathway



Risk Reductions			
	Economic Costs (Direct)	$5.7 B	
	Economic Impacts (Indirect)	$9.7 B	
No.	Building Block Cost Estimate	Capital	Annual
1.1	Improved delta levee maintenance	-	$12M
1.2	Upgraded delta levees to HMP standards	$6.3M	-
1.3	Enhanced emergency preparedness/response	$50M	-
1.5	Land use changes to reduce island subsidence	$60M	$6.2M
1.7	Isolated conveyance facility (15,000 cfs)	$4.9B	
2.1	Raise SR 4,12 & 160 and place on piers (similar to I-80 across Yolo Bypass)	$4.9B	-
3.1	Suisun Marsh tidal wetland restoration	$167M	-
3.2	Cache Slough restoration	$410M	-
3.3	Fish screens at ag. river diversions	$165M	-
3.4	Set back levees to restore shaded riverine habitat (20 miles)	$0.7 B	-
	Total	$11.4B	$18.2M
	Note: Environmental Benefit Not Quantified		

FIGURE 17. DRMS Scenario 3: Isolated Conveyance Facility

RANKING OF PRELIMINARY SCENARIOS

The ranking of the preliminary DRMS scenarios is shown in the following table. These rankings were developed by DWR and DFG staff based on DRMS analyses, with adjustments based on the BDCP analyses. Scenario 1 (Improved Levees) ranks moderate for reducing risk and is the least expensive of the three. Scenario 2 (Armored Pathway) and Scenario 3 (Isolated Conveyance Facility) rank high and very high respectively for reducing risk, but also cost more than Scenario 1. Potential cost reductions will need to be considered during continuing refinements.

In addition, AB 1200 asks for ranking of options for their ability to protect "area of origin" water rights. However, protecting water rights of the "area of origin" is already a requirement of California Law in several sections of the Water Code and all options would abide by these:

- Water Code (*Section 10500*) addresses the county of origin
- Water Code (*Section 11460*) address the watershed of origin
- Water Code (*Section 12200*) addresses water in the Delta
- Water Code (*Section 1215*) addresses other protected areas

The AB 1200 rankings for protection of highways, utility facilities, and other utilities are covered by the "Preserve lands and protect levees" goal in the above table. In addition, separate means to protect this infrastructure could be taken regardless of the scenario chosen.

While these preliminary rankings were made as directed by AB 1200, they need further refinement during 2008 to aid decisions about the future of the Delta. All three scenarios are based on conceptual-level evaluations and require further analysis, especially considering their high costs. These preliminary findings from the DRMS will be refined into the spring of 2008.

TABLE 5. PRELIMINARY PERFORMANCE RANKING1 FOR DRMS SCENARIOS

Goal[2]	**Existing:** (Through Delta)	**Scenario 1** (Improved Levees)	**Scenario 2** (Armored Pathway)	**Scenario 3** (Isolated Conveyance)
Prevent water supply disruption	●	●●	●●●	●●●●
Improve export water quality for drinking and agriculture (reduce salinity)	●	●	●●●	●●●●
Maintain Delta water quality[3]	●●●	●●●	●●●	●●●
Preserve lands and protect levees	●	●●●●	●●●	●●
Improve ecosystem	●	●●	●●	●●●●
Overall risk reduction	●	●●	●●●	●●●●
Total long-term costs (including losses)	●●	●●●	●●	●●●

Notes: 1. Performance ranks are were prepared by DWR and DFG staff based on preliminary information from DRMS and BDCP:
- ●●●● = Best performing
- ●●● = Second best performing
- ●● = Third best performing
- ● = Lowest performing

Where ranks are equal, the Scenarios receive the same rank.

2. All goals are not necessarily equal
3. Rankings ultimately will depend on how the scenario is operated

SECTION V - OTHER ONGOING PROCESSES

Other processes that began after AB 1200 will also help shape the future of the Delta and will benefit from the information developed by DRMS.

2006 BONDS

In November 2006, California voters entrusted DWR with about $5 billion in new bond funds (Propositions 1E and 84) for flood management, a portion of which will be available for levees in the Delta. Two hundred seventy-five million dollars from Proposition 84 is specifically for flood projects in the Delta. Within Proposition 1E, the Delta is eligible to share a portion of the $3 billion in (*Section 5096.821*). DFG was provided $135 million for the protection of fishery resources, BDCP planning and ERP project implementation.

DELTA VISION

While DRMS has focused on the risks relating to failure of Delta levees, the Delta Vision process is looking more broadly at the sustainability of the Delta. The Blue Ribbon Task Force for Delta Vision, appointed by Governor Schwarzenegger, has prepared its vision for sustainable management of the Delta (http://deltavision.ca.gov/BlueRibbonTaskForce/FinalVision/Delta_Vision_Final.pdf). A strategic plan to implement the vision will be the focus of the task force during 2008.

The Delta Vision document notes that changes in the Delta and in California's use of Delta resources are inevitable. Current patterns of use are unsustainable, and catastrophic events, such as earthquakes could cause dramatic changes in minutes. The comprehensive vision addresses water, land use, environmental and institutional elements necessary to a desired solution.

> "The time for action is now. The Delta is in crisis, and each day brings us closer to a major disaster. What the nation learned from New Orleans and Hurricane Katrina is the terrible price of waiting. Our twelve linked recommendations lay out a vision that offers hope for resolution of the vexing and difficult water and environmental problems of California"
>
> *Blue Ribbon Task Force Delta Vision, Our Vision for the California Delta, 2007*

Although the vision is intended to be for the long-term, some threats to the Delta and Suisun Marsh are so serious that specific recommendations for short- and mid-term action are warranted. Any proposed near-term action should flow directly from the key goals, principles, and outcomes contained in the vision (see text box on following page). The near-term actions recommended by the Task Force include:

1. State government should immediately begin acquiring title or easements to floodplains, establish flood bypasses where feasible, and discourage residential building in flood-prone areas.

2. The Governor should immediately issue an Executive Order that provides guidance consistent with this vision on inappropriate land development in the Delta.

3. State government should promptly set appropriate standards for all levee improvements to protect heavily populated areas and key parts of the water delivery system and other infrastructure. The State of California should also use available bond funds to address strategic levee and floodplain improvements.

4. State government should embark upon a comprehensive series of emergency management and preparation actions within a few months.

5. State government should promptly incorporate expected sea level increases into decision making and improve knowledge of constructing more secure and affordable levees.

6. High priority ecosystem revitalization projects should be pursued aggressively by the responsible agencies and departments, upon direction by the Governor.

7. Improvements in the current water conveyance and groundwater and surface water storage systems should be pursued as rapidly as possible by the responsible agencies and departments, upon direction by the Governor.

Twelve Integrated And Linked Recommendations At The Heart Of The Delta Vision

1. The Delta ecosystem and a reliable water supply for California are the primary, coequal goals for sustainable management of the Delta.
2. The California Delta is a unique and valued area, warranting recognition and special legal status from the State of California.
3. The Delta ecosystem must function as an integral part of a healthy estuary.
4. California's water supply is limited and must be managed with significantly higher efficiency to be adequate for its future population, growing economy, and vital environment.
5. The foundation for policymaking about California water resources must be the longstanding constitutional principles of "reasonable use" and "public trust"; these principles are particularly important and applicable to the Delta.
6. The goals of conservation, efficiency, and sustainable use must drive California water policies.
7. A revitalized Delta ecosystem will require reduced diversions—or changes in patterns and timing of those diversions upstream, within the Delta, and exported from the Delta—at critical times.
8. New facilities for conveyance and storage, and better linkage between the two, are needed to better manage California's water resources for both the estuary and exports.
9. Major investments in the California Delta and the statewide water management system must integrate and be consistent with specific policies in this vision.In particular, these strategic investments must strengthen selected levees, improve flood plain management, and improve water circulation and quality.
10. The current boundaries and governance system of the Delta must be changed. It is essential to have an independent body with authority to achieve the co equal goals of ecosystem revitalization and adequate water supply for California—while also recognizing the importance of the Delta as a unique and valued area. This body must have secure funding and the ability to approve spending, planning, and water export levels.
11. Discouraging inappropriate urbanization of the Delta is critical both to preserve the Delta's unique character and to ensure adequate public safety.
12. Institutions and policies for the Delta should be designed for resiliency and adaptation.

BAY DELTA CONSERVATION PLAN

BDCP has a different and more specific purpose than DRMS and Delta Vision. BDCP is being developed consistent with the federal Habitat Conservation (HCP) and the State Natural Community Conservation Planning (NCCP) processes. The purpose of BDCP is to develop a conservation plan that resolves the conflict between fishery protection under the State and federal Endangered Species acts and water operations of the State Water Project (SWP), Central Valley Project (CVP) and Mirant Power facilities in the legal Delta. The goal of BDCP is to develop a plan that satisfies both the conservation and water supply goals of the Planning Agreement signed in October 2006. The BDCP Steering Committee is composed of 19 groups that represent the State and federal water agencies and export contractors, non-governmental organizations representing environmental and farming interests, and Mirant Power, with the State and federal fishery agencies serving as ex-officio members. BDCP is ultimately focused on satisfying permitting requirements for the water supply system in the Delta. Among other things, the plan will:

• Provide for conservation and management of at risk fish species impacted by the covered activities.

• Preserve, restore, and conserve aquatic, riparian and associated terrestrial habitats.

• Provide clear expectations and regulatory assurances for Delta water operations and facilities (CVP, SWP, and Mirant Corporation).

The covered species for BDCP include:

• delta smelt
• longfin smelt
• winter-run Chinook salmon
• spring-run Chinook salmon
• fall and late-fall run Chinook salmon
• Central Valley steelhead
• green sturgeon
• white sturgeon
• Sacramento splittail

The steering committee for BDCP has been actively working since April 2007 to set the scope and focus of this planning effort. The committee initially developed ten options. These options were narrowed to four options for conveyance and opportunities that provide for habitat restoration and enhancement: http://resources.ca.gov/bdcp/options_evaluations.html:

• **Option 1: Existing Through-Delta Conveyance.** Includes use of existing through-Delta conveyance with physical habitat restoration in the north and west Delta and Suisun Marsh (about 28 percent of BDCP planning area).

• **Option 2: Improved Through Delta Conveyance.** Includes improving through-Delta conveyance with operable barriers on some channels, separating water supply conveyance flows from the San Joaquin River, and providing habitat restoration in the north, west, central and south Delta and Suisun Marsh (about 35 percent of the BDCP planning area).

• **Option 3: Dual Conveyance.** Similar to Option 2 with the addition of an isolated conveyance facility from the Sacramento River to the south Delta export facilities.

• **Option 4: Peripheral Aqueduct.** Includes construction of a peripheral aqueduct from the Sacramento River to the south Delta export facilities, which would allow habitat restoration throughout the Delta and Suisun Marsh (about 75 percent of the BDCP planning area).

The Steering Committee Also Agreed On The Need To Consider Other Important Elements Along With Conveyance And Habitat:

- Stressors such as contaminants, non-native species, entrainment at non-Central Valley Project/SWP facilities, harvest, genetic diversity and integrity, and effects of climate change
- Water operations and management
- Monitoring, assessment and adaptive management
- Scientific input
- Cost and funding
- Implementation structure

The options are shown on the maps on the following pages.

BDCP RANKING OF THE OPTIONS

The following table shows a summary of how the BDCP Steering Committee consultant ranked the options during the evaluations. A more detailed ranking (table 7) following the options maps shows a further breakdown of the biological, planning, flexibility/sustainability, durability, and impacts on other resources categories in this summary table.

TABLE 6. SUMMARY, OVERALL COMPARISON OF BDCP OPTIONS BY CRITERIA CATEGORY (RANK)1

Evaluation Criteria Category	Conservation Strategy Option			
	Option 1: Existing Through Delta	**Option 2:** Improved Through Delta	**Option 3:** Dual Conveyance	**Option 4:** Peripheral Aqueduct
Biological	●	●●	●●●	●●●●
Planning	●	●	●●●●	●●●●
Flexibility/Sustainability/Durability	●	●●●	●	●●
Impacts on Other Resources	●●●●	●●●	●	●●

Notes: 1. Performance ranks are:
●●●● = Best performing
●●● = Second best performing
●● = Third best performing
● = Lowest performing

Where ranks are equal, the options receive the same rank

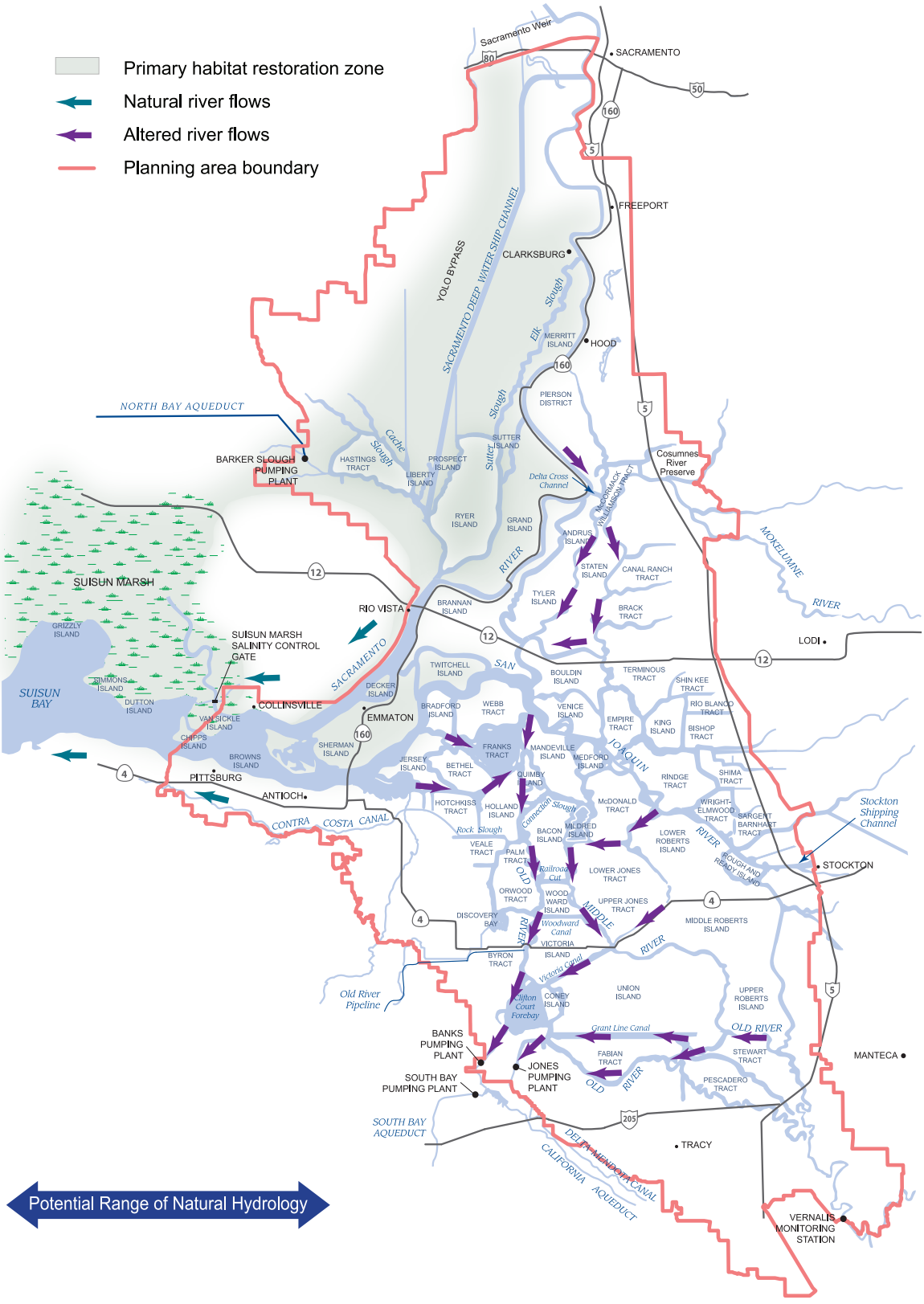


FIGURE 18. BDCP Option 1: Existing Through Delta Conveyance

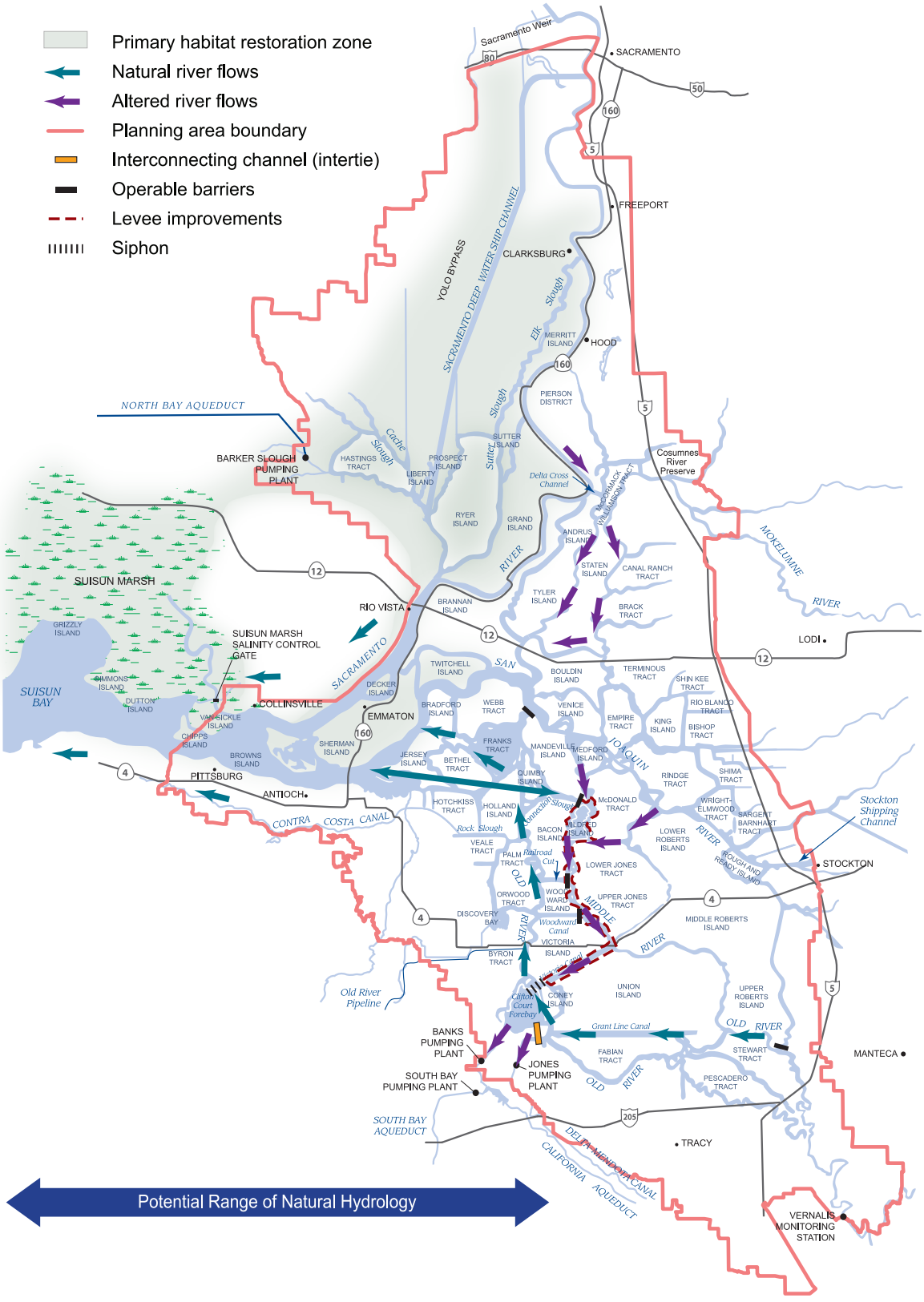


FIGURE 19. BDCP Option 2: Improved Through Delta Conveyance

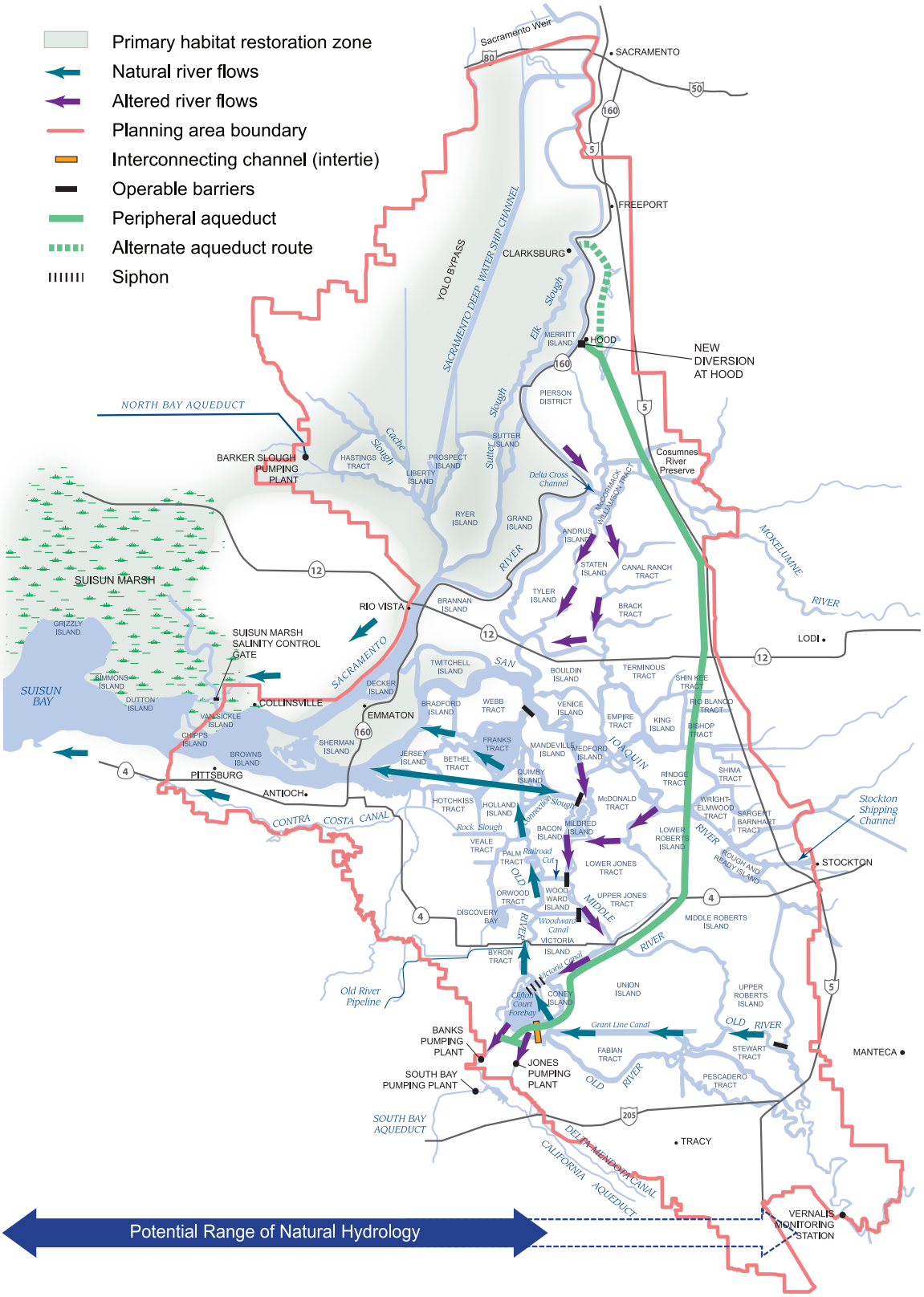


FIGURE 20. BDCP Option 3: Dual Conveyance

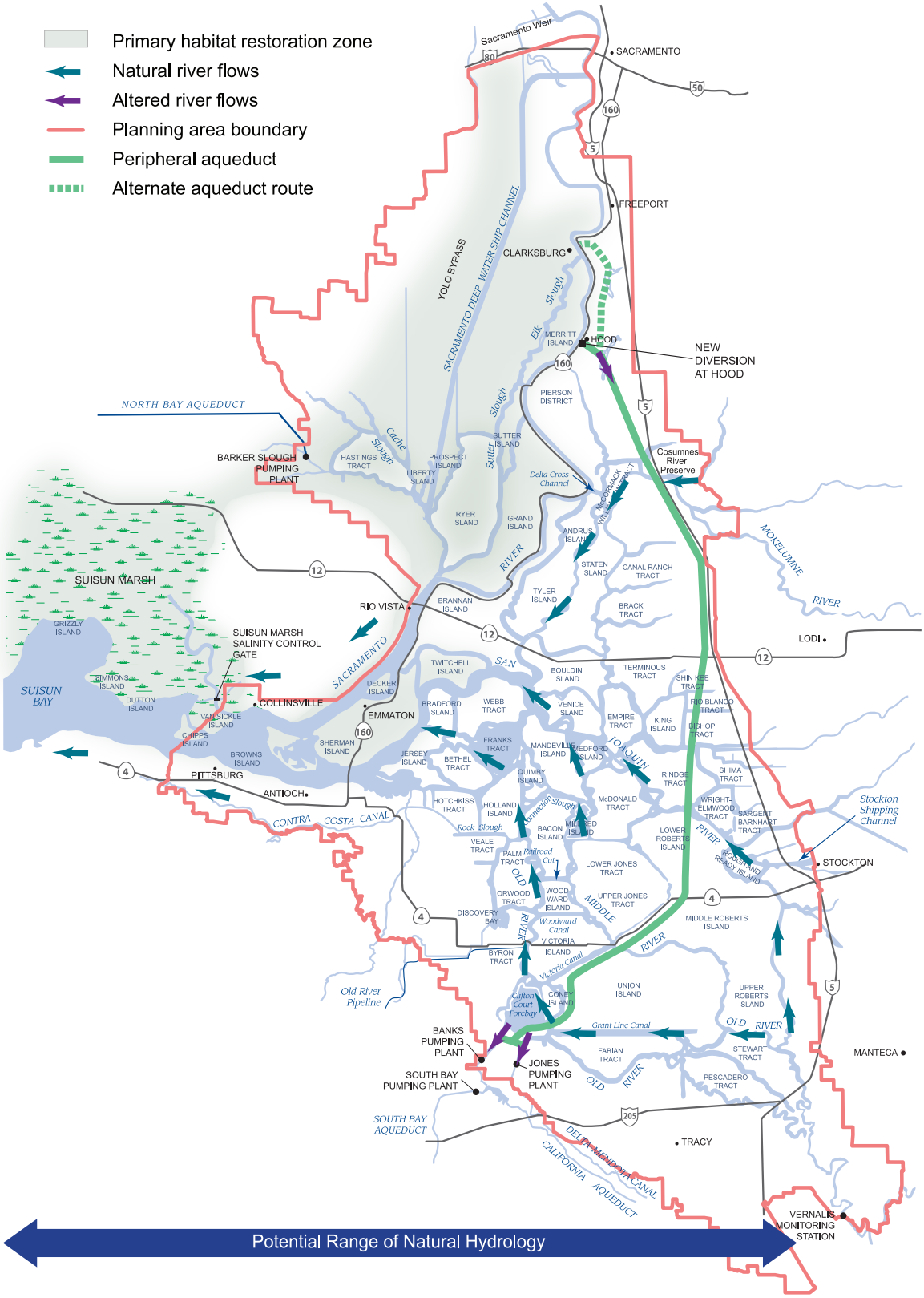


FIGURE 21. BDCP Option 4: Peripheral Aqueduct

TABLE 7. COMPARISON OF RANKS FOR BDCP OPTIONS				
Criterion	**Performance Rank**[1]			
	Option 1: Existing Through Delta	**Option 2:** Improved Through Delta	**Option 3** Dual Conveyance	**Option 4** Peripheral Aqueduct
Biological (Benefits Fish Species)				
Delta Smelt	●	●●	●●●	●●●●
Longfin Smelt	●	●	●●●	●●●●
Sacramento River Salmonoids	●●●	●●●	●●●	●●●●
San Joaquin River Salmonoids	●	●●	●●●	●●●●
White Sturgeon	●	●●●	●●●	●●●●
Green Sturgeon	●●●	●●●	●●●	●●●●
Sacramento splittail	●●	●●	●●●	●●●●
Planning Criteria				
Water Supply	●●	●	●●●●	●●●
Feasibility/practicability	●●●●	●●●●	●●●●	●●●●
Minimize cost	●	●●	●●●	●●●●
San Joaquin River Salmonoids	●	●●	●●●	●●●●
White Sturgeon	●	●●●	●●●	●●●●
Green Sturgeon	●●●	●●●	●●●	●●●●
Sacramento splittail	●●	●●	●●●	●●●●
Flexibility/Sustainability/Durability Criteria				
Durability to catastrophic events	●	●●	●●●●	●●●
Minimize ongoing resource for long-term conservation	●	●●	●●●	●●●●
Flexibility/adaptability	●	●●	●●●	●●●●
Reversibility	●●●●	●●●	●●	●●
Other Resource Impacts Criteria				
Avoidance of impacts on other native species (in-Delta)	●●●●	●●	●	●●●
Avoidance of impacts on human environment (in-Delta)	●●●●	●●●	●	●●
Avoidance of impacts on native species (outside-Delta)	●●	●●	●●●●	●●●

Notes: 1. Performance ranks are:
- ●●●● = Best performing
- ●●● = Second best performing
- ●● = Third best performing
- ● = Lowest performing

Where ranks are equal, the Scenarios receive the same rank.

BDCP FINDINGS FROM THE BDCP POINTS OF AGREEMENT DATED NOVEMBER 16, 2007

BDCP Conveyance. The steering committee agrees that the most promising approach for achieving the BDCP conservation and water supply goals involves a conveyance system with new points of diversion, the ultimate acceptability of which will turn on important design, operational and institutional arrangements that the steering committee will develop and evaluate through the planning process. The main new physical feature of this conveyance system includes the construction and operation of a new point (or points) of diversion in the north Delta on the Sacramento River and an isolated conveyance facility around the Delta. Modifications to existing south Delta facilities to reduce entrainment and otherwise improve the SWP's and CVP's ability to convey water through the Delta while contributing to near and long-term conservation and water supply goals will also be evaluated. This approach may provide enhanced operational flexibility and greater opportunities for habitat improvements and fishery protection. During the BDCP process, the steering committee will evaluate the ability of a full range of design and operational scenarios to achieve BDCP conservation and planning objectives over the near- and long-term, from full reliance on the new facilities to use of the new facilities in conjunction with existing facilities.

BDCP Habitat Restoration and Enhancement. BDCP will contain a habitat restoration and enhancement program consistent with the ERP Conservation Strategy, and is designed to increase the quality and quantity of habitat and otherwise help achieve the conservation objectives for covered species, enabled in part by improvements to conveyance over the near and long term. Initial habitat restoration and enhancement efforts will be directed toward areas that offer the greatest conservation opportunities, such as in Suisun Marsh and in the north and west Delta. Completion of a new Sacramento River intake and isolated conveyance facilities would change the hydrodynamic conditions in the Delta in a manner that would likely afford new opportunities for habitat restoration and enhancement in various other parts of the Delta.

The types of habitat restoration and enhancement actions which will be initially evaluated for inclusion in the conservation strategy include:

- Restoring intertidal habitat to establish vegetated marshes and associated sloughs to increase habitat diversity and complexity, food production and in-Delta productivity, and rearing habitat for covered species.

- Increasing hydraulic residence time and tidal exchange within the Delta sloughs and channels by changing circulation patterns to increase primary productivity and food web support and improve turbidity conditions for Delta smelt and longfin smelt.

- Increasing the amount of functional floodplain habitat to increase the quantity and quality of rearing habitat for salmonids and sturgeon and spawning habitat for Sacramento splittail, and generate food resources for pelagic species.

- Providing adequate water quality and quantity within the Delta at appropriate times to help conserve resident native fishes and improve rearing and migration habitats for salmon moving through the Delta.

- As information is gathered through the planning process and as part of project implementation, the steering committee anticipates that additional restoration and enhancement opportunities may be identified, evaluated and implemented based upon their ability to achieve applicable conservation objectives.

CALFED BAY DELTA ECOSYSTEM RESTORATION PROGRAM CONSERVATION STRATEGY

During 2007, the ERP implementing agencies were developing the Conservation Strategy to guide future ecosystem restoration implementation based on evaluation of past actions, new information and changing understanding of the ecosystem. The Strategy is a guidance document for future ecosystem restoration implementation and is non-regulatory and based on willing seller participation.To date, the effort has focused on the Delta due to the emphasis focused on it by the pelagic organism decline (POD) and other planning efforts. In future versions of the Strategy, comparable conservation strategies will be developed for the entire ERP focus area including the Sacramento and San Joaquin River watersheds.

The Conservation Strategy is a biological view of where restoration of the focal habitat types could occur to restore ecosystem form and processes to the maximum extent, existing ERP Strategic Plan goals. The ERP Delta-Suisun Planning area map (see Figure 22) identifies areas with potential for various kinds of habitat restoration within the Delta-Suisun Marsh based upon existing elevations, habitat and natural process requirements of pelagic organisms and other native fishes. Elevation and soil type are the drivers for this preliminary depiction that does not consider the constraints of water conveyance options, infrastructure, or land use patterns and ownership. As noted in BDCP, discussion above new conveyance focused on a new North of Delta diversion(s) from the Sacramento River which would divert water for export around the Delta offers the greatest potential for meeting ecosystem restoration objectives. Information is also being incorporated from other Delta-related planning efforts (e.g., Delta Risk Management Strategy, Suisun Marsh Implementation Plan, ERP End of Stage 1 Assessment, and Federally-listed species recovery plans) and technical and public input.

The draft of the strategy focuses on five broad habitat categories for restoration or management in the Delta. These categories include managed wetland and wildlife friendly agriculture (primarily subsided islands), inter-tidal, floodplain, upland transition, and grassland/vernal pool transition corridor.

Information on ecosystem processes, such as hydrodynamics, temperature, salinity, residence times and productivity is being developed. Detail on restoration actions that address flow and river operations, which are the primary drivers of aquatic systems and habitats, will be incorporated once the Delta Regional Ecosystem Restoration Implementation Plan conceptual models (January 2008) and the anadromous fish recovery plans (Spring 2008) are completed and in coordination with the BDCP process.

The Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) is one of four regional plans intended to guide the implementation of the CALFED Ecosystem Restoration Program

http://www.delta.dfg.ca.gov/erpdeltaplan/

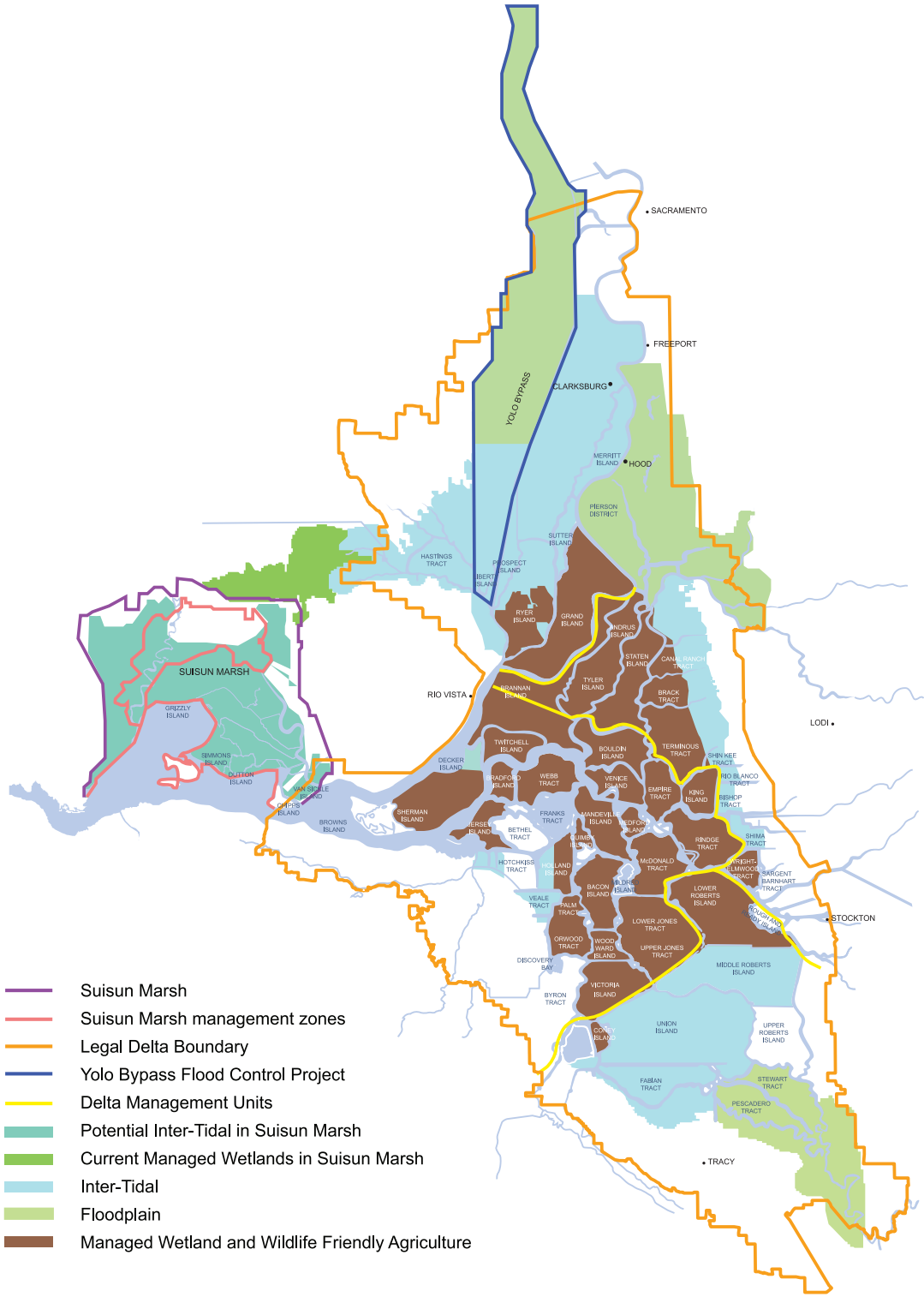


FIGURE 22. Preliminary Map Of Delta And Suisun Marsh Planning Area, Showing Potential Suitability For Protection, Restoration, And Management Of The Five Habitat Categories Indentified In The Draft Ecosystem Restoration Program Stage 2 Conservation Strategy

SECTION VI - NEXT STEPS

This document is a progress report of ongoing processes to address concerns about the future of the Delta. DRMS was modified specifically to support answers to the questions proposed by AB1200. The Delta Vision, ERP, and BDCP processes will also provide valuable information and direction.

None of these processes is complete, and each will continue into 2008. This report presents preliminary findings that will be refined with further evaluations. Although the details and specific quantification of risks and options may change, the overall findings are not expected to significantly change. Also, additional ideas and approaches can be expected to emerge as the evaluations continue.

Implementing actions to secure the future of the Delta will take time. However, policy and funding to effect the necessary change is being developed now. Therefore, progress is required over several time frames:

• **Interim Actions.** These are actions that are not dependent on the long-term decision and can be implemented until that decision is made for the long-term health of the Delta and the services it supports. Interim actions may include legislative support for mitigation banking that will provide early habitat benefits and accelerate the permitting for implementation of selected alternatives. Another legislative interim action would be renewing the Delta Levees Program by extending the sunset date in Water Code (*Section 12986*) to July 1, 2020. The Legislature recently directed DWR to prepare a State Plan of Flood Control by 2012.

• **Early Implementation.** These are actions that would be implemented after a decision on long-term actions is made, but before the long-term actions are in place. They include activities that can provide progress towards meeting both ecosystem and water supply goals in the near-term as well as being useful in the long-term solution. They may also include expansion of emergency response capability by pre-positioning supplies and developing "contingency contracts" that may be activated in the event of an emergency.

• **Long-Term Implementation.** These are actions necessary to implement the long-term options that are selected. They include the permitting and construction of long-term facilities, and operations, maintenance, and adaptive management actions necessary to see that long-term options remain viable.

Governor's Interim Delta Actions

In July 2007, Governor Schwarzenegger called for about $160 million of incremental improvements to the Delta before long-term plans are in place:

- Help prevent the spread of invasive species
- Improve scientific understanding of delta smelt
- Screen Delta agricultural intakes to protect smelt
- Restore habitat at Cache Slough in the north Delta
- Improve availability to respond to Delta emergencies
- Build channel barrier(s) at Franks Tract for fish protection and improved water quality
- Conduct demonstration projects to sequester carbon
- Restore additional Delta habitat
- Improve ability to respond to Delta emergencies
- Offer water management assistance
- Evaluate a low flow screen at SWP Delta intake

While DRMS, Delta Vision, ERP, and BDCP are separate processes, they will continue to share ideas and refinements in 2008:

• During the first half of 2008, DRMS will finalize its analysis of the risks of levee failure and risk-reduction strategies. DRMS will provide information to the other processes.

• The Blue Ribbon Task Force will prepare their strategic plan for their Delta Vision during 2008.

• The BDCP Steering Committee will complete developing the content of BDCP during 2008. The proposed plan will then be analyzed under relevant

State and federal environmental laws, including the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA).

• The ERP will prepare an evolving Stage 2 Conservation Strategy for the Delta and Suisun Bay in 2008 and make it available for use in all of the above mentioned planning processes.

The preliminary information obtained from each planning process includes consideration of an improved water conveyance system for the Delta. For DRMS, water conveyance improvement is a primary way to improve water conveyance reliability and to reduce economic risks. For Delta Vision, balancing the two co-equal values of the functioning of the Delta estuarine ecosystem and water supply is required to achieve either value. For BDCP, an isolated conveyance facility can aid the ecosystem by reducing entrainment and enlarging the area available for species and habitat restoration. New dual water conveyance systems can also aid water supply by adding operational flexibility and improving water quality (i.e., reducing salt loads). The processes have reached important conclusions at the end of 2007. Each will influence one another during 2008 as refinement of each process continues to develop.